101 K’NEX challenges

…for school and home

www.knexusergroup.org.uk

Contents

A.1 Introduction

This book has been written for both schools and families. It consists mainly of IDEAS …101 K'NEX challenges, hints on using K'NEX, suggestions for follow-on activities, K'NEX troubleshooting tips … built up since we started using K'NEX in 1996.

A.1.1 What is K'NEX?

K'NEX was invented in the US in 1988 by Joel Glikman and fast became a construction craze on both sides of the Atlantic, and won a myriad of awards including "Best Construction Toy" and "Toy of the Year".

K'NEX is a unique construction system, with colour-coded pieces called 'connectors' and 'rods' that let you build anything from simple flat models to large, strong 3-D constructions.

You will find that K'NEX is easy to use, once you have mastered the three basic ways of connecting rods to connectors. Start making models by following the instructions in your K'NEX set, and then move on to attempt the Challenges in this book - it won't be long before you can call yourself a real K'Nexpert!

A.1.2 Why choose K'NEX?

There are a number of reasons why we would recommend K'NEX for your school and home projects. These include:

- as engineers, we judge K'NEX to be a carefully thought out engineering system, in many ways akin to real-life civil and mechanical engineering
- K'NEX has relatively few components, which makes it easy to use, and means that a single K'NEX set can be used for dozens of different projects
- K'NEX is competitively priced
- K'NEX has a high level of appeal to children and adults, male and female

101 K'NEX challenges

The K'NEX challenges in section B are:

Baby buggy	Block and tackle
Bridge that gap	Bulldozer
Burglar alarm	Butterfly
Cable car	Car electrics
Castle	Circus
Clock	Crane
Crash helmet	Croquet
Crossbow	Digger
Dinosaur	Disco lights
Dominoes	Drill
Drum	Earthquake
Fan	Farm
Ferris wheel	Fire engine
Flower	Fork lift truck
Friendship bracelet	Frisbee
Giant chess	Golf
Great book race	Guitar
Helicopter	Hockey
Hole punch	Hot air balloon
Indiana Jones	Jewellery
Kaleidoscope	Kite
K'Nexcalibur	Land yacht
Lifeboat	Lift
Lighthouse	Locks
Magic wand	Magnetic fishing
Magnetic roundabout	Mars rover
Martian	Motorcycle
Mousetrap	Netball
Newton's Disc	Obstacle football
Pendulum	Periscope
Pet home	Puppet show
Railway	Remote control jumps
Robot	Rocket
Rocking horse	Rollerblades
Roundabout	Seesaw
Shadows	Semaphore
Shape and colour trail	Shopping trolley
Skeleton	Sleigh
Solar system	Speed trials
Spinning tops	Spotlight
Sundial	Suspension bridge
Swing	Table tennis
Table-top football	Tennis
Ten-pin bowling	Tower of strength
Tractor	Traffic lights
Umbrella	Water wheel
Weather vane	Weighing machine
Wheelbarrow	Windmill
Wheelchair	Yacht
Year 2000	Zoo
8-ball pool	

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A.2 K'NEX at school

The UK National Curriculum defines the programmes of study and attainment targets that children must follow from 5 to 16. K'NEX spans the whole of this age range, and there is also a version of K'NEX called ***Kid K'NEX***, which is suitable for 3 to 4 year olds.

K'NEX can help schools deliver the National Curriculum in three main subject areas:

Design and Technology

Science

Mathematics

The challenges in this book are based around the requirements of **Design & Technology** and **Science** in the National Curriculum. Many challenges also have cross-curricular links with other subjects, such as the History Curriculum.

We have also written a separate guide entitled "K'NEX for hands-on Maths", which includes 101 K'NEX activities related to shape and space, numeracy, measure and handling data in the Maths curriculum.

A.2.1 Key topics

For ease of cross-referencing, section A.5.6 shows the 101 challenges listed by the **Key topics** in science and technology to which they relate. These Key Topics are:

Animals
Designing skills
Earth & beyond
Electricity
Forces
Humans
Light
Magnetism
Making skills
Mechanisms
Sound
Structures

K'NEX on its own is excellent for Key topics such as developing Designing skills and Making skills, and learning about Forces, Structures and Mechanisms. To extend your K'NEX set into topics such as Electricity and Light, we would recommend acquiring the range of **add-on components** described in section C.

Key topics are particularly useful in helping class teachers select projects which will complement the themes that the class is following in Science and Design & Technology each term.

A.2.2 Value for money?

We have found that K'NEX provides schools with good for value for money, because:

- the general-purpose K'NEX sets (eg the Discovery set) provide quite a lot of K'NEX components at a realistic price
- once your school has purchased K'NEX, it will not sit in a cupboard for eleven months of the year, but will be used time and again for different projects with all age groups

If you are considering buying K'NEX, please refer to section D.

A.2.3 Projects for girls and boys

We find K'NEX is equally popular with girls and boys. Girl pupils sometimes start the projects with less confidence than boys, but once they have mastered the basics of K'NEX they often go on to build even better models.

We have tried to ensure that the 101 challenges in this book will appeal to both boys and girls. Please let us know if there is any way we can improve the challenges to make them truly gender-independent.

A.2.4 Adapting for different ages

All the challenges in this book are suitable for children aged 7-plus. Those marked with a ***✓5*** are also suitable for children aged 5 and 6.

We would not recommend using K'NEX for children younger than 5, because the children's fingers may not be strong enough to make the connections, and small pieces may end up in mouths. *Kid K'NEX* is more suitable for children under 5.

We also find that school teachers enjoy doing the K'NEX challenges in this book, once they have mastered the three basic ways of making K'NEX connections (see section C). Many teachers in primary schools do not have a background in science and technology, but this is by no means a pre-requisite to teaching with K'NEX.

Every challenge has three levels of difficulty listed. Level 1 is for younger children and beginners, Level 2 for older children and experienced K'NEX users, and Level 3 is for real K'Nexperts!

We recommend carrying out K'NEX challenges on a whole-class basis, with the children working in pairs. Regardless of age, we initially ask each pair to try and achieve Level 1 on the Challenge. We find that every pair will achieve this by the end of a 90 minute session, even if some pairs will have needed more help than others. Those children who complete Level 1 are asked to attempt Level 2, and then finally Level 3.

This approach ensures that by the end of the session every child will have completed at least one level, and will finish with a real sense of achievement.

A.2.5 Children with special needs

K'NEX challenges can work very successfully with children who have special educational needs.

One of the key reasons for this success is that the Challenge Sheets in this book may be used to give instructions to the class verbally. This means that the ability to read is *not* a prerequisite for completing each challenge.

Generally we have found that children with learning difficulties carry out the challenges quite well, and on occasion exceed the expectations of their teachers. For children who find it difficult to achieve good results in traditional subjects such as reading, writing and mathematics, success in a K'NEX challenge can help greatly in increasing their self-esteem.

We have often (but not always) found that children who find it difficult to concentrate for long periods do well on our challenges too, because a high enjoyment level is maintained throughout the project.

Some children with physical disabilities may find K'NEX difficult, though, particularly if they lack the physical or visual ability to make K'NEX connections. We have achieved some success in such cases by pairing the child with another child who is good at K'NEX, so that the child with special needs becomes the 'designer' and the other child the 'maker'.

A.3 K'NEX at home

A major benefit of K'NEX is that it is really good fun for all the family!

We work a lot with boys and girls aged from 5 to 16 out of school, in clubs, playschemes and family learning. Whenever we bring out the K'NEX challenges, we have a lot of happy children.

Five and six year olds greatly enjoy challenges such as 'making flowers', 'building a home for your pet', 'making a magic wand' and 'designing jewellery'. Older children spend hours on challenges such as 'make a mousetrap to catch a mouse without hurting it', 'build a golf club and complete a par 3 golf hole with it', and 'build a dinosaur that walks along'.

We find that mothers, fathers and grandparents also enjoy K'NEX, and become good at it quite quickly. This is very helpful for younger children, who may occasionally need help in making a particular K'NEX connection, or working out how their model can achieve the desired result.

K'NEX can then become a genuine family activity. We have even seen brothers and sisters who normally argue continuously working happily together on K'NEX challenges (although we cannot guarantee this!).

A.3.1 Value for money?

In our experience K'NEX does give families good value for money, provided that you start off by buying the biggest general-purpose K'NEX set you can afford - the bigger the set, the more pieces you get for every £ you spend.

All sets come with clear pictorial instructions, which will help your family to get started. The general-purpose sets have a booklet showing how to make a number of different models.

Unlike many toys for children, K'NEX should get used repeatedly as the months and years go by. We hope this book will maintain the interest, and encourage families to attempt ever more interesting and demanding challenges with their K'NEX set.

If you are considering buying K'NEX, please refer to section D.

A.3.2 Educational benefits

We believe *enjoyment* is an essential part of education, and we have tried to ensure that every single K'NEX challenge in this book is enjoyable for the child carrying it out.

Children carrying out the challenges at home will probably ignore the section on each Challenge Sheet entitled 'For teachers'. Parents though may be interested to see how the Challenges are used in school, and may even wish to *extend* some of the challenges, by following the suggestions for teachers shown (eg for follow-on activities).

K'NEX challenges can be used to *introduce* new topics to a child, such as the reflection of light, or the opposing of magnetic poles, before they cover these topics at school. They are also useful in *reinforcing* topics that the child has already studied at school, such as the effect of balanced and unbalanced forces. Carrying out challenges with a friend can also help children develop their ability to work in groups.

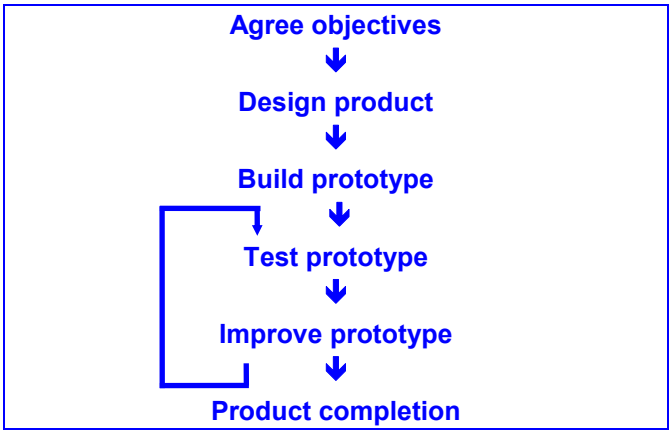
For the education-conscious parent, the K'NEX challenges in this book are an ideal way to complement their school's progress, in helping children develop knowledge, understanding and practical ability in science and technology.

A.4 Setting challenges

K'NEX sets, in common with other children's construction sets, provide detailed pictorial instructions showing how specific models may be made.

These are fine for getting started, and making models step-by-step from instructions does initially give children some enjoyment and satisfaction. Such an approach though only scratches the surface of the potential of a product such as K'NEX.

As engineers, we like to encourage children to follow a true *product development cycle*:



This is a more challenging approach than simply following instructions, but properly done it is more educational, and gives a greater sense of achievement.

All the challenges in this book are based on this approach. We define the *Objective* of the challenge, and then give some hints and troubleshooting tips that may help the child as they proceed to complete a finished product to their own design.

We find the *Design* stage is usually done in the children's heads, and by discussion if children are working in pairs. Some teachers prefer a more formal design stage using paper and pencil, and this can certainly encourage children to think through their design before they start.

Prototyping is critical - no-one should expect to produce a perfect finished model first time, and sometimes it is even necessary to 'go back to the drawing board' if a design idea simply does not work well enough.

Teachers (and with younger children at home, parents) can be particularly helpful in this process:

- To help the children get started with design and then with construction
- To offer advice and assistance with model-building on request
- To help the child ensure that the model really does meet the original objectives (eg that the mouse caught in the mousetrap is not hurt)

A.4.1 K'NEX sets

Whilst the bigger the K'NEX set, the better value for money, we appreciate that not every school can afford to purchase the largest of the K'NEX education sets, and many families will only have a limited budget.

Most of the challenges in this book are therefore based on the *K'NEX Discovery Set.*

On each Challenge Sheet we show that the Challenge either:

- Needs a Discovery Set
- Needs a larger set (such as the Simple Machines Deluxe Set)

Please note these comments are only *guidelines,* which relate to the example shown in the photo.

A.4.2 Extra K'NEX components

Some of the challenges also require specialised K'NEX components which are not included in the general-purpose sets. These are:

Spring motors	A pull-back-and-release motor which can be bought separately (good for high-speed low power models such as a racing car)
Battery motor	A battery pack and 3v motor which can be bought separately (good for high-power low-speed models such as Ferris wheels)
Rubber bands	Rubber bands are provided in some K'NEX sets.
Gear wheels	Three sizes of gear wheel are included in some K'NEX education sets such as the *Introduction to Simple Machines: Gears* set.

We would recommend buying at least one type of motor, as motors greatly increase the enjoyment factor and educational benefit of K'NEX – see section D.

A.4.3 Add-on components

Some of the Challenges also require low cost materials and components, which we find enable K'NEX to be used in ways which were never intended by the manufacturers!

Examples include ring magnets, cardboard, mirrors and light bulbs.

Some of the components such as cardboard are generally available, but many are best purchased from educational suppliers.

A full list of add-on components may be found on Section C.

Add-on components are essential if you wish to carry out Challenges with Key topics such as electricity and light.

Please let us know of any add-on components that you yourselves use with K'NEX, so we can pass on details to schools and families in the next issue of this book.

A.4 Layout of Challenge Sheets

All Challenge Sheets follow a common format, with the top half of the sheet explaining the Challenge, and the bottom half providing extra information for teachers, as

follows:

Title	Design considerations
Objective	
Levels of difficulty	Handy hints
Equipment needed	Troubleshooting tips
Test area (if any)	Warnings
Key topics	Educational objective
Components in photo	Cross-curricular links
	Before starting
Photo of example	Conclusion
	Follow-on activities

General information

Title	All Challenges have a title
Objective	Outlines the objective in general terms
Levels of Difficulty	States the specific objective to be achieved at each of the three levels of difficulty
Equipment Needed	Lists the K'NEX set, extra K'NEX components and add-on components needed
Test area	Any special area which needs to be set up to test the finished model (eg a water trough for Lifeboats and Yachts)
Design considerations	Suggests a few design considerations for each level of difficulty
Handy hints	Lists Hints that may assist in building a successful model
Troubleshooting tips	Lists Tips that may assist if the model does not work as expected
Warning	A warning is included with some challenges

Information for teachers

Key topics	Lists the Key topics for this Challenge
Components	Lists the components used in the photo below
Photo	A photo of a possible finished model, usually to level 3
Educational objective	The educational objective of the Challenge
Cross-curricular links	Suggested ways in which the challenge might be linked to other parts of the National Curriculum
Before starting	Ideas for preparing pupils for the Challenge
Conclusion	Suggestions as to how the maximum educational benefit can be gained from the Challenge once the K'NEX model is finished
Follow-on activities	Ideas for follow-on activities that could be considered for the days and weeks following the Challenge

Please note that the photo is only intended to give teachers an example of how the Challenge *might* be completed. Ideally it should not be shown to the children.

We would be very pleased to receive feedback from families and teachers as to how the information on the Challenge Sheets could be improved, both in general terms, and for specific Challenges.

A.5 Challenges in the classroom

We are not educational experts, and cannot state with authority the best way to operate the K'NEX Challenges in this book in the classroom.

We can though describe the approach we are most familiar with, which has found favour in many schools, and which the children enjoy.

We usually adopt a format giving a 90 minute session for each Challenge, which allows us to carry out three different Challenges in a day with three classes.

There are five phases:

90 minute session

Preparation
↓
Introduction
↓
Model-building
↓
Conclusion
↓
Follow-on

The proportion of time allocated to each phase varies considerably for each Challenge. The Introduction phase is usually only 5 to 10 minutes, but in *The Mousetrap* the Model-building phase might occupy 80% of the session, whereas in *Magnetic Roundabout*

it might occupy only 20%, because in the latter case most of the educational value is in the Conclusion

phase.

The information contained in this section assumes that the Challenges will be set on a whole-class basis. If you prefer to use K'NEX on a smaller group basis, some minor modifications to the procedure will be required.

A.5.1 Preparation

The list of Challenges by Key topic in section A.5.6 is useful in choosing a Challenge which is suitable for the age of the class, and which will complement the themes that the class is following in the current term.

The individual Challenge Sheets then provide all the information:

- to ensure that you have the necessary equipment
- to look through the Handy Hints and Troubleshooting Tips for this Challenge
- to attempt the Challenge yourself, perhaps by using the photo as a guide
- to consider whether you should carry out the 'before starting' activities on the Sheet prior to carrying out the Challenge
- to think about the relevance of any cross-curricular links

Please note that 90 minutes is usually sufficient to complete a Challenge, but some may take longer than others, particularly if all the suggested 'Conclusion' activities are used.

Before starting a Challenge we would recommend seating the children at tables of four, working in pairs. Consideration should be given to pairing children whose special needs may make using K'NEX difficult with another child who is good at K'NEX.

One or more K'NEX sets should then be placed on each table. Any extra K'NEX components and add-on components required by the Challenge may be placed in the K'NEX boxes, or (if too large) directly on the tables.

A.5.2 Introduction

The best way to introduce a Challenge to a class will depend on many factors, such as the age of the children, their existing knowledge of the Key topics, and the teacher's own style.

The following checklist may assist:

- ✓ Ask which children have used K'NEX before (this helps identify the children who will need most help to get started)
- ✓ Explain that K'NEX is easy to use, and demonstrate the three ways of connecting K'Nex rods to K'NEX connectors (see Handy Hint 1 in section C)
- ✓ Demonstrate any other Handy Hints listed for this Challenge which you think would help the children to get started
- ✓ Explain Level 1 of the Challenge in your own words, using the Challenge Sheet as a guide
- ✓ Tell the children that you will be coming around to help them if they are not sure how to get started, and ask them to put their hand up if they get stuck at any time
- ✓ Allow the children to open their sets, and experiment with the contents until they are confident enough to make a start on the Challenge

Note that we do not ourselves give copies of the Challenge Sheets to the children, but rather we use the Sheet as a 'crib sheet' for the teacher. Some teachers may prefer though to photocopy the top half of the Challenge Sheet for their pupils.

A.5.3 Model-building

The amount and type of help given to the children during the Model-building phase is entirely the decision of the class teacher. In general, we find it is best to choose a balance between giving too little help (and causing frustration) and giving too much help (and losing some of the educational benefit).

We find most help is needed in getting the children started with using K'NEX (particularly if it is new to them), and in planning the design of their model.

Thereafter, constantly circulating around the tables to give assistance when requested works well. The Handy Hints listed on the Challenge Sheet may help, and the Troubleshooting Tips will be useful in assisting children whose models don't work in the way they expect.

As the pairs of children progress, they will eventually reach a point where they believe they have completed Level 1 of the Challenge. If you are happy that they have done so, Level 2 of the Challenge can be explained to them, and if they complete that, Level 3.

One concern that children often have is whether they are allowed to copy good ideas which other children in the class have built into their models. We tend to encourage this - it is in any case very difficult to prevent - *provided* that the pair have first attempted to solve the design issue for themselves. An example is level 3 on Windmills - making a hammer go up and down as the sail turns. This involves both a lever and a cam, and the children learn nearly as much by copying a successful solution as they would have by coming up with the idea themselves.

One or two of the many primary schools we have visited have managed to persuade a mother or father to help the class with their K'NEX Challenge. This is obviously very useful, particularly in the first ten minutes when the most queries arise, but we appreciate this is a luxury not available to many schools.

A.5.4 Conclusion

The purpose of the Conclusion phase is to use the models the children have built to carry out further tasks, thereby extending the educational value of the session.

There usually comes a point after (say) 50 or 80 minutes of the 90 minute session when the state of progress around the classroom means that the Model-building phase can be brought to a close, and the Conclusion phase can commence.

The teacher is then able to call a halt to model-building, review with the class what has been achieved, and start the Conclusion activities. The ones shown on the Challenge Sheets are only guidelines - the class teacher may well have other ideas for conclusion activities that fit in better with the pupils' current level of knowledge, the themes being followed, and the specific educational objectives.

It is also worth noting that in most Challenges the Model-building phase is primarily a Design and Technology activity, whereas the Conclusion Phase is often the stage at which:

- the Science underpinning the Challenge can be discussed and reinforced
- investigative science experiments can be carried out using the models that have been built
- diagrams, tables of results, graphs and written descriptions can be prepared

For example, *Crane* is a Challenge which requires Designing Skills and Making Skills and develops the child's knowledge and understanding of Structures. The principles of *Balanced and Unbalanced forces* underpin this Challenge, in that unbalanced forces cause unsuccessful models to fall over when they pick up a weight, whereas in successful ones the forces are balanced.

It is therefore important not to let the model-building phase go on too long, if the opportunity to gain maximum scientific benefit from the Challenge is not to be lost.

Once the Conclusion activities are complete, we would recommend that the children are asked to dismantle their models, and put all the pieces back in the box. This will probably take about five minutes, unless the models are very complex.

Don't be afraid that the children will damage the K'NEX components in taking their models to pieces too vigorously. This is a rare occurrence.

A.5.5 Follow-on

The benefit from the K'NEX Challenge will not necessarily end with the Conclusion phase.

Many Challenge Sheets suggest one or more *follow-on activities*, which can be used in class in the days and weeks following the K'Nex Challenge.

An example from the *Windmills* project is discussing where windmills are best sited, and finding examples of gears, pulleys, levers, and cams in bikes and cars.

A.5.6 Key Topics

Animals: Butterfly, Circus, Dinosaur, Farm, Mousetrap, Pet home, Rocking horse, Zoo

Designing skills: All

Earth & beyond: Mars rover, Martian, Rocket, Solar system, Sundial

Electricity: Burglar alarm, Car electrics, Disco lights, Jewellery, Lighthouse, Traffic lights

Forces: Baby buggy, Block and tackle, Bridge that gap, Bulldozer, Butterfly, Cable car, Clock, Crane, Crash helmet, Crossbow, Digger, Drill, Fan Earthquake, Ferris wheel, Fire engine, Flower, Fork lift truck, Frisbee, Great book race, Helicopter, Hole punch, Hot air balloon, Kite, K'Nexcalibur, Land yacht, Lifeboat, Motorcycle, Pendulum, Puppet show, Railway, Remote control jumps, Roundabout, Seesaw, Sleigh, Speed trials, Suspension bridge, Swing, Tractor, Water wheel, Weather vane, Weighing machine, Wheelbarrow, Windmill, Wheelchair, Yacht

Humans: Baby buggy, Crash helmet, Robot, Skeleton

Light: Kaleidoscope, Newton's disc, Periscope, Shadows, Spotlight

Magnetism: Magic wand, Magnetic fishing, Magnetic roundabout, Pendulum

Making skills: All

Mechanisms: Block and tackle, Bulldozer, Cable car, Castle, Clock, Crane, Crossbow, Digger, Drill, Fan, Ferris wheel, Fire engine, Fork lift truck, Friendship bracelet, Great book race, Helicopter, Hole punch, Land yacht, Lift, Locks, Magnetic fishing, Magnetic roundabout, Mars rover, Martian, Motorcycle, Mousetrap, Railway, Robot, Rollerblades, Roundabout, Shopping trolley, Speed trials, Spotlight, Swing, Tractor, Umbrella, Water wheel, Wheelbarrow, Windmill, Wheelchair

Sound: Drum, Guitar

Structures: Bridge that gap, Castle, Circus, Croquet, Dinosaur, Earthquake, Farm, Golf, Guitar, Indiana Jones, K'Nexcalibur, Lift, Lighthouse, Netball, Obstacle football, Periscope, Pet home, Rocket, Rocking horse, Rollerblades, Skeleton, Sundial, Suspension bridge, Tower of strength

A.6 Accredited Learning with K'NEX

The K'NEX User Group has developed a number of K'NEX-based learning units, which have been approved by the National Open College Network (NOCN). This Guide forms the basis of the educational materials required by three of those learning units, namely:

- K'NEX for hands-on Technology (Level 1)
- K'NEX for hands-on Technology (Level 2)
- K'NEX for hands-on Science (Level 1)

All three are 10-hour progression units, which typically include 10 1-hour K'NEX activities. The educational organisation delivering any of these units may determine for themselves which K'NEX activities should be delivered for each unit, as this will depend upon factors such as the age and prior experience of the learners.

However, by way of example we include below suggestions for the K'NEX activities which might be used for each unit.

A.6.1 Hands-on Technology (Level 1)

The 10-hour unit might commence with the learners spending an hour building K'NEX models from instructions. The instructions might be taken from the instruction books that came with your K'NEX sets, or from the Instructions page of our website www.knexusergroup.org.uk. This first session will give all learners experience and confidence in using K'NEX.

The remaining nine one-hour sessions might then be made up of nine one-hour K'NEX challenges, each one of which comprises a fairly simple challenge with technology content. For instance:

1. **Swing**
2. **Frisbee**
3. **Fan**
4. **Bridge that gap**
5. **Roundabout**
6. **Great book race**
7. **Lifeboat**
8. **Sleigh**
9. **Tower of strength**

A.6.2 Hands-on Technology (Level 2)

It is assumed that learners will already have completed the Hands-on Technology (Level 1) unit, or have gained significant experience with K'NEX in other ways. The 10-hour unit might then comprise 10 K'NEX challenges that have a significant element of problem-solving, for instance:

1. **Castle**
2. **Mousetrap**
3. **Ferris wheel**
4. **Dinosaur**
5. **Golf**
6. **Fire engine**
7. **Lift**
8. **Robot**
9. **Tractor**
10. **Wheelchair**

A.6.3 Hands-on Science (Level 1)

The 10-hour unit might commence with the learners spending an hour building K'NEX models from instructions. The instructions might be taken from the instruction books that came with your K'NEX sets, or from the Instructions page of our website www.knexusergroup.org.uk. This first session will give all learners experience and confidence in using K'NEX.

The remaining nine one-hour sessions might then be made up of nine one-hour K'NEX challenges, each one of which comprises a different challenge with science content. For instance:

1. **Wheelbarrow**
2. **Crash helmet**
3. **Speed trials**
4. **Lighthouse**
5. **Crane**
6. **Land yacht**
7. **Mars rover**
8. **Windmill**
9. **Spotlight**

A.6.4 Delivery of accredited learning units

The K'NEX UK User Group would be pleased to hear from you if you are considering delivering accredited learning with K'NEX, or if you have any queries on this section of the Guide. Our email address is info@knexusergroup.org.uk

Baby buggy

Please help - our baby doll isn't old enough to walk yet, and we need to take her shopping. Could you build a baby buggy for us, to keep her warm and safe?

Think about how you could make your baby buggy. How will you make a box big enough for the doll to sit in or lie in? How many wheels will you need? How will you fasten them on? Will you need a handle to push the buggy with?

If you are moving on to level 2, think about how you could make a brake. Will it prevent the wheels turning, or will it stop the buggy in some other way?

For level 3, you will need to think very carefully how the buggy could fold up as small as possible. Don't be afraid to take your original model to pieces and start again with a new design, if it will help.

Levels of difficulty

Level 1	✓5	Make a simple baby buggy for the doll, and push it around the room.
Level 2		As level 1, with a seat belt and brakes to hold it stationary on a slope.
Level 3		As level 2, plus the buggy can be folded up to take on a bus.

Equipment needed:	**K'NEX** Discovery set Doll 20cm high
Test area (level 2):	*A slope to test the buggy on*

☺ Handy hints

L1 3 ways to connect rods and connectors

L3 Making corners with blue and purple connectors

L5 Wheels and tyres

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R2 Blue and purple connectors won't join together

R3 Model is not strong enough

R4 Wheels won't turn around easily

For teachers

Key topics: Forces **Designing skills** **Humans** **Making skills**

Components used in sample level 2 model below

Connectors: White 1 Blue 8 Purple 4 Red 4 Orange 6 Grey 8

Rods: Red 9 Yellow 9 Blue 4

Small wheels/tyres 4

Educational objective

To encourage the children to consider the design characteristics of a familiar object, and then to design and build a model which achieves the same result. For level 2 and 3, to gain practical experience of the use of levers, and to consider the safety issues involved in baby buggies

☑Cross-curricular links

☑ History - history of prams and baby buggies

√ Before starting

√ Look at an example of a baby buggy, and discuss why they are used

→ Conclusion

→ Ask the children to test the models by taking the baby for a walk

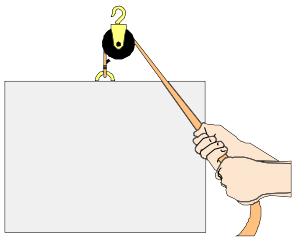
→ Draw a diagram of the buggy, showing how all parts move

→ Then (for level 2) ask them to consider the need for the seat belt and brake. What factors will affect whether the buggy moves (eg pushing it, putting on a slope, brake on/off, baby in/out)? Finally carry out an experiment to determine what angle of slope the buggy will move down with the brake on/off and the baby in/out, and produce a table of the results.

⇒ Possible follow-on activities

⇒ Examine a real baby buggy in detail, and discuss the purpose of every part

Block and tackle



Pulling up a heavy weight with a rope is very difficult, even if you put the rope over a pulley. But can you use two pulleys to make life easier - or even three or four?

Make a weight by putting as many white connectors onto a blue rod as you can, and tying a length of string to it. Try and lift it by pulling on the string. Now build a K'NEX frame with a pulley on it, put the string over the pulley, and pull on the string to lift the weight. Is it any easier?

For Level 2, then make a block and tackle with two pulleys, and see if it is easier to lift the weight..

For Level 3, make a block and tackle with four pulleys and try again.

Levels of difficulty

Level 1	✓5	Lift a weight using a pulley and a length of string
Level 2		Lift the weight using a block and tackle with two pulleys
Level 3		Lift the weight using a block and tackle with four pulleys

Equipment needed: **K'NEX** Discovery set
1 metre length of string

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L5 Wheels and tyres
L7 Pulleys
N1 String

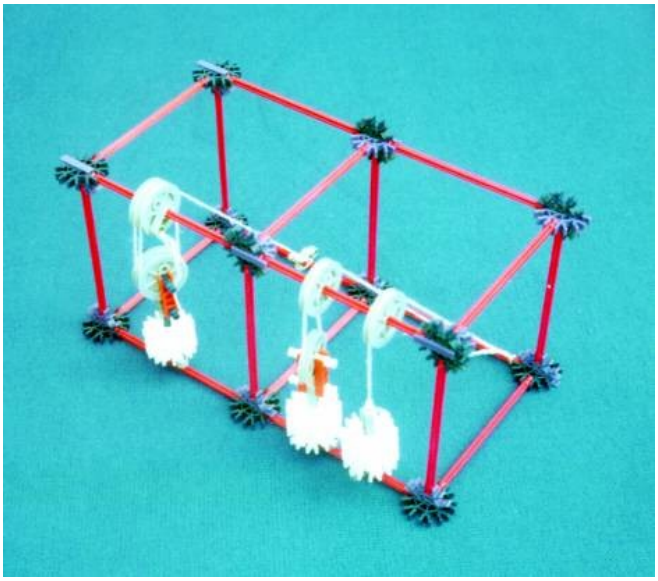
☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily

For teachers

Key topics: Forces **Designing skills**
Mechanisms **Making skills**

Components used in sample level 3 model below
Connectors: White 12 Blue 12 Purple 12 Orange 4 Grey 8
Rods: Red 14 Blue 5 White 2
Small wheels 7



Educational objective

To enable the children to experiment with the use of a pulley, and for Level 2 and 3, study the principles of using a number of pulleys in combination

☑Cross-curricular links

☑ History - use of block and tackle in ships, etc

√ Before starting

√ Find examples or look at pictures of pulleys in use, and if possible a picture of a real block and tackle

→ Conclusion

→ Draw a diagram of a block and tackle with one, two and four pulleys, showing how the string moves in each case

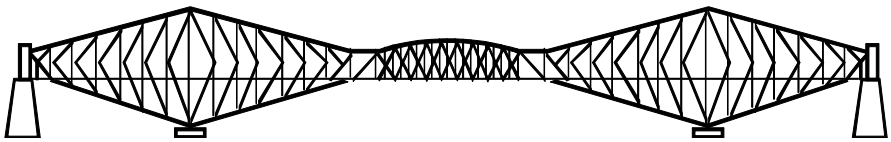
→ If you have one, use a spring balance to measure the force needed to lift the weight with differing numbers of pulleys, and use this data to create a table and graph

→ Then determine how far the string has to travel when you use different number of pulleys to lift the weight a set distance, and show (hopefully!) that the amount of energy needed (force x distance traveled) is always the same regardless of the number of pulleys used

⇒ Possible follow-on activities

None

Bridge that gap



A big storm has washed away part of the main road near your school. A child in the school is very ill, and the Ambulance can't get through. We need your help - can you design and build a bridge that can carry the ambulance across the big gap in the road?

Levels of difficulty

Level 1	Make a bridge which will span a 1m gap without supports
Level 2	Make a bridge which will span a 2m gap without supports
Level 3	As level 2, and will also support the weight of a box of K'NEX in the middle

Equipment needed:	**K'NEX Giant** set
For level 3:	Books to use as weights
Test area:	*Gaps of 1m and 2m for testing*

K'NEX is superb for building bridges, provided you get the design right. Think about how you can make your bridge really strong. Try out your ideas in a short bridge, and test it between two tables. Does it break or sag in the middle? If so, how could you strengthen it?

Push down on the centre of the bridge - does it start to fail in any way? How can you prevent this? Don't be afraid to start again after you have tested your bridge - getting the best design is not easy.

When you are happy with your short bridge, extend it to 1 metre long, and test it again. Can you improve your design even further?

Finally extend the bridge to 2 metres, and test it. If it stands up OK, try adding books to the centre one at a time (carefully!). If the bridge starts to bend or break - back to the drawing board!

☺ Handy hints

L1 3 ways to connect rods and connectors

L4 Strong 3-D structures

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R3 Model is not strong enough

For teachers

Key topics: Structures **Designing skills**

Forces **Making skills**

Components used in sample level 3 model below

Connectors: Yellow 50

Rods: Red 71 Yellow 48

Educational objective

How to make structures more stable and withstand greater loads. How structures can fail when loaded, and techniques for reinforcing and strengthening them

☑Cross-curricular links

☑ Geography - purpose and location of bridges

☑ History - early peoples, Victorians

☑ Mathematics - symmetry

√ Before starting

√ Look at pictures of different types of bridge, and consider which might work best with K'NEX

√ If possible, visit a real example of a bridge built from steel girders

→ Conclusion

→ Ask the children what they have learnt in the process of completing the challenge

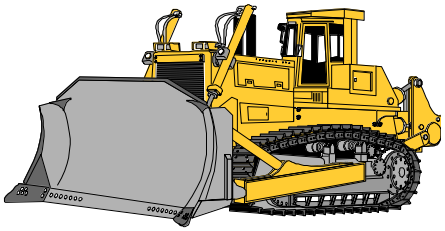
→ Ask them to compare the different bridges built by the class, and assess the strengths and weaknesses of each

⇒ Possible follow-on activities

⇒ Visit (or look at pictures of) examples of different types of bridge, and discuss why each type has been used

⇒ Project on the history and structure of a local bridge

Bulldozer



We want to build a new classroom at your school.
But the ground we are going to build it on is not flat, and we need to level it out before we can start building. Could you make a bulldozer for us, that will push earth out of the way to make the ground flat?

Bulldozers usually have a vehicle body, and a blade on the front to push the earth out of the way. How can you make each of these out of K'NEX? How can you join them together?

For level 2/3, how can you fix the motor on, and make it drive the wheels? If you have K'NEX chain, can you build a caterpillar track to drive your bulldozer along?

Levels of difficulty

Level 1	✓5	Make a simple bulldozer with four wheels
Level 2		As level 1, but powered by a battery motor
Level 3		As level 2, that can successfully flatten the sand in a sand-pit

Equipment needed:	**K'NEX** Discovery set
For level 2:	K'NEX battery motor
	K'NEX chain (optional)
Test area (level 3):	*Sandpit*

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L5 Wheels and tyres
L6 Making rods turn with wheels or connectors
M2 Battery motors
M4 Chain

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily

! Warning !

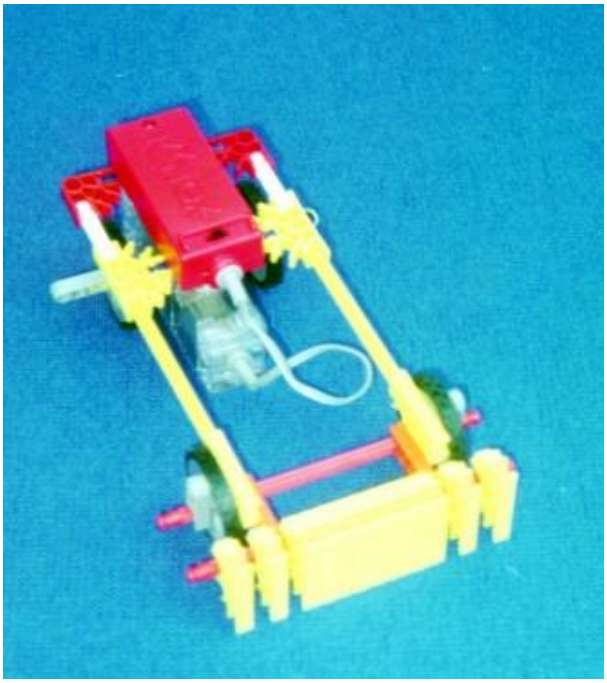
DON'T get sand into your K'NEX motor!

For teachers

Key topics: Forces **Designing skills** **Mechanisms** **Making skills**

Components used in sample level 3 model below

Connectors: Yellow 17 Red 2 Orange 2 Grey 4 Tan 2
Rods: Red 2 Yellow 3 Blue 2 White 2
Battery motor Small wheels/tyres 4



Educational objective

To think about the design characteristics of a real construction vehicle, and design and build a model that achieves the same result. At level 2/3, to consider the forces involved in pushing the earth out of the way, and achieving necessary traction through the wheels or caterpillar tracks

☑Cross-curricular links

☑ Geography - land use

√ Before starting

√ Look at some pictures of real bulldozers
√ Tell the children about the warning above

→ Conclusion

→ Compare each model produced in the class, and test which moves the earth most effectively. What are the successful features built into the best design?

⇒ Possible follow-on activities

⇒ Carry out a project describing all the stages necessary to build a new classroom at your school

Burglar alarm

We want to make absolutely sure that no burglars break into our classroom! Can you make a model of your classroom, and add a burglar alarm that will sound a buzzer when anyone comes into the room?

Levels of difficulty

Level 1	Make a model of your classroom out of K'NEX
Level 2	As level 1, plus a buzzer that sounds and a light that comes on when the door is opened
Level 3	As level 2, plus a buzzer that sounds and a light that comes on when anyone walks on the floor

Equipment needed:	**K'NEX** Discovery set Correx/Cardboard panels (optional)
For level 2:	Battery pack Lengths of wire/crocodile clips Buzzer Light bulb

What does your classroom look like? Can you make a model out of K'NEX that has got the right shaped floor, with the door in the right place? If you have Cardboard/Correx panels, can you use these to build a floor and walls around your K'NEX frame?

For level 2/3, experiment with how to connect the wires so that the buzzer sounds. Now think - how could you make the buzzer sound if the door opens, or if someone walks onto the floor?

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L9 Hinges
N2 Correx/cardboard panels
N3 Electrical circuits

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
T1 Crocodile clips won't attach
T2 Light bulb won't light up
T4 Buzzer won't make a noise

! Warning !

We would not recommend this project for younger children, as they may worry about the idea of burglars

For teachers

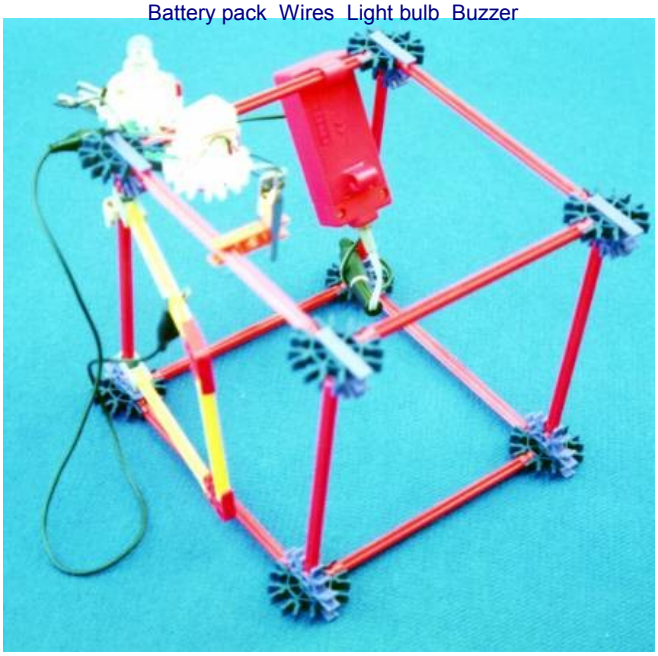
Key topics: Electricity **Designing skills** **Making skills**

Components used in sample level 2 model below

Connectors: White 2 Blue 8 Purple 8 Red 2 Orange 1 Grey 2 Tan 1

Rods: Red 12 Yellow 3 Green 2

Battery pack Wires Light bulb Buzzer



Educational objective

To set the children the task of designing and building an electrical circuit for a practical purpose, and in particular to experiment with the uses of different types of switches

☑Cross-curricular links

☑ Religious Education - moral implications

√ Before starting

√ Draw a floor plan of your classroom, showing the position of the door

→ Conclusion

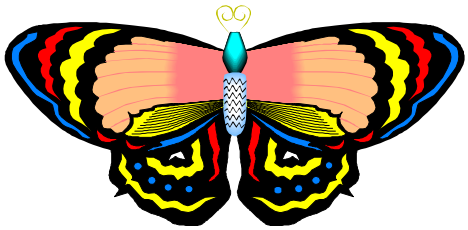
→ Draw a circuit diagram for your burglar alarm

→ Get the children to test each others' alarms, and explain how they work

⇒ Possible follow-on activities

⇒ Research all the different types of alarms that may be found in school, at home, in cars, in clocks, etc

Butterfly



All the colours of the rainbow in the wings of a butterfly! Can you use the many different coloured K'NEX rods and connectors to make a really beautiful butterfly?

Levels of difficulty

Level 1	✓5	Make a simple butterfly
Level 2	✓5	Make a butterfly whose wings can be flapped
Level 3		Make a butterfly whose wings flap when you pull a piece of string

Equipment needed:	**K'NEX** Discovery set
For level 3:	1m length of string

What shape is a butterfly's body? Where would you find its head, body and wings? Now think how you can use K'NEX to make a butterfly. What rods and connectors will you need? Can you use lots of different colours? Can you make both wings look the same?

For level 2, think about how you might enable the wings to flap.

For level 3, can you tie a piece of string to the wings, so that they flap when you pull the string?

☺ Handy hints

L1 3 ways to connect rods and connectors

N1 String

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R3 Model is not strong enough

For teachers

Key topics: **Animals** **Designing skills** **Forces** **Making skills**

Components used in sample level 3 model below

Connectors: White 7 Green 9 Red 2 Orange 4 Grey 4

Rods: Red 14 Yellow 20 White 2

String

Educational objective

A simple project for younger children, which encourages them to look at real-life objects, and build a model that has similar characteristics. For level 2/3, they will also have to consider the uses of pushes and pulls in making the wings flap

☑Cross-curricular links

☑ Mathematics - shape and symmetry

√ Before starting

√ Look at pictures of butterflies, and if possible a video showing how their wings flap

→ Conclusion

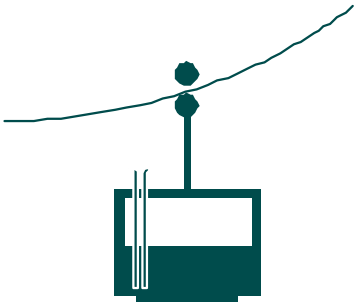
→ Ask the children to name the colours used in their model, and look at the models the other children have made

→ For level 2/3, ask them to explain what makes the wings flap in their own model, and in other models

⇒ Possible follow-on activities

⇒ Project on butterflies

Cable car



In countries with tall mountains, they sometimes use cable cars to carry people to the top of a mountain. They are particularly helpful for people who find it difficult to walk. Could you make a cable car, that could carry four people to the top of a mountain?

Levels of difficulty

Level 1	Make a cable car that will run down a rope
Level 2	As level 1, plus it can pull itself up the rope as well
Level 3	As level 2, with a safety device that stops it automatically if it starts to slide down

Equipment needed:	K'NEX Discovery set 1m length of string
For level 2:	1m length of string K'NEX battery motor
Test area:	*Length of string tied between a desk and the wall at an angle of 45 degrees*

Think about the parts of a real cable car. How could you make these out of K'NEX? You will probably need some sort of box for the people to sit or stand in, and something on top to run along the string.

For level 2, how can you use the motor and the second piece of string to make the cable car pull itself up the string?

For level 3, what could you add that will stop the car if it starts to move backwards?

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L5 Wheels and tyres
L7 Pulleys
M2 Battery motors
N1 String

☹ Troubleshooting tips

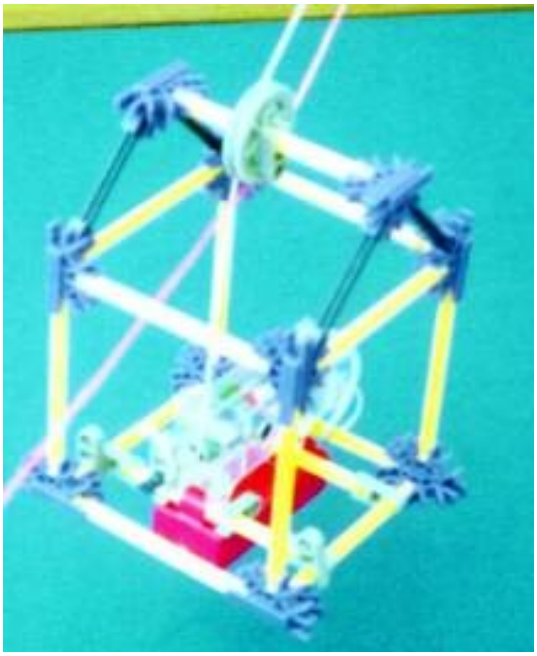
R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily
S1 Rod won't go into motor
S2 Motor won't turn the wheels
S3 Can't connect the motor to my model

For teachers

Key topics: Forces **Designing skills** **Mechanisms** **Making skills**

Components used in sample level 2 model below

Connectors: Purple 20 Grey 11
Rods: Yellow 15 Blue 5
Small wheel Battery motor String 2



Educational objective

To provide a practical project which demonstrates how the force supplied by a motor can be used to overcome the force of gravity.

☑Cross-curricular links

☑ Geography - transport and mountains

√ Before starting

√ Try and look at a picture or video of a real cable car
√ Tie a length of string at a 45 degree angle between the wall and a desk

→ Conclusion

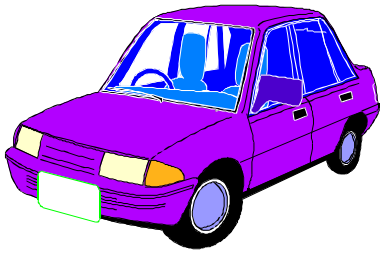
→ Ask the children to explain and draw a diagram of the forces involved

→ Carry out an experiment to predict and then test what will happen if the angle of the fixed string is gradually increased

⇒ Possible follow-on activities

⇒ Project on means of transport used in different countries

Car electrics



Can you think of all the things in a car that work by electricity? Do you know where the electricity in a car comes from? Could you make a model of a car, with car electrics that really work?

Make a simple model of a car, with four wheels. Then think about how the headlights in a real car work. How can you fasten light bulbs on to the front of your car, and wire them to the battery so they light up?

For level 2, how can you introduce a switch into your electrical circuit? And then add two red lights at the back of the car?

For level 3, how can you make the buzzer sound as a horn? And can you make a switch, using K'NEX and the crocodile clips on the wires, that will flash indicator lights to show whether the car is going to turn left or right?

Levels of difficulty

Level 1	Make a simple model of a car with headlights
Level 2	As level 1, with headlights and rear lights that go on when you press a switch
Level 3	As level 2, plus a horn and indicator lights

Equipment needed:	**K'NEX** Discovery set Battery pack Wires with crocodile clips 2 Light bulbs
For level 2:	Push-button switch 2 red LEDS
For level 3:	Buzzer 2 yellow LEDs

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L5 Wheels and tyres
N3 Electrical circuits

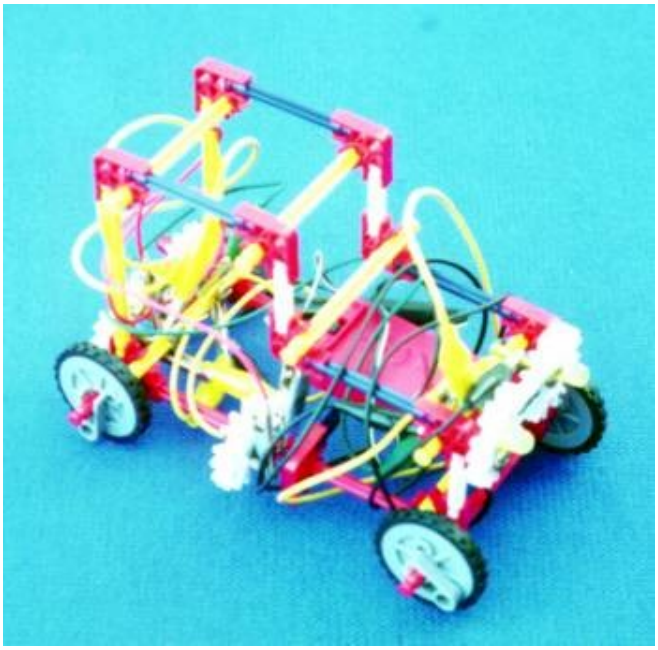
☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily
T1 Crocodile clips won't attach
T2 Light bulb won't light up
T3 LED won't light up
T4 Buzzer won't make a noise

For teachers

Key topics: Electricity **Designing skills** **Making skills**

Components used in sample level 2 model below
Connectors: White 5 Red 14 Grey 4
Rods: Red 4 Yellow 7 Blue 5 White 4 Green 2
Small wheel/tyre 4 Battery pack Wires LED 4 Switch 1



Educational objective

A practical project to create electrical circuits that function in a similar way to those found in real life.

☑Cross-curricular links

☑ Geography - environmental impact of the car

√ Before starting

√ Look at a real car (or other vehicle), to see how the lights and horn work

→ Conclusion

→ Ask the children to draw a circuit diagram

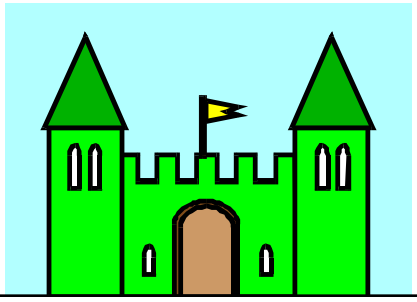
→ Compare the different ways that switches have been constructed in each model

⇒ Possible follow-on activities

⇒ Add some other mechanical or electrical features (eg a steering wheel and brakes)

⇒ A project on the history and future development of the car, and the benefits and problems of using cars

Castle



It is the year 1297. There are rumours that enemies are thinking of invading your town. Could you help by building a castle, in which the townspeople can all shelter if an invasion does take place?

Think about how to design your castle. What shape will it be? How can you make it as strong as possible? Once you have made the structure of the castle out of K'NEX, could you add Cardboard or Correx panels to the outside of the structure to make walls?

For level 2, how could you make a drawbridge that will go up and down when you turn a handle.

For level 3, how could you make a portcullis out of K'NEX, and raise it and lower it?

Levels of difficulty

Level 1	✓5	Build a simple castle with walls and a tower
Level 2		As level 1, plus a drawbridge that opens and closes when a handle is turned
Level 3		As level 2, plus a portcullis that raises and lowers when a handle is turned

Equipment needed:	**K'NEX Giant** set
	Cardboard/Correx panels
For level 2:	1m length of string
For level 3:	1m length of string

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L4 Strong 3-D structures
L8 Handles
N1 String
N2 Correx/cardboard panels

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough

For teachers

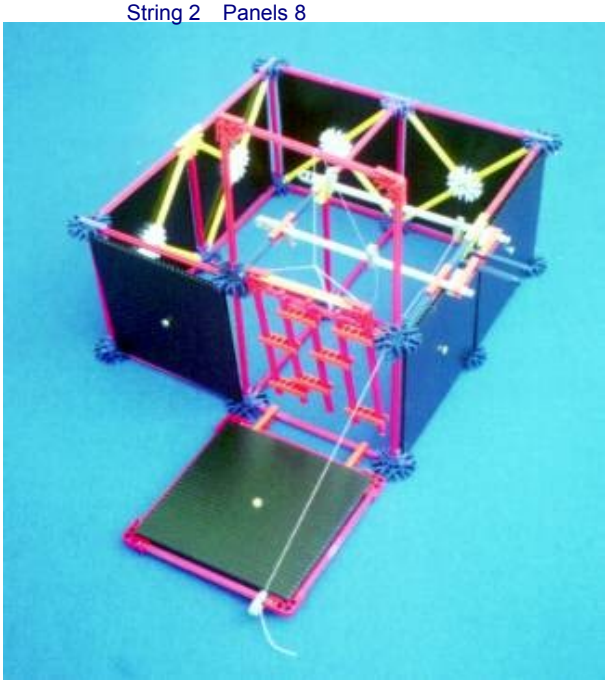
Key topics: Structures Designing skills Mechanisms Making skills

Components used in sample level 3 model below

Connectors: White 8 Blue 17 Purple 13 Yellow 3 Red 6 Orange 13
Grey 9

Rods: Grey 2 Red 41 Yellow 26 Blue 4

String 2 Panels 8



Educational objective

To encourage the children to design a structure which is both strong and stable. For level 2/3, to consider how mechanical elements can be added to the structure

☑Cross-curricular links

☑ History - Medieval times

√ Before starting

√ Look if possible at a 'cutaway' diagram of a castle, which shows how features such as drawbridges and portcullises work

→ Conclusion

None

⇒ Possible follow-on activities

⇒ Write a story about the people who lived in the castle

⇒ Discuss the best place to site castles, and the materials that were really used in their construction

Circus

The Circus is coming! Can you make some circus performers, animals and circus acts for us? What about a big top, or a flying trapeze?

Have you ever seen a clown? What does his or her face look like? Could you use K'NEX to make a picture of a clown's face?

For level 2, can you think of any animals or performers that you might find in a circus? Could you make models of them?

For level 3, could you make a 'big top' (a big circus tent) out of K'NEX for your animals and performers? And make a 'flying trapeze' that a person can swing on at the top of it? How might you attach the trapeze so that it swings easily?

Levels of difficulty

Level 1	✓5	Make some circus animals and performers
Level 2	✓5	As level 1, plus a big top to put them in
Level 3		As level 2, and a flying trapeze on which the performers can swing

Equipment needed: **K'NEX** Discovery set

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L4 Strong 3-D structures

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough

For teachers

Key topics: Structures **Designing skills** **Animals** **Making skills**

Components used in sample level 3 model below
Connectors: White 3 Purple 16 Yellow 8 Green 16 Orange 10 Grey 6
Rods: Red 24 Yellow 3 Blue 5 White 5 Green 17

Educational objective

A project mainly for younger children, to give them practical experience of building models of familiar objects. At level 3, to also ask them to build a structure, and a simple swing

☑Cross-curricular links

☑ Music - sounds in a circus environment

√ Before starting

√ Look at pictures and read stories about circuses
√ Draw up a list of suggestions from the whole class about the animals and performers who may be found in a circus

→ Conclusion

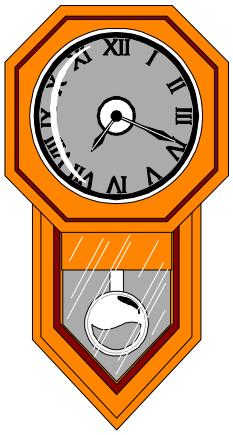
→ Count how many different animals and performers have been made
→ List the different colours used in the models
→ For level 3, discuss what makes the trapeze swing backwards and forwards

⇒ Possible follow-on activities

⇒ Writing a story about a visit to a circus

Clock

Clocks have existed for hundreds of years, and many different methods have been tried to ensure they tell the time accurately. Do you think you could make a clock out of K'NEX?



Think how you could make a clock face out of K'NEX. What rods and connectors would you use for the face? What about the minute and hour hand? Which would be longer? How could they be made to go round and round?

For level 2, experiment with the gear wheels. How can you use them within your clock? How many times does the blue gear turn for a single turn of the red gear?

For level 3, how could you attach the battery motor? Can you use extra gears to make the clock go as slow as a real clock? How can you make a chime sound every time the minute hand reaches the top?

Levels of difficulty

Level 1	✓5	Make a clock face out of K'NEX, with an hour hand and a minute hand
Level 2		As level 1, using gears that make the hour hand go round when the minute hand is turned
Level 3		As level 2, with a battery motor to drive the clock, and a chime that sounds every hour

Equipment needed:	**K'NEX** Discovery set
For level 2:	K'NEX gear wheels
For level 3:	K'NEX battery motor
	Chime bar

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
M2 Battery motors
M5 Gear wheels

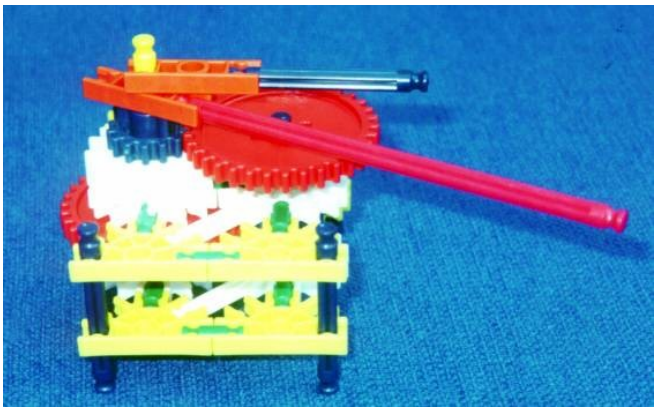
☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily
S1 Rod won't go into motor
S2 Motor won't turn the wheels
S3 Can't connect the motor to my model

For teachers

Key topics: Mechanisms Designing skills Forces Making skills

Components used in sample level 2 model below
Connectors: White 6 Yellow 8 Orange 2 Tan 3
Rods: Red 1 Yellow 1 Blue 6 White 4 Green 14
Red gear wheel 2 Blue gear wheel 2
Pin (to join white connector on minute hand to blue gear wheel)



Educational objective

To consider the purpose and operation of clocks. To design, build and test a clock using K'NEX components. To gain a practical understanding of the use of gear wheels

☑Cross-curricular links

☑ Maths - measuring instruments

√ Before starting

√ Look at examples of clocks and clock faces in the school

→ Conclusion

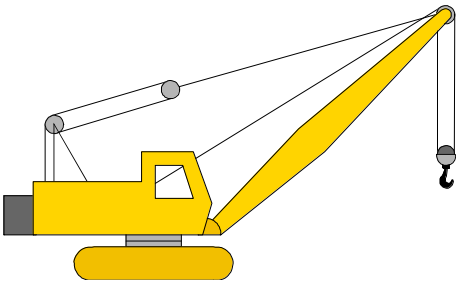
→ Test to see whose clock comes closest to keeping accurate time

→ Create tables and graphs showing the time recorded by each clock compared to the real time

⇒ Possible follow-on activities

⇒ Project to investigate different types of clock, and how they work

Crane



Four large tractor wheels have fallen out of a helicopter flying over your school, and luckily landed in the playground when no-one was there. We need to put them on a lorry, as they are urgently needed by a local farmer. Can you help, by building a crane that will lift the wheels onto the back of the lorry?

Levels of difficulty

Level 1	✓5	Build a simple model of a crane
Level 2		Build a crane with a hook on the end of the string that goes up and down when you turn a handle
Level 3		As level 2, and the crane can pick up 4 of the larger K'NEX wheels and tyres without falling over

Equipment needed: **K'NEX Giant** set
1m length of string

Do you know what cranes are used for? What do they look like? - there are lots of different types. How could you build one out of K'NEX? What shape will it be?

For level 2, how can you add a handle, and a length of string that will make a hook go up and down when you turn the handle?

For level 3, test your crane with 4 wheels on the hook. Does it work OK, or does it overbalance? If it does, how can you improve the design to prevent it overbalancing?

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L5 Wheels and tyres
L6 Making rods turn with wheels or connectors
L7 Pulleys
L8 Handles
N1 String

☹ Troubleshooting tips

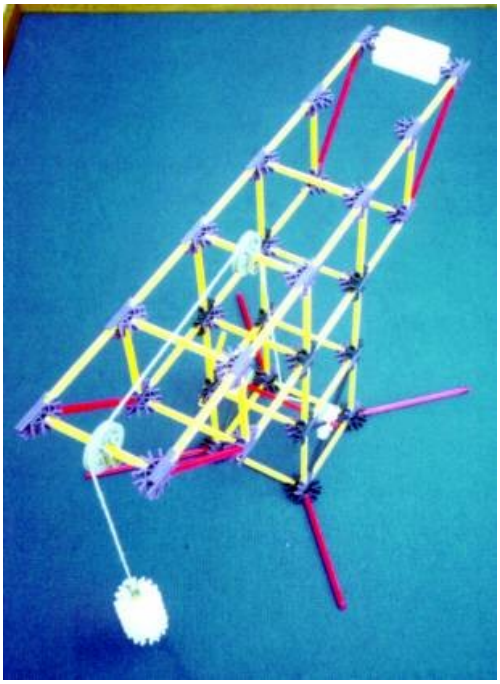
R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily

For teachers

Key topics: **Mechanisms** **Designing skills** **Forces** **Making skills**

Components used in sample Level 3 model below

Connectors: White 22 Blue 12 Purple 44 Orange 1 Grey 9
Rods: Red 9 Yellow 45 Blue 8
Small wheels 2 String



Educational objective

A practical project to design and build a model of a familiar working object. At level 3, a project which demonstrates the effects of balanced and unbalanced forces on a static object

☑Cross-curricular links

None

√ Before starting

√ Look at pictures or real examples of different types of crane, and discuss how they work

→ Conclusion

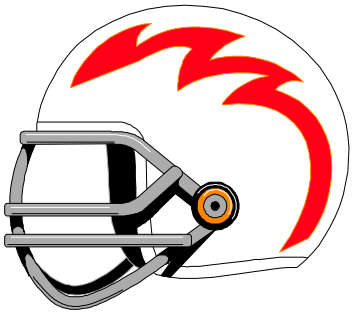
→ Test all the models in the class, to see whose model can lift the most wheels

→ Discuss the different ways in which the models achieve the objective, and why the design of the winning model is the best

⇒ Possible follow-on activities

None

Crash helmet



Whether you're playing American Football, riding a bike or working on a building site, your head is in danger! Can you make a crash helmet that will protect it?

How could you make a hat or helmet that is the right shape for your head? What K'NEX rods and connectors could you use to make it fit snugly? How can you make it as strong as possible?

For level 2, test your helmet by putting it on your head and patting it. Did it bend or break? How could you improve the design, so it won't break? Don't be afraid to start again if you want to try a new design.

For level 3, put your hat on the floor, and put your foot on it gently. Does it bend or break? Keep improving your design, so eventually you can stand on it.

Levels of difficulty

Level 1	✓5	Make a simple hat or helmet
Level 2		As level 1, but the helmet does not break if you pat the top of your own head quite hard
Level 3		As level 2, and the helmet does not break if you stand on it (on the floor!)

Equipment needed: **K'NEX** Discovery set

☺ Handy hints

L1 3 ways to connect rods and connectors

L3 Making corners with blue and purple connectors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R2 Blue and purple connectors won't join together

R3 Model is not strong enough

For teachers

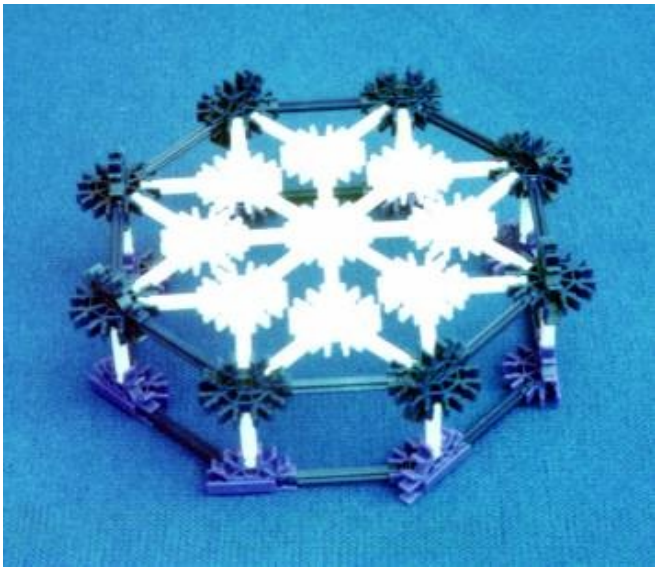
Key topics: Humans **Designing skills**

Forces **Making skills**

Components used in sample Level 3 model below

Connectors: White 9 Blue 16 Purple 16

Rods: Blue 16 White 24



Educational objective

To encourage the children to consider the safety issues associated with head protection. To then design and build a helmet, which will resist the forces that would otherwise cause damage to their head

☑Cross-curricular links

None

√ Before starting

√ Ask the children to bring in examples of different types of protective headgear

√ Ask each child to measure around their own head (eg in handspans, or in K'NEX-rod-lengths)

→ Conclusion

→ Ask the children what improvements they had to make to increase the strength of their helmets

→ Compare the different approaches the children have used to make strong helmets

⇒ Possible follow-on activities

⇒ Project on safety clothing and equipment at home, in school, in sport and in industry

Croquet

Croquet has been played for many centuries. You use a mallet (a sort of hammer) to knock a ball through a series of hoops. It is a lot harder to play than it looks! Could you make a croquet set out of K'NEX, and play a game with it?

Levels of difficulty

Level 1	Make a simple croquet mallet
Level 2	As level 1, but strong enough to hit a tennis ball 5 metres
Level 3	As level 2, make some croquet hoops, and play a game of croquet with them

Equipment needed: **K'NEX** Discovery set
Tennis ball

Think about how you could make a croquet mallet - it is a bit like a golf club, but with a mallet head on the bottom rather than a club head. How can you make it strong enough to hit a tennis ball with? Will the ball go the way you want it to?

For level 2 and 3, test your croquet mallet. When it is strong enough to hit the ball five metres, make some croquet hoops. They need to be strong enough to stand upright, even if the ball hits them as it goes through.

Then enjoy your game!

☺ Handy hints

L1 3 ways to connect rods and connectors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

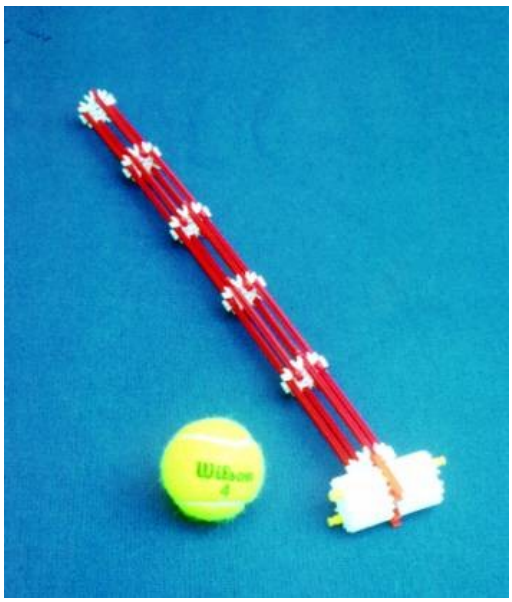
R3 Model is not strong enough

For teachers

Key topics: Structures **Designing skills** **Making skills**

Components used in sample level 3 model below

Connectors: White 16 Orange 2
Rods: Red 20 Yellow 2



Educational objective

An enjoyable sporting project which is also a practical lesson in building structures

☑Cross-curricular links

☑ Physical education - games

√ Before starting

√ Find the rules of croquet, and explain them in simple terms to the children (if you can't find any rules, make up some simple ones)

√ If possible, find a picture or video of croquet being played

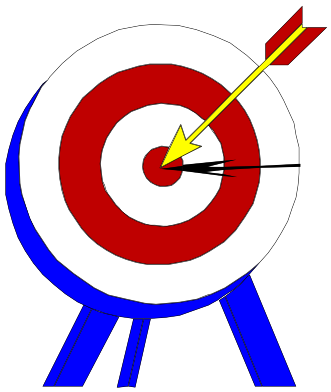
→ Conclusion

→ Hold a Croquet tournament

⇒ Possible follow-on activities

⇒ Investigate the history of croquet, and find out in which countries it is played

Crossbow



The brave outlaw Robin Hood has been captured, and is being held by the wicked Sheriff of Nottingham in his castle! We need the best shot in the land to fire a crossbow bolt and split the rope that holds the drawbridge up, to let Robin escape. Can you build a crossbow for us, and then use it to hit the target?

Levels of difficulty

Level 1	Make a simple crossbow that can fire a bolt
Level 2	As level 1, and hit a target 2 metres away
Level 3	As level 2, and the crossbow has a lever which can be released to fire it

Equipment needed: **K'NEX** Discovery set
Test area (level 2): Paper target on a wall, and 3m distance from it marked

Crossbows were a bit like bows and arrows, but they fired a 'bolt' (a short arrow), and had a lever which you pulled to shoot the crossbow. How could you make a bolt out of K'NEX? What could you use to fire it with? What will the crossbow frame look like?

For level 2, you will probably need to keep testing the crossbow, and improving it if it doesn't shoot far enough or straight enough.

For level 3 - a real crossbow - think about how a lever could be used to hold the bolt back until you are ready to fire it.

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough

! Warning !

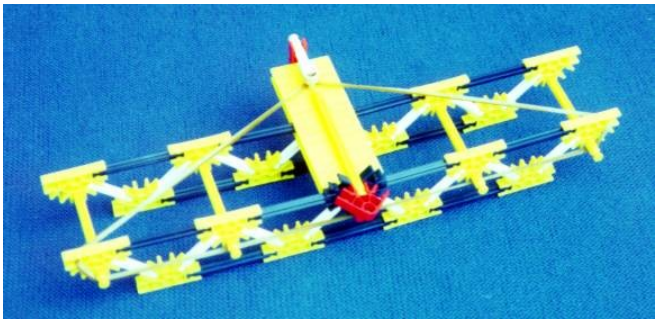
Crossbows can be dangerous - only fire at the target - **NEVER fire when there is someone in front of you**
Not recommended for younger children

For teachers

Key topics: Forces **Designing skills** **Mechanisms** **Making skills**

Components used in sample level 3 model below

Connectors: Blue 1 Yellow 32 Orange 1 Tan 1
Rods: Red 1 Yellow 4 Blue 14 White 17
Rubber band



Educational objective

A practical project that demonstrates that energy can be stored by stretching an elastic band, and then released to create rapid movement

☑Cross-curricular links

☑ History - history of the crossbow

√ Before starting

√ Try and find a picture of a crossbow
√ Explain the safety rules needed for this project

→ Conclusion

→ If you have a spring balance, measure the force necessary to pull back the elastic band fully

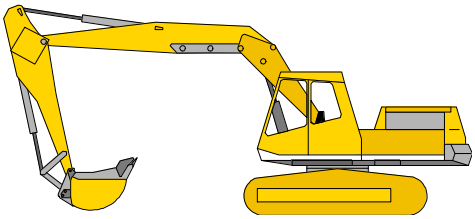
→ Get the children to describe the forces involved when the bolt is released, and when it flies through the air

→ Explore the factors which explain why some of the crossbows built fire their bolt further than others

⇒ Possible follow-on activities

⇒ Investigative experiment resulting in a table and graph showing how far a projectile flies when different factors are varied (eg force applied, angle of fire, shape of projectile)

Digger



We want to build a new children's swimming pool near your school. Could you make a digger for us, that will dig a deep hole to put the swimming pool in?

Levels of difficulty

Level 1	Make a simple model of a digger
Level 2	As level 1, including an arm with a shovel on it that move up and down, from side to side, and can scoop the sand up in a sandpit
Level 3	As level 2, with three handles or levers which control the three types of movement

Equipment needed:	**K'NEX Discovery** set
For level 2:	1m length of string
Test area (level 3):	*Sandpit*

Have you ever seen a digger at work? A skillful operator can dig holes exactly the shape and depth needed. Could you make a digger out of K'NEX? What components would you need to build the shovel that goes into the ground? How could this fasten onto the body of the digger? What will make the shovel scoop up the earth?

For level 2, how can you give your shovel the three types of movement needed - up/down, left/right, and 'scoop'?

For level 3, how could you add three handles or levers that will create each of these three movements?

☺ Handy hints

- L1 3 ways to connect rods and connectors
- L3 Making corners with blue and purple connectors
- L5 Wheels and tyres
- L6 Making rods turn with wheels or connectors
- L7 Pulleys
- L8 Handles
- N1 String

☹ Troubleshooting tips

- R1 Rods difficult to join to connectors
- R2 Blue and purple connectors won't join together
- R3 Model is not strong enough
- R4 Wheels won't turn around easily

! Warning !

DON'T get sand into your K'NEX motor!

For teachers

Key topics: Mechanisms Designing skills Forces Making skills

Components used in sample level 3 model below

Connectors: White 4 Blue 20 Purple 22 Yellow 6 Red 2 Orange 7 Grey 6

Rods: Red 3 Yellow 8 Blue 18 White 32 Green 13 Small wheel/tyre 4 String 1

Educational objective

A fairly difficult project, which will stretch the children's abilities in design, and in applying forces to create different types of motion

☑Cross-curricular links

None

√ Before starting

√ Look at pictures or real examples of different types of digger

→ Conclusion

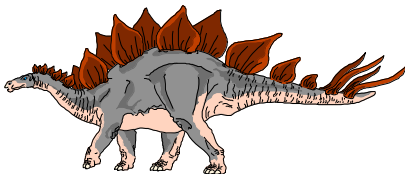
→ Set the children a task to complete, such as digging a hole 5 centimetres deep

→ Draw a diagram of the digger, showing how the different types of motion have been achieved

⇒ Possible follow-on activities

⇒ Visit to a building or civil engineering project nearby

Dinosaur



Exploring with a friend, you discover that a recent earth slip has uncovered a cave, which you follow down for a long way until it opens up into a huge space deep underground. Many animals live in this 'Lost World' which have died out on the surface, including Dinosaurs, which have evolved into clever and friendly animals well adapted to living in the 20th Century. When you return home, though, no-one believes what you have found! You decide to build a working model of the dinosaur, to convince everyone that they exist.

Levels of difficulty

Level 1	✓5	Make a simple model of a dinosaur
Level 2		Make a dinosaur which walks along
Level 3		As level 2, plus a mouth which opens and closes as it walks along

Equipment needed:	**K'NEX** Discovery set
For level 2:	Battery motor

Think about the different sorts of dinosaurs you have seen pictures of. Could you try and make a model of one of these out of K'NEX? How big will it be? Does it walk on two legs or four? Will a 20th Century dinosaur be different to one that lived millions of years ago?

For level 2, think how you could use the motor to make the dinosaur 'walk'.

For level 3, how could you transmit the power from the motor to the head as well as to the legs?

☺ Handy hints

L1 3 ways to connect rods and connectors
L5 Wheels and tyres
L6 Making rods turn with wheels or connectors
M2 Battery motors

☹ Troubleshooting tips

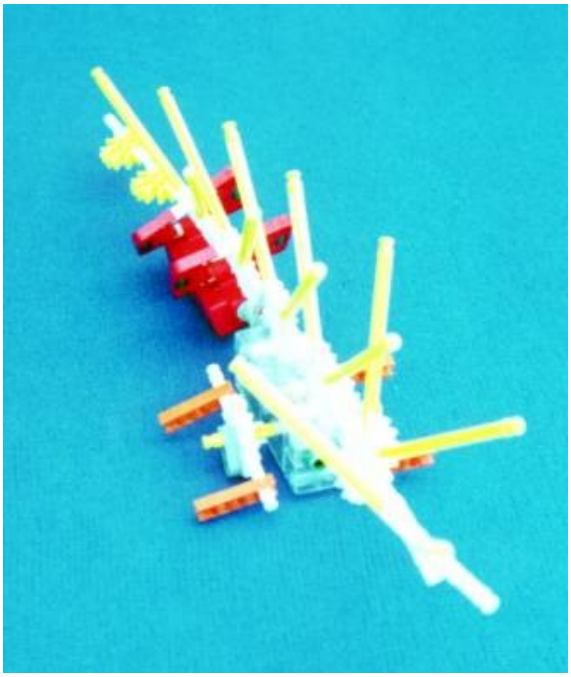
R1 Rods difficult to join to connectors
R3 Model is not strong enough
S1 Rod won't go into motor
S2 Motor won't turn the wheels
S3 Can't connect my motor to my model

For teachers

Key topics: Animals **Designing skills**
Structures **Making skills**

Components used in sample level 2 model below

Connectors: White 9 Yellow 2 Red 8 Orange 4 Grey 2 Tan 2
Rods: Yellow 12 White 20 Green 4
Battery motor



Educational objective

To encourage the children to consider the characteristics of a large animal, and to model these. Building a successful dinosaur also requires some understanding of structures

☑Cross-curricular links

☑ History - pre-history

√ Before starting

√ Look at some pictures or models of dinosaurs - skeletons are particularly useful

→ Conclusion

→ Compare the models created to any pictures or models available

→ Get the children to explain how their dinosaur has adapted to the 20th century. What do they eat? Are they affected by pollution?

→ Suggest that the children might like to add skin to their dinosaurs, using materials of their own choice

⇒ Possible follow-on activities

⇒ Project on dinosaurs, or on the skeletons of different animals

⇒ Exploring how 20th century conditions have affected different animals

Disco Lights

No disco is complete without coloured lights! Can you design and build your own set of flashing lights for the disco?

Levels of difficulty

Level 1	✓5	Make three different coloured lights light up
Level 2		As level 1, plus a switch to turn the lights on and off
Level 3		As level 2, plus a way of making the lights turn on and off continuously

Equipment needed:	**K'NEX** Discovery set Battery pack Wires with crocodile clips 3 coloured LEDs
For level 2:	Push button switch

Think about how you can light up the first light. Can you make a 'circuit', so that the electricity can go from the battery, through the LED, and back to the battery again? How an you add a second light - and a third?

For level 2, how can you add a switch to make your lights turn on and off?

And finally, for level 3, what could you add to your model that would make the lights flash on and off, for instance when you turn a handle or move a lever backwards and forwards?

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
N3 Electrical circuits

☹ Troubleshooting tips

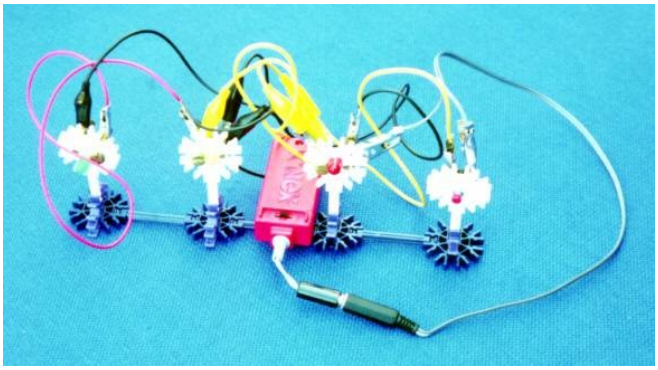
R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
T1 Crocodile clips won't attach
T3 LED won't light up

For teachers

Key topics: Electricity **Designing skills** **Making skills**

Components used in sample level 2 model below

Connectors: White 4 Blue 4 Purple 4
Rods: Blue 3 White 4
Battery pack Wires LED 3 Switch



Educational objective

A practical project to create electrical circuits that function in a similar way to those found in real life

☑Cross-curricular links

☑ Music - music at discos

√ Before starting

√ Discuss how electrical circuits work
√ Explain that LEDs must have the current flowing in correct direction to light up

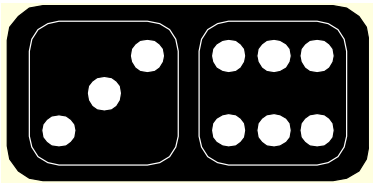
→ Conclusion

→ Compare the different ways that the desired result has been achieved
→ Draw a circuit diagram

⇒ Possible follow-on activities

⇒ Ask a DJ to bring his equipment into school and demonstrate how his disco lights and other electrical equipment work

Dominoes



Dominoes has been a popular game for many years. But could you make a K'NEX domino set, and play a game with it?

Levels of difficulty

Level 1	✓5	Make a set of simple dominoes using six different colours on each end, and play a game with it
Level 2		Make a set of dominoes with numbers one to six on each end, and play a game with it
Level 3		Make a set of giant dominoes at least 0.5m long, and play a game with it

Equipment needed: **K'NEX** Discovery set

Ordinary dominoes have the numbers one to six at each end. Think about how you could use colours instead of numbers. How could you fasten the different coloured pieces together to make all the dominoes?

For level 2, how could you use a number at each end rather than a colour? Remember, the number doesn't have to be a number of white spots, as in real dominoes.

For level 3, how could you make giant dominoes that would be at least 0.5m long?

☺ Handy hints

L1 3 ways to connect rods and connectors

☹ Troubleshooting tips

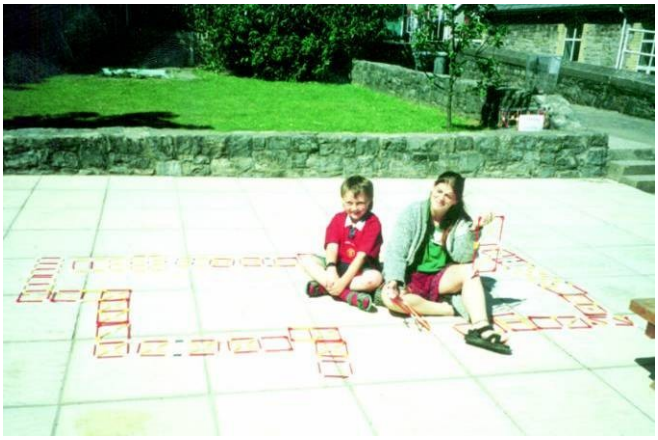
R1 Rods difficult to join to connectors

R3 Model is not strong enough

For teachers

Key topics: Designing skills

Making skills



Educational objective

To consider the purpose of dominoes, and to achieve the objective of a set of dominoes with different components

☑Cross-curricular links

☑ Mathematics - number

√ Before starting

√ Allow the class examine a real set of dominoes

→ Conclusion

→ Compare how different children have achieved the objective

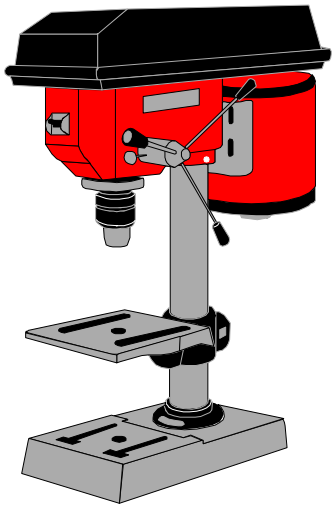
→ Play a game with the domino sets

⇒ Possible follow-on activities

⇒ Making the equipment needed for other games

Drill

You might have seen an electric drill used at home. In factories they sometimes use larger drills called 'pedestal drills' that will drill a hole in an object placed on a plate on the drill. Could you make a drill out of K'NEX?



All drills have a drill 'bit', which turns round and round to make a hole. Can you make a model of a hand-held drill, in which a K'NEX rod is the drill bit?

For level 2, think how you could build a drill in a frame, with the handle on the side, and the drill bit turning vertically. How will you transfer the movement from the handle to the drill?

For level 3, where will you put the piece of paper to be cut? And how will you make the drill go through it?

Levels of difficulty

Level 1	Make a hand-held drill, with a rod that will go round and round with a motor
Level 2	Make a pedestal drill, in which the drill can be made to go up and down via a handle
Level 3	As level 2, and the rod can drill a hole in a piece of paper

Equipment needed: **K'NEX** Discovery set
Battery motor

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L5 Strong 3-D structures
L6 Making rods turn with wheels or connectors
L8 Handles
L9 Making gear wheels from rods and connectors

☹ Troubleshooting tips

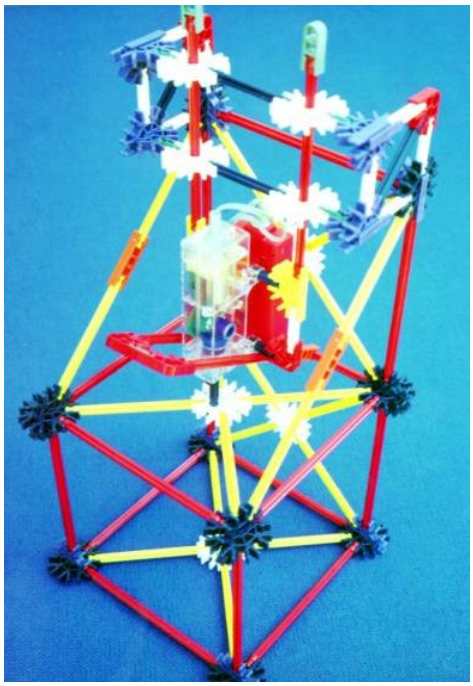
R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily
S1 Rod won't go into motor
S3 Can't connect my motor to my model

For teachers

Key topics: Forces **Designing skills**
Mechanisms **Making skills**

Components used in sample level 3 model below

Connectors: White 8 Blue 15 Purple 15 Yellow 2 Red 6 Orange 4 Grey 2
Rods: Red 19 Yellow 20 Blue 7 White 11 Green 5
Battery motor



Educational objective

An interesting mechanical project to build a real piece of manufacturing equipment

☑Cross-curricular links

None

√ Before starting

√ Demonstrate a hand-held drill

→ Conclusion

→ Draw a diagram of the model, showing the forces and movement involved

⇒ Possible follow-on activities

⇒ Visit a local manufacturing company which uses drills

Drum

Drums are one of the oldest forms of musical instrument, and are found all around the world. Can you use your K'NEX set to make a drum?

A percussion instrument is one where the noise is made by two objects striking each other. Examples include drums and rattles. Can you use your K'NEX set to make a simple percussion instrument?

For level 2, can you stretch a plastic sheet over a K'NEX model to make a drum? How will you fasten the plastic sheet to your model?

For level 3, can you improve your model so that the plastic sheet can be tightened, perhaps when you pull a lever or turn a handle? What effect do you think this will have on the sound of the drum?

Levels of difficulty

Level 1	✓5	Make a simple percussion instrument
Level 2		Make a drum using a drum skin stretched across a K'NEX frame
Level 3		As level 2, plus a way of changing the tension of the drum skin

Equipment needed:	**K'NEX** Discovery set
For level 2:	Plastic sheet

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L4 Strong 3-D structures
N4 Plastic sheet

☹ Troubleshooting tips

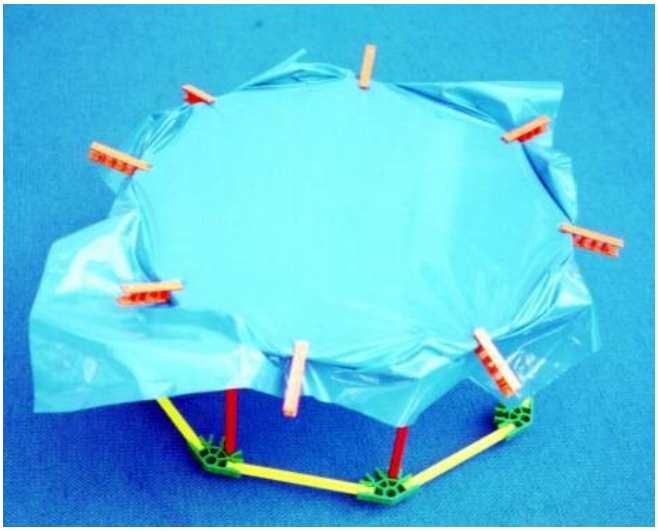
R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough

For teachers

Key topics: Sound **Designing skills** **Making skills**

Components used in sample level 3 model below

Connectors: Green 16 Orange 8
Rods: Red 8 Yellow 16
Plastic sheet



Educational objective

To discover that sound can be made by striking an object so that it vibrates, and that the loudness of the sound can be varied. For level 3, to experiment with changing the pitch of the sound

☑Cross-curricular links

☑ Music - percussion instructions

√ Before starting

None

→ Conclusion

→ Ask the children to use their models to produce quiet and loud sound, and discuss how this happens

→ For level 2 and 3, discuss what is happening when the drum skin is struck. Experiment with vibrations by seeing the effect on small light objects when the drum skin is struck (eg sand), and with deadening the vibration of the drum skin by touching it.

→ For level 3, discuss what is happening to the sound when the drum skin is tightened

⇒ Possible follow-on activities

⇒ Project on different types of drum, and where in the world they come from

Earthquake

On a visit to San Francisco, you hear a radio warning that an earthquake is going to take place the next day. Can you help the local people, who will lose their houses and blocks of flats, by making them an earthquake-proof building to live in?

When the earthquake comes, the ground underneath your building will move and shake. Can you build a house that is strong enough not to break, and stable enough not to fall over?

For level 2 and 3, think about the effect the earthquake will have on a tall building. How can you stop the movement making your tower fall over sideways?

Levels of difficulty

Level 1	✓5	Build a house that will stand up in an earthquake
Level 2		Build a 0.5m tower that will stand up in an earthquake
Level 3		As level 2, but a 1m tower

☺ Handy hints

L1 3 ways to connect rods and connectors

L3 Making corners with blue and purple connectors

L4 Strong 3-D structures

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R2 Blue and purple connectors won't join together

R3 Model is not strong enough

Equipment needed: **K'NEX** Discovery set

Test area: Sheet of board or stiff cardboard 50cm square, on 4 blocks each 5cm high

For teachers

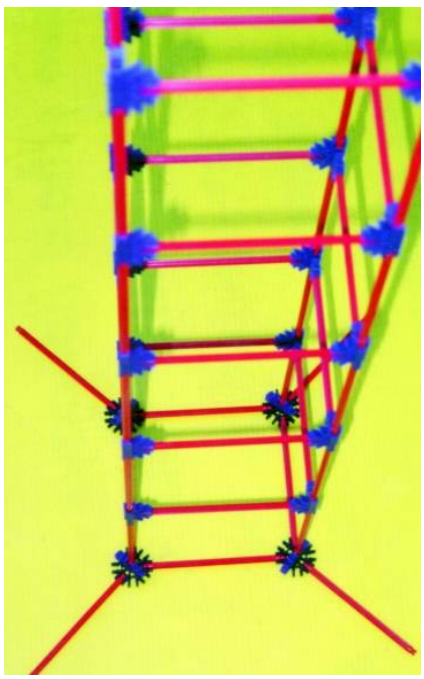
Key topics: Forces **Designing skills**

Structures **Making skills**

Components used in sample level 3 model below

Connectors: Blue 4 Purple 44

Rods: Red 48



Educational objective

To consider how naturally-created forces can cause a building to fall. To design a structure which will have the stability to prevent this

☑Cross-curricular links

☑ Geography - earthquakes

√ Before starting

√ Demonstrate how an earthquake can be simulated in the Test area by knocking the blocks away one at a time

→ Conclusion

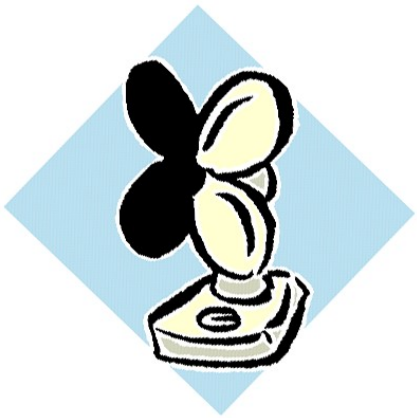
→ Tell the class that you are going to increase the scale of the earthquake by putting taller blocks under the board. Ask them to predict the effects this will have on their models, and state the modifications they will need to prevent it falling. Then test the larger earthquake with and without the modifications, and discuss the results.

⇒ Possible follow-on activities

⇒ Project on forces in nature making objects move, such as wind, waves, tides, earthquakes and volcanoes.

Fan

On a hot day, an electric fan is just the thing to cool you down! Can you make a fan from K'NEX, that spins fast enough to cool you?



Levels of difficulty

Level 1	✓5	Make a fan that turns when you spin it by hand
Level 2		Make a fan that spins with a spring motor
Level 3		As level 2, with a switch to turn it on once the spring motor is wound up

Equipment needed: **K'NEX** Discovery set
Spring motor

How could you make the blade of the fan from K'NEX rods and connectors? Can you make a frame to hold up the blade while it spins?

For level 2, how could you attach a spring motor to your model?

For level 3, usually when you wind up a spring motor and let it go, it spins straight away. Can you add some sort of lever or switch to your model that will stop it turning until you want it to?

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L4 Strong 3-D structures
L6 Making rods turn with wheels or connectors
M1 Spring motors

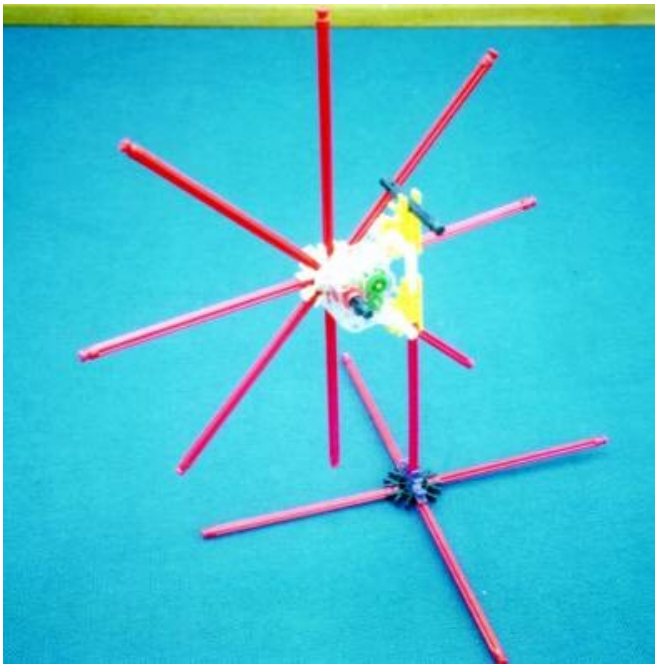
☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
S1 Rod won't go into motor
S2 Motor won't turn the wheels
S3 Can't connect my motor to my model

For teachers

Key topics: Forces **Designing skills**
Mechanisms **Making skills**

Components used in sample level 3 model below
Connectors: White 1 Blue 1 Purple 1 Yellow 2 Grey 1 Tan 1
Rods: Red 13 Blue 2 White 3
Spring motor



Educational objective

To build a model in which the turning blades of a fan create a wind. To demonstrate that winding up a spring motor stores energy, and that letting it go releases energy

☑Cross-curricular links

None

√ Before starting

√ If possible, demonstrate a working electric fan

→ Conclusion

→ Draw a diagram showing the forces involved and all moving parts.

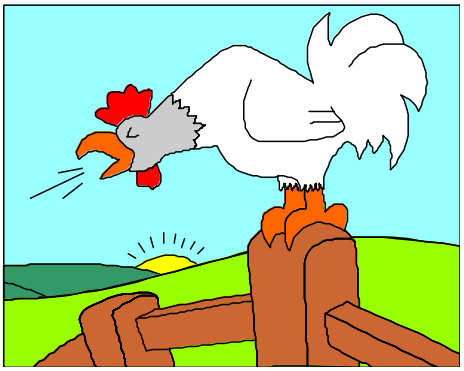
→ Write a description of how the force applied during the winding-up process is transferred to the spring and stored there, and then how on release the forces are transferred to create a wind

→ Consider why a fan makes you feel cooler

⇒ Possible follow-on activities

⇒ Project on wind and the effects of wind forces (eg on windmills)

Farm



Farms first appeared thousands of years ago, but sadly the last fifty years have seen farms in many parts of the country replaced by houses and roads. Could you build a farm us, complete with animals, buildings and farm machinery?

Levels of difficulty

Level 1	✓5	Make models of some farm animals
Level 2	✓5	As level 1, plus a farm building with a door for them to live in
Level 3		As level 2, plus an item of farm machinery that really works

Equipment needed:	**K'NEX** Discovery set
For level 3:	Battery motor

What animals might you find on a farm? How many have two legs and how many four? Could you make models of some of them?

For level 2, think how you might make a barn or other farm building for the animals to live in. Can you make it really strong? Will it have a door?

For level 3, think about the types of machinery that you find on a farm. Could you make a model of one type? You can use a battery motor if you want to.

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L4 Strong 3-D structures
L5 Wheels and tyres
L6 Making rods turn with wheels or connectors
L9 Hinges
M2 Battery motors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily
S1 Rod won't go into motor
S2 Motor won't turn the wheels
S3 Can't connect my motor to my model

For teachers

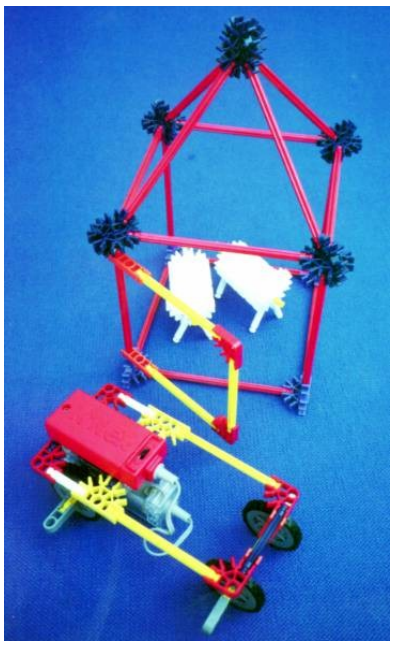
Key topics: **Animals** **Designing skills** **Structures** **Making skills**

Components used in sample level 3 model below

Connectors: White 22 Blue 20 Purple 16 Yellow 2 Red 4 Orange 4
Grey 6 Tan 2

Rods: Red 16 Yellow 9 Blue 3 White 10

Battery motor Small wheel/tyre 4



Educational objective

To consider the construction of a range of familiar animals and structures, and to come up with ideas on how these can be modeled. To build moving parts into their models, such as a door and (for level 3) machinery

☑Cross-curricular links

☑ Geography - farming and land use

√ Before starting

√ Look at some pictures of a farm

→ Conclusion

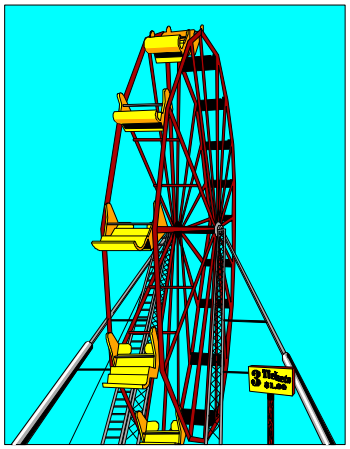
→ Make a list of all the animals and types of farm machinery that have been selected

⇒ Possible follow-on activities

⇒ Write a story about the farm animals

⇒ Visit a working farm (or watch a video if a visit is not possible)

Ferris wheel



It is the school holidays, and a fair is being held near your school. Then a phone call comes - all the fairground rides have been damaged in a big storm and can't be used. The fair opens tomorrow, and we need your help - to build an exciting Ferris wheel for the children to ride on.

Levels of difficulty

Level 1	Make a simple Ferris Wheel
Level 2	As level 1, with a motor that makes it turn
Level 3	As level 2, with seats that always hang downwards when the wheel turns

Equipment needed:	**K'NEX** Discovery set
For level 2:	Battery motor

What does a Ferris wheel look like? How can you build a frame which is strong enough to hold the wheel up? What design will you use for the wheel? Where will the people sit?

For level 2, think about how you can attach your motor. Will you attach it to the frame or to the wheel?

For level 3, we do not want to have the people turning upside down as they go around the wheel! How can you ensure that the seats are always hanging downwards?

☺ Handy hints

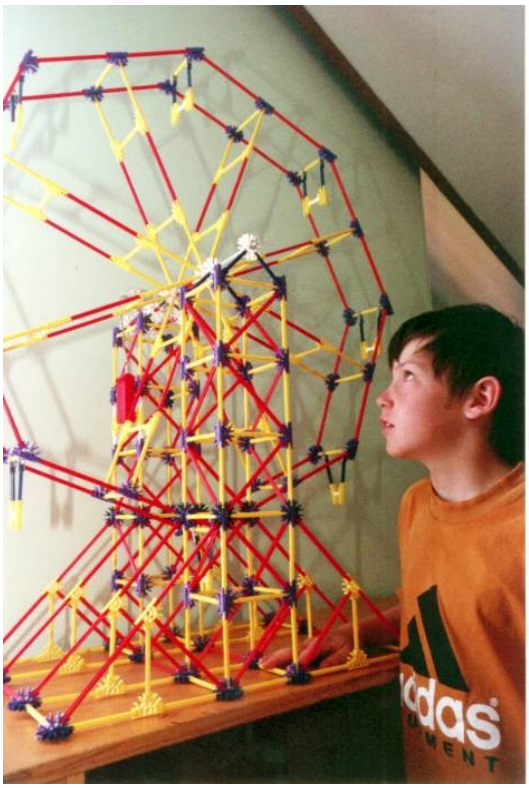
L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L4 Strong 3-D structures
L6 Making rods turn with wheels or connectors
M2 Battery motors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily
S1 Rod won't go into motor
S2 Motor won't turn the wheels
S3 Can't connect my motor to my model

For teachers

Key topics: Forces **Designing skills** **Mechanisms** **Making skills**



Educational objective

To consider the design and function of a familiar piece or machinery. To build a working model that achieves the same functionality. To experiment with pushes and pulls and balanced/unbalanced forces

☑Cross-curricular links

None

√ Before starting

√ If possible, look at a picture of a Ferris wheel

→ Conclusion

→ For younger children, use the model to experiment with pushes and pulls

→ For older children on a model without a motor, ask the children to predict what will happen if you add some K'NEX as a weight at the top of the wheel, and test their prediction. Then predict and test the effects of adding various weights onto the wheel in different positions, to show that unbalanced forces create movement, whereas balanced forces do not.

→ Repeat the above on a model with a motor

⇒ Possible follow-on activities

⇒ Project on the forces that may be found in a Fairground

Fire engine

Quick! A fire has started in an office block nearby. Can you make a fire engine that can help the office workers escape, and then put out the fire?

Levels of difficulty

Level 1	Make a fire engine vehicle
Level 2	As level 1, with a ladder on a turntable which you can turn with a handle
Level 3	As level 2, and the ladder extends when you turn a second handle

Equipment needed:	**K'NEX** Discovery set
For level 3:	1m length of string

Can you think of all the different parts of a Fire Engine? How can you build them into your model?

For level 2, how can you make a long ladder with K'NEX? Can it lie flat when the vehicle is moving, and be put upright when you arrive at the fire? Could you build it on a turntable, which turns with a handle?

For level 3, how could you make a ladder in two sections which extends when you turn a handle?

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L5 Wheels and tyres
L6 Making rods turn with wheels or connectors
L8 Handles
N1 String

☹ Troubleshooting tips

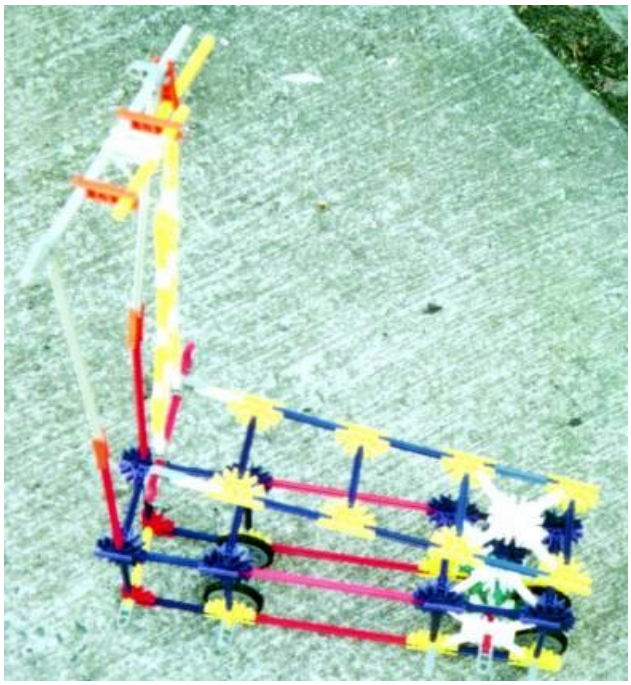
R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily

For teachers

Key topics: Forces **Designing skills** **Mechanisms** **Making skills**

Components used in sample level 3 model below

Connectors: White 6 Blue 10 Purple 8 Yellow 22 Red 2 Orange 5 Grey 18 Tan 1
Rods: Grey 3 Red 8 Yellow 6 Blue 20 White 34 Green 16
String Small wheel/tyre 4



Educational objective

To design and build a model of a vehicle with a specific design objective

☑Cross-curricular links

☑ History - history of fire fighting

√ Before starting

√ Discuss why fire engines are needed
√ If possible look at a picture of a fire engine, or visit a fire station

→ Conclusion

→ List the different pieces of equipment that the children have built into their models

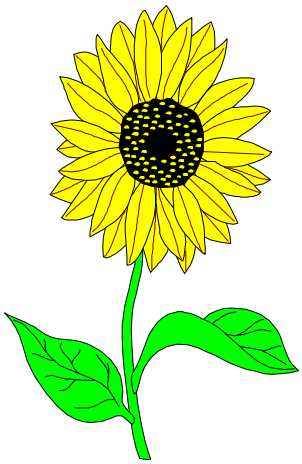
→ Set an exercise in which you pretend that a model of a building is on fire, and each pair of children have to arrive with their vehicles and extend their ladders as quickly as possible to put it out. Using a stop watch, time each pair, and draw a table and graph of the result.

⇒ Possible follow-on activities

⇒ Project on fires in buildings - causes of fire, what to do if one happens, how fire brigade put them out, effect of fire brigade being called to false alarms, etc

Flower

Reds ... yellows ... greens ... we need to make the room more colourful! Can you make a model of a flower for us, the bigger the better?



How many different sorts of flower do you know? What colours are they? What shape are they? Can you make a model of one of them from K'NEX?

For level 2, can you make a pot for the flower to grow in? How will you fasten your flower into the pot?

For level 3, can you make the stalk of your flower slide up and down in the pot? Do you think you could tie a piece of string to it, so that when you pull the string the flower grows?

Levels of difficulty

Level 1 ✓5 Make a simple flower
Level 2 ✓5 As level 1, plus a pot that it grows in
Level 3 ✓5 As level 2, plus a string to pull to make the flower grow!

Equipment needed: **K'NEX** Discovery set
For level 3: 1m length of string

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
N1 String

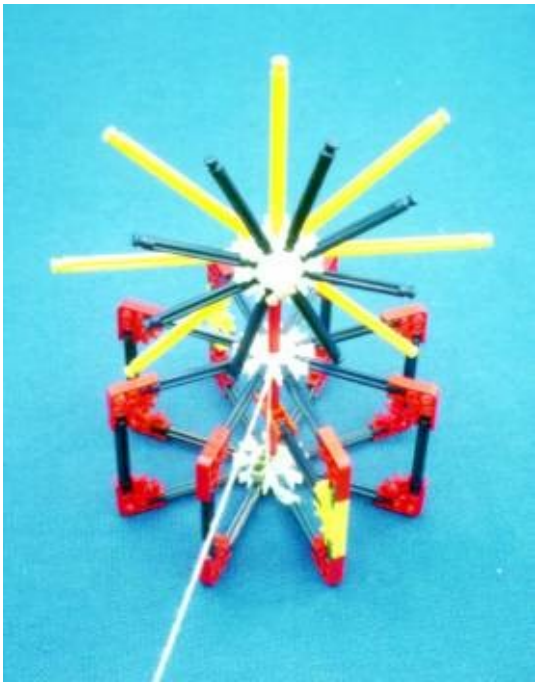
☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough

For teachers

Key topics: Plants **Designing skills**
Forces **Making skills**

Components used in sample level 3 model below
Connectors: White 4 Yellow 2 Red 16 Orange 1 Grey 1 Tan 2
Rods: Red 13 Blue 2 Green 3
String



Educational objective

To consider the various parts of a flower, and then to build as many as possible into a model. For level 3, to use pushes and pulls to make the flower grow

☑Cross-curricular links

☑ Mathematics - shape and symmetry
☑ Art - colours

√ Before starting

√ If possible, look at some flowers growing, or if not, at some pictures
√ Discuss the parts of a flower

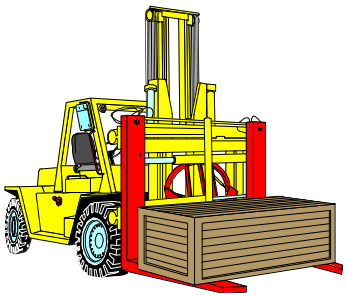
→ Conclusion

→ Ask every child to list the colours in their flower
→ Draw round the flowers to make a picture, and colour it in
→ For level 3, discuss what makes their flower grow

⇒ Possible follow-on activities

⇒ Project to grow some flowers from seed

Fork lift truck



A very big box has arrived at our local factory, containing a million nuts and bolts. We need to take it off the lorry, but it is too heavy to lift. Can you make a fork lift truck, which will the lift the box down, and then take it into the factory?

How can you make a 'fork' out of K'NEX to carry a box? Can you make a vehicle which will carry the fork on the front?

For level 2, can you make the fork go up and down? How could you add a handle to your model, which will make the fork go up and down when it is turned?

For level 3, can you fasten a motor to your vehicle that will make the fork go up and down?

Levels of difficulty

Level 1	Make the vehicle for a fork lift truck, with a simple fork on the front to carry a weight
Level 2	As level 1, plus a fork on the front which goes up and down
Level 3	As level 2, with the fork operated by a handle

Equipment needed:	**K'NEX** Discovery set Paperback books to use as weights
For level 3:	1m length of string

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L5 Wheels and tyres
L6 Making rods turn with wheels or connectors
L8 Handles
M2 Battery motors
N1 String

☹ Troubleshooting tips

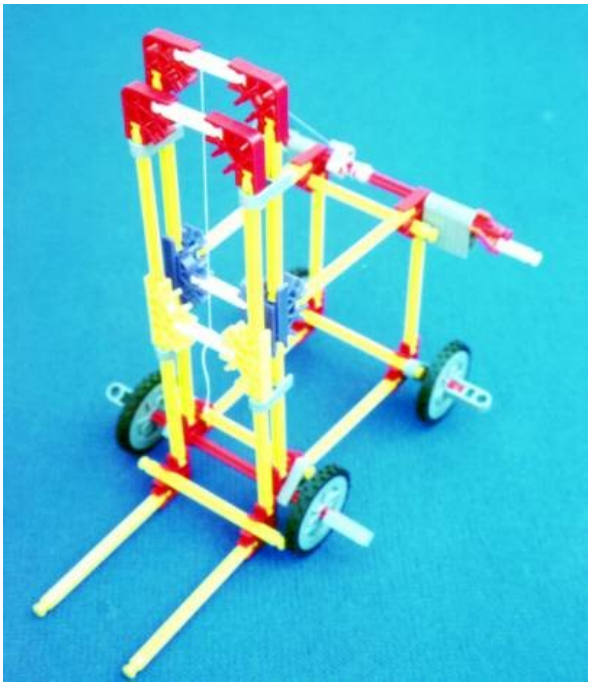
R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily
S1 Rod won't go into motor
S2 Motor won't turn the wheels
S3 Can't connect my motor to my model

For teachers

Key topics: Forces **Designing skills** **Mechanisms** **Making skills**

Components used in sample level 3 model below

Connectors: Purple 4 Yellow 2 Red 12 Orange 1 Grey 19 Tan 1
Rods: Red 3 Yellow 20 White 5
Small wheel/tyre 4 String



Educational objective

A practical project to build a model which is capable of lifting weights, and which can then be used as the basis for an experiment on balanced and unbalanced forces

☑Cross-curricular links

☑ Mathematics - measuring

☑ History - early machines for moving heavy weights (eg at Stonehenge)

√ Before starting

√ If possible, visit a factory to see a fork lift truck in use

→ Conclusion

→ Ask the children to predict what will happen to their model if the weight to be lifted is increased (it will tip forward).

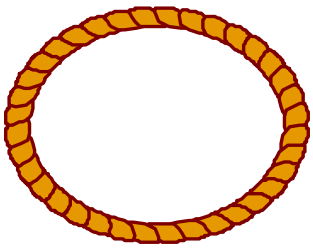
→ Then ask them to consider how they can prevent this happening (eg a counterbalance weight set as far to the back of the vehicle as possible), and to test their ideas.

→ Finally, ask them to try and determine the relationship between the weight of the counterbalance and its distance from the front wheels, using a graph

⇒ Possible follow-on activities

⇒ Investigate as many ways as possible of lifting and moving heavy weights

Friendship bracelet



Friendship bracelets make lovely presents to give to your friends, especially if you have made them yourself. Could you make a machine out of K'NEX, that will spin wool or thread to make friendship bracelets?

Levels of difficulty

Level 1	Make a K'NEX stand to hold four reels of cotton or wool, so that you can pull the thread off them, and twist it by hand to make a friendship bracelet
Level 2	As level 1, plus a handle that you can turn to twist the threads
Level 3	As level 2, and the handle also winds the twisted thread around itself

Equipment needed:	**K'NEX** Discovery set 4 small reels of cotton or wool
For level 2:	2 large rubber bands

Put a K'NEX rod through the hole in each of your cotton reels. How could you make a frame to hold the four reels? When you have made one, hold the four ends of thread, and pull them towards you, twisting them as you pull. When the friendship bracelet you have made is long enough, cut it off and tie it.

For level 2, think how you could use the holes in a K'NEX connector to do the twisting for you. Can you make a handle, which will turn the connector with the threads going through it?

Finally, for level 3, can you attach the end of the bracelet to your handle, so that when you turn the handle it not only twists the thread, but it also winds the finished bracelet onto the handle?

☺ Handy hints

- L1 3 ways to connect rods and connectors
- L3 Making corners with blue and purple connectors
- L4 Strong 3-D structures
- L5 Wheels and tyres
- L6 Making rods turn with wheels or connectors
- L7 Pulleys
- L8 Handles

☹ Troubleshooting tips

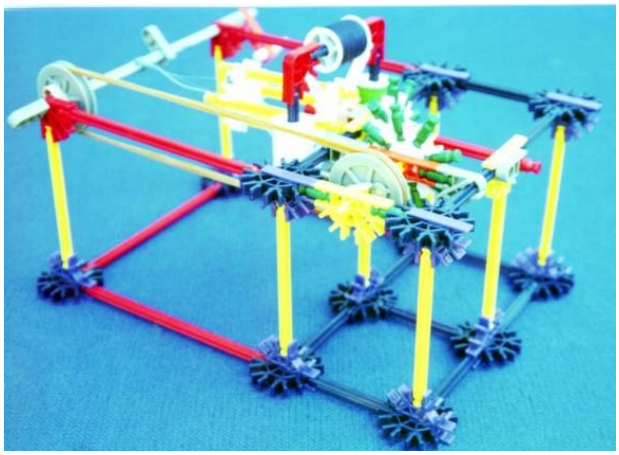
- R1 Rods difficult to join to connectors
- R2 Blue and purple connectors won't join together
- R3 Model is not strong enough
- R4 Wheels won't turn around easily

For teachers

Key topics: Mechanisms Designing skills Making skills

Components used in sample level 3 model below

Connectors:	White 4 Blue 12 Purple 12 Yellow 3 Red 4 Orange 2 Grey 11 Tan 8
Rods:	Grey 1 Red 6 Yellow 13 Blue 16 White 5 Green 20
	Small wheel 2 Rubber band 1



Educational objective

A difficult but satisfying project for older children, to make a machine which will manufacture a finished product.

☑Cross-curricular links

☑ History - history of rope making

√ Before starting

√ Examine examples of friendship bracelets made from twisted wool, and discuss how they might have been made

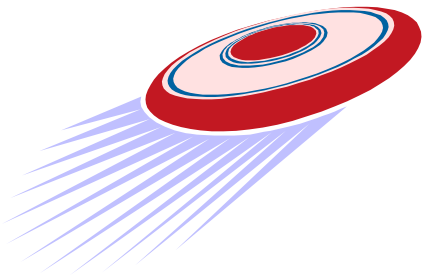
→ Conclusion

→ Compare the models made, and compare the techniques used in different models

⇒ Possible follow-on activities

⇒ Get the class to plan and launch a business making and selling friendship bracelets (eg at a school fair). Consider material costs, selling price and profit; marketing; quality control; batch sizes; packaging; etc.

Frisbee



It flies, but it isn't a bird or a plane … it's a Frisbee! Can you make a frisbee out of K'NEX? How far do you think you will be able to throw it?

What shape will fly best when you spin it? A ring? A star? A flying saucer? Try making different shapes out of K'NEX, and testing which flies best.

For level 2, think how can you increase the distance that your frisbee flies. Is it better if it is light or heavy? How should you throw it? If there is a wind, does it fly better into the wind or down wind?

For level 3, think how you can make it fly into a cardboard box 5m away. Should it land flat in the box, or sideways? Is there a shape that flies best for this task?

Levels of difficulty

Level 1	✓5	Make a shape out of K'NEX, that will fly through the air when it spins
Level 2		As level 1, and it will fly at least 5m
Level 3		As level 2, and you can land it in a box 5m away

Equipment needed:	**K'NEX** Discovery set
Test area (level 2):	*5m distance marked out*
Test area (level 3):	*Cardboard box as a target*

☺ Handy hints

L1 3 ways to connect rods and connectors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R3 Model is not strong enough

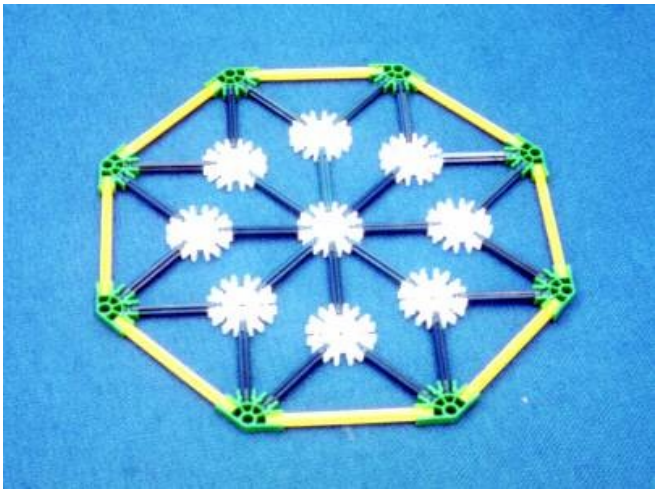
For teachers

Key topics: Forces **Designing skills** **Making skills**

Components used in sample level 3 model below

Connectors: White 9 Yellow 8

Rods: Yellow 8 Blue 24



Educational objective

A practical experiment into flight. Starting with predictions, through testing, leading to conclusions

☑Cross-curricular links

☑ Mathematics - symmetry and shape

√ Before starting

√ Ask each child to predict the factors that will affect the flight of a frisbee, and write down their ideas

→ Conclusion

→ Ask if the predictions made were borne out in practice, and whether any additional factors have been found which affect the flight of a frisbee

→ Hold a competition to see which frisbee flies the furthest, and who can get theirs in the box most times out of five throws

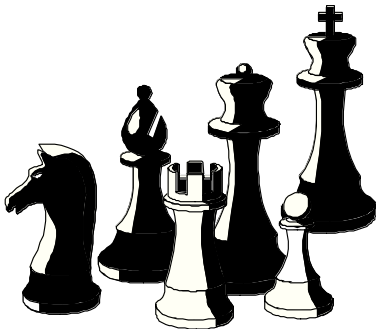
→ Draw a table and graph of the competition results

⇒ Possible follow-on activities

None

Giant chess

We want to challenge IBM's chess playing computer Big Blue to a chess game … but first we need a chess set. Can you help?



What shape will your king and queen be? What colours will you use? How will the pieces be made to stand up?

For level 2, what will your bishops, knights, rooks and pawns look like? Can you try and keep all your pieces mainly the same colour?

For level 3, find someone else who has made a giant chess set, and then play a game of chess with them.

Levels of difficulty

Level 1	Make a king and queen
Level 2	As level 1, plus all the other pieces of a chess set
Level 3	As level 2, and play a complete game of chess with the pieces against another player

☺ Handy hints

L1 3 ways to connect rods and connectors

L3 Making corners with blue and purple connectors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R2 Blue and purple connectors won't join together

R3 Model is not strong enough

Equipment needed: **K'NEX** Discovery set

Test area (level 3): Large chess board (eg indoors on carpet tiles, or outdoors on square paving stones)

For teachers

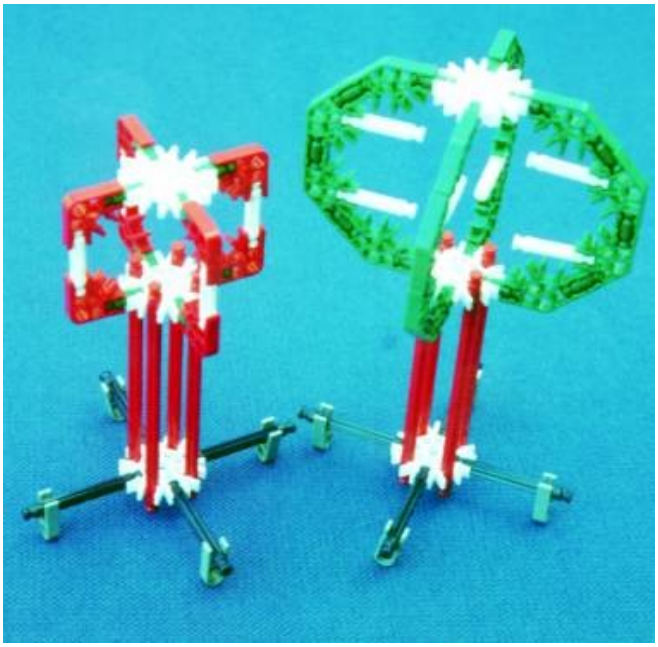
Key topics: Designing skills

Making skills

Components used in sample level 1 model below

Connectors: White 6 Green 16 Red 8 Grey 8

Rods: Red 8 Blue 8 White 12 Green 28



Educational objective

To design and make objects familiar from the game of chess

☑Cross-curricular links

None

√ Before starting

√ Look at the pieces of a real chess set

→ Conclusion

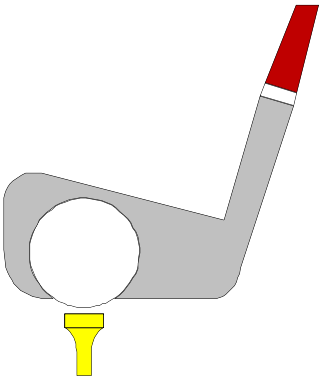
→ Play a game with 2 sets, having first explained the rules if necessary (if you want a shorter game, try starting without some of the pawns)

⇒ Possible follow-on activities

None

Golf

Even Tiger Woods has never played golf this way. Before you can play a par 3 hole, you must first make your own golf club!



How long will your golf club be? How can you make the shaft which you hold? What will the club head that strikes the ball look like? How will you fasten the head to the shaft?

For level 2, how can you make the club strong enough to hit the ball hard? Should the club head be flat like a putter, or at an angle like an iron and a wedge? If your club breaks when you hit the ball, how can you prevent this?

For level 3 … the best of luck!

Levels of difficulty

Level 1	Make a simple golf club, and hit a golf ball with it
Level 2	Make a golf club that can hit a golf ball 5 metres
Level 3	As level 2, and complete a golf hole in only 3 shots (with a witness!)

☺ Handy hints

L1 3 ways to connect rods and connectors

L11 Making shafts for sports equipment

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R3 Model is not strong enough

Equipment needed: **K'NEX** Discovery set
Golf ball (eg a light practice plastic ball with holes in)
Test area (level 2): *5m distance marked out*
Test area (level 3): *Simple par 3 golf hole, with a starting point to tee off from, and a hole to finish in*

For teachers

Key topics: Structures **Designing skills** **Making skills**

Components used in sample level 3 model below
Connectors: White 5 Yellow 14
Rods: Red 16 Blue 3 Green 9

Educational objective

A project to design, make and test a strong structure, which will particularly interest children who enjoy sport

☑Cross-curricular links

☑ Physical education - golf

√ Before starting

√ Set up a par three golf hole on the playground, or on an area with well-mown grass

→ Conclusion

→ Hold competitions to see who can hit the ball furthest, and who can complete the golf hole in fewest shots

→ Examine the best clubs to see how the makers have built a strong structure

⇒ Possible follow-on activities

⇒ Asking a golfer to visit, and talk about the different things that can happen when you hit a golf ball with different clubs (spin, height, force, etc)

Great book race

The Great Book Race is about to start. They're under starter's orders … they're away! Can you make a vehicle for the Great Book race, that can carry a book right across the room?

Carrying a book along isn't quite as easy as it sounds! How can you build a vehicle strong enough to carry the weight of the book? How will you stop the book falling off as the vehicle goes along?

For level 2, how can you attach a motor to your vehicle?

For level 3, does your vehicle steer in a straight line? It will need to if you are going to complete the Great Book Race!

Levels of difficulty

Level 1	✓5	Make a vehicle that will carry a paperback book
Level 2		As level 1, with a motor
Level 3		As level 2, that will carry the book right across a room

Equipment needed:	**K'NEX** Discovery set Paperback book
For level 2:	Battery motor
Test area (level 3):	*Course marked out across a room*

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L5 Wheels and tyres
L6 Making rods turn with wheels or connectors
M2 Battery motors

☹ Troubleshooting tips

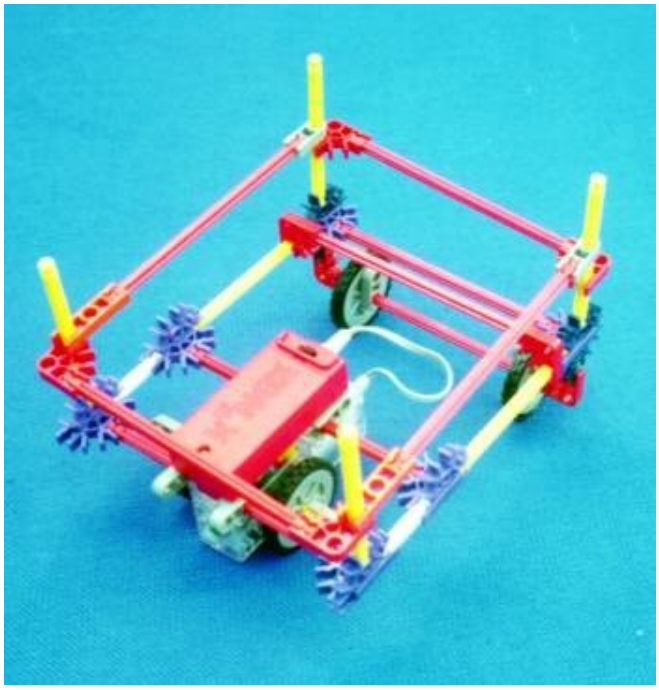
R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily
S1 Rod won't go into motor
S2 Motor won't turn the wheels
S3 Can't connect my motor to my model

For teachers

Key topics: Forces **Designing skills** **Mechanisms** **Making skills**

Components used in sample level 3 model below

Connectors: Blue 2 Purple 10 Red 8 Orange 2 Grey 10 Tan 2
Rods: Red 9 Yellow 7 White 2 Green 2
Battery motor Small wheels/tyres 4



Educational objective

To set a specific practical design and technology task, in which the design of the vehicle required is entirely up to the child.

☑Cross-curricular links

None

√ Before starting

None

→ Conclusion

→ Compare the different designs which have successfully completed the course, and list the different ways that the objective has been used

→ Predict what will happen to each of the models as the number of books is increased, and then carry out tests to check those predictions

⇒ Possible follow-on activities

None

Guitar

We would like to hear the sound of music! Can you make a guitar, with strings that really play a note when you pluck them?

Do you know what shape a guitar is? Could you make one out of K'NEX? You will need to make it very strong if you are planning to go onto the next level.

For level 2, think where you could fasten the ends of each of the rubber bands to be used as 'strings'. Does your guitar break when you stretch the strings - if so, how could you strengthen it to prevent this?

For level 3, think how you could put rods across just below the strings, so that when you push down any string with your fingers onto the 'fret' (ie the rod), it changes the pitch of the note played.

Levels of difficulty

Level 1	Make a model shaped like a guitar
Level 2	As level 1, plus strings that can be plucked
Level 3	As level 2, plus frets where you can hold down the string with your fingers to change the pitch of the note

Equipment needed:	**K'NEX** Discovery set
For level 2:	Rubber bands

☺ Handy hints

L1 3 ways to connect rods and connectors

L3 Making corners with blue and purple connectors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R2 Blue and purple connectors won't join together

R3 Model is not strong enough

S4 Rubber bands

For teachers

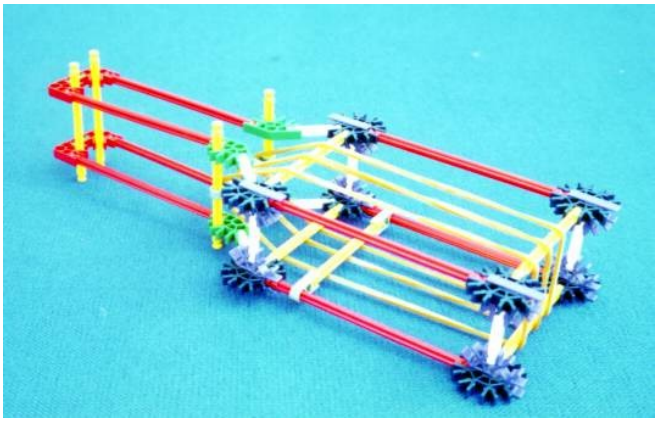
Key topics: Sound **Designing skills**

Structures **Making skills**

Components used in sample level 3 model below

Connectors: Blue 8 Purple 8 Green 4 Red 4 Grey 4

Rods: Grey xx Red xx ….



Educational objective

A practical project to design and build a stringed instrument in which pitch and loudness can be varied. Also requires an understanding of how strong structures can be built

☑Cross-curricular links

☑ Music - stringed instruments

√ Before starting

√ Allow the children to see and hear a real guitar being played, and to see for themselves how frets work (any similar stringed instrument could be used if a guitar is not available)

→ Conclusion

→ Ask the children what actually creates a sound when they pluck a string

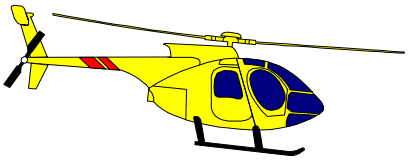
→ Get the children to play their guitars loudly and softly, and ask them to explain why the loudness varies

→ For level 3, get the children to demonstrate that using the frets really does change the pitch, and ask them to explain why

⇒ Possible follow-on activities

⇒ Examine a variety of musical instruments, to see how vibration causes sound, and how loudness and pitch can be varied

Helicopter



It is 4pm … and you need to be in Paris by tea-time! Your helicopter pad is ready and waiting, and you have clearance from Air Traffic Control to take off. All you need is a helicopter!

Levels of difficulty

Level 1	Make a model of a helicopter
Level 2	As level 1, with rotor blades and a tail rotor that turn
Level 3	As level 2, and a spring motor makes the main rotor blades turn

Equipment needed:	**K'NEX** Discovery set
Level 3:	Spring motor

What shape is a helicopter? How can you make the different parts in your K'NEX model? How big will the model be?

For level 2, how can you make a large and a small rotor blade? How can you fasten them both onto your model so that they spin freely?

For level 3, how will you attach the spring motor to your model? How will the motor make the blades spin?

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L6 Making rods turn with wheels or connectors
M1 Spring motors

☹ Troubleshooting tips

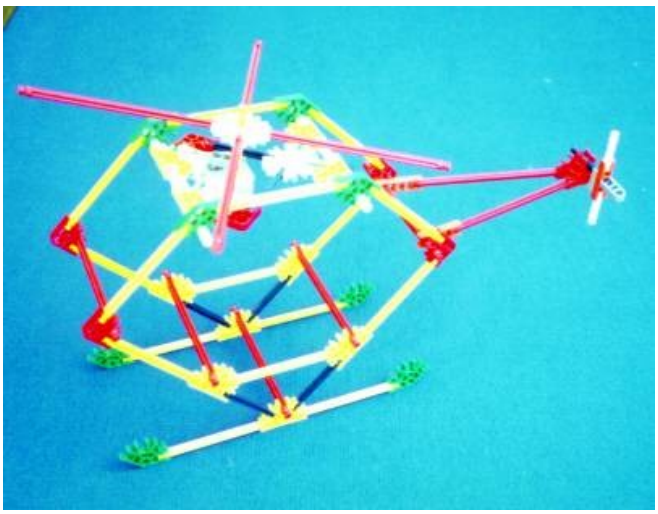
R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily
S1 Rod won't go into motor
S2 Motor won't turn the wheels
S3 Can't connect my motor to my model

For teachers

Key topics: **Forces** **Designing skills** **Mechanisms** **Making skills**

Components used in sample level 3 model below

Connectors:	White 2 Yellow 10 Green 8 Red 8 Orange 3 Grey 1 Tan 1
Rods:	Red 11 Yellow 17 Blue 7 White 10 Green 4
	Spring motor



Educational objective

To make a working model of a real-life object, and to use the model as a base for experimentation

☑Cross-curricular links

☑ History - history of flight

√ Before starting

√ Look at a photo or video of a helicopter

→ Conclusion

→ Draw a diagram and write a description of how the force applied during the winding-up process is transferred to the spring and stored there, and then how on release the forces are transferred to make the rotor blade turn

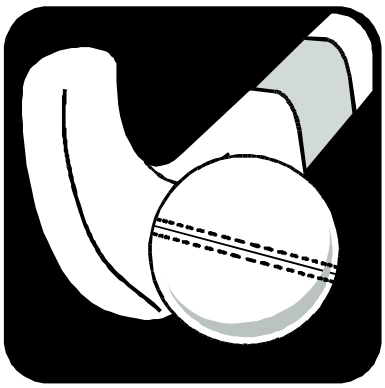
→ Carry out an experiment to establish if there is a relationship between the number of turns you make when you wind up the motor, and the number of turns that occur when you let go. Record the results as a table and a graph.

⇒ Possible follow-on activities

⇒ Project on why different types of flying vehicle are needed, and their strengths and weaknesses (planes, helicopters, balloons, rockets, etc)

Hockey

Have you ever bullied off? You can in the K'NEX hockey challenge - but first you need to build your hockey stick!



Have you ever played Hockey, or seen it on TV? How could you make a Hockey stick out of K'NEX? Will it look like a traditional hockey stick, or can you think of a better shape?

For level 2, can you make it strong enough to hit the ball quite hard?

For level 3, is the shape of the head good for pushing the ball along between the markers or poles?

☺ Handy hints

L1 3 ways to connect rods and connectors

L11 Making shafts for sports equipment

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R3 Model is not strong enough

Levels of difficulty

Level 1	Make a simple hockey stick
Level 2	As level 1, that can hit a tennis ball 5m
Level 3	As level 2, and complete a Hockey Slalom with it, in and out of 12 markers or poles

Equipment needed:	**K'NEX** Discovery set
For level 2:	Tennis ball
Test area (level 3):	*12 markers or poles about 2m apart set out in a square*

For teachers

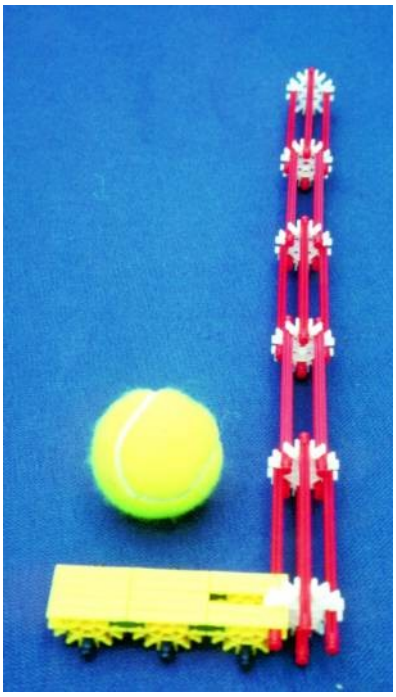
Key topics: Designing skills

Making skills

Components used in sample level 3 model below

Connectors: White 6 Yellow 14

Rods: Red 20 Blue 3 Green 9



Educational objective

To design and build a good working model of a hockey club, which can then be used to complete a slalom course

☑Cross-curricular links

☑ Physical education - hockey

√ Before starting

√ Look at an example or picture of a real hockey club

→ Conclusion

→ Hold a competition to see who can hit the ball the furthest, and who can complete the slalom in the least time

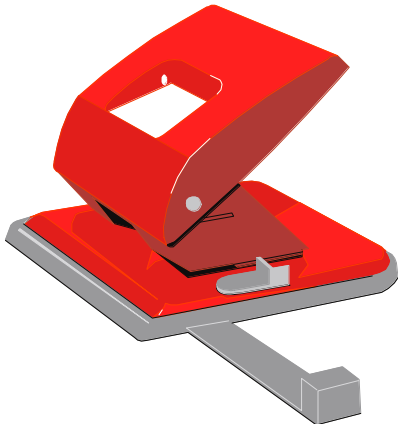
→ Compare the design considerations for the distance competition and the slalom competition - are they the same?

⇒ Possible follow-on activities

⇒ Find out which countries play hockey, and which is the nearest hockey club to where you live

Hole punch

We need to make some holes in this Challenge Sheet, to put it in our file … but we have lost our hole punch! Could you make one for us out of K'NEX?



Have you ever looked at a hole punch to see how it works? There are lots of different types, such as hand-held one hole punches, and desktop two- and four-hole punches. Could you make a simple hole punch out of K'NEX? What K'NEX piece will you use to actually make the hole?

For level 2, how will you hold the paper while the hole is being made? Or will the paper sit on the side of a desk?

For level 3, how far apart do you want the holes to be? How can you make both holes at the same time?

Levels of difficulty

Level 1	Build a punch that will make a hole when you push it down on a piece of paper held by a friend
Level 2	As level 1, but the piece of paper must not be held by anyone
Level 3	As level 2, and the punch makes two holes in the paper at the same time

Equipment needed:	**K'NEX** Discovery set
For level 2:	2 springs

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
N5 Springs

☹ Troubleshooting tips

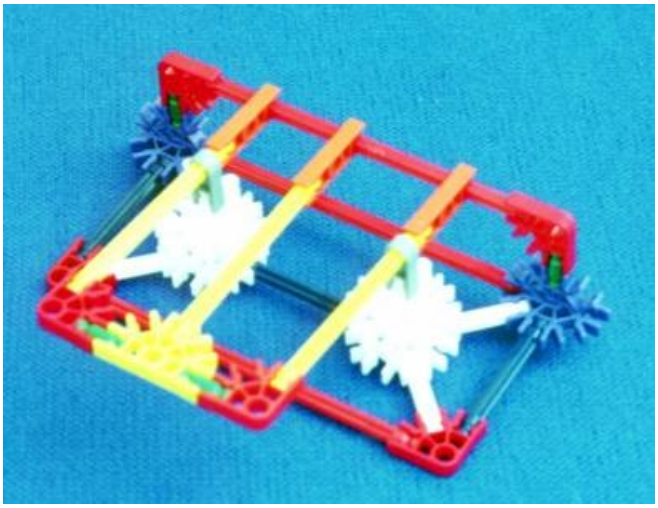
R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough

For teachers

Key topics: Forces **Designing skills** **Mechanisms** **Making skills**

Components used in sample level 3 model below

Connectors: White 4 Purple 4 Yellow 1 Red 6 Orange 3 Grey 2
Rods: Red 3 Yellow 3 Blue 3 White 8 Green 4



Educational objective

To create a model which will deliver sufficient force to make a hole in a piece of paper, via a lever. For level 2/3, to learn how to use springs to return the lever to its original position

☑Cross-curricular links

None

√ Before starting

√ Examine an example of a hole punch

→ Conclusion

→ Test the hole punches, and see which work best. Are any good enough to punch a hole in more than one thickness of paper?

⇒ Possible follow-on activities

⇒ Look at the science and technology of other items of other office equipment (forces, mechanisms, electrical circuits, optical components, sounds, etc)

Hot air balloon

Two hundred years ago the human race learnt to fly … not in aeroplanes or helicopters, but in balloons! Can you make a model of a hot air balloon?

What shape is a hot air balloon? How can you use the different K'NEX rods and connectors to make a similar shape? What colours can you build in?

For level 2, how can you make a gondola underneath, for the people to sit in or stand in? Can you make it swing freely?

For level 3, put the string over a bar close to the ceiling, an attach one end to your model. Can you make the model rise and fall just like the real thing?

Levels of difficulty

Level 1	✓5	Make a simple model of a hot air balloon
Level 2		As level 1, with a gondola which swings freely on the bottom
Level 3		As level 2, hanging from a piece of string which you can use to make it go and up and down to the ceiling

Equipment needed:	**K'NEX** Giant set
For level 3:	5m length of string
Test area (for level 3):	*Bar near the ceiling to suspend finished balloon from*

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
N1 String

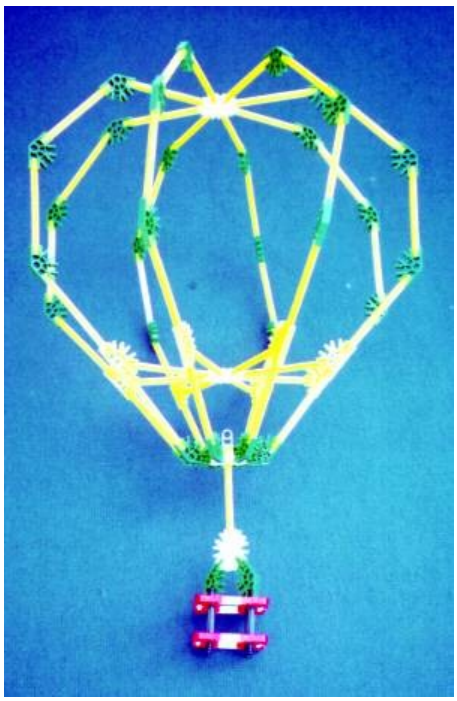
☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R3 Model is not strong enough

For teachers

Key topics: Forces **Designing skills** **Making skills**

Components used in sample level 3 model below
Connectors: White 4 Yellow 8 Green 34 Red 8 Grey 1
Rods: Yellow 49 Blue 4 White 8 Green 10



Educational objective

To design and build a model of a familiar object. To use the model to carry out a simple experiment with forces

☑Cross-curricular links

☑ Maths -symmetry

√ Before starting

√ Look at a picture of a hot-air balloon

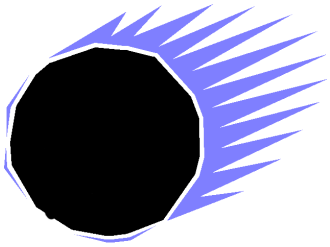
→ Conclusion

→ For level 3, discuss the forces that cause the balloon to fall (gravity) and rise (pulling on the string). Now compare these to the forces in a hot-air balloon (where the lower density of the hot air causes the balloon to rise) and a helium-filled balloon (where the lower denisty of helium causes the balloon to rise).

⇒ Possible follow-on activities

⇒ Project on the history of balloons as a means of transport

Indiana Jones



Creeping into the long lost tomb which contains the Inca treasure, you step on a broken stone slab - and a giant balls starts rolling down the tunnel towards you! What do you do next?

Levels of difficulty

Level 1	Build a small cage which is not crushed or broken by the rolling ball
Level 2	As level 1, and which is big enough for a child to crouch down inside
Level 3	As level 2, and the shape of the cage makes the ball roll over the top and down the other side

Equipment needed:	**K'NEX** Giant set Giant inflatable ball
Test area:	*A slope down which the ball can roll*

How can you make a cage that will provide protection against a giant rolling ball? What shape will it be? How can you make it very strong?

For level 2, how are you going to fit inside the ball - sitting, lying, crouching? What construction method can you use which won't break when the ball hits the cage?

For level 3, what shape should you make the cage so that the ball rolls over it?

☺ Handy hints

L1 3 ways to connect rods and connectors

L3 Making corners with blue and purple connectors

L4 Strong 3-D structures

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R2 Blue and purple connectors won't join together

R3 Model is not strong enough

For teachers

Key topics: Structures **Designing skills** **Making skills**

Educational objective

An enjoyable project which necessitates careful consideration of how to build a strong and stable structure

☑Cross-curricular links

None

√ Before starting

√ Show the children how the ball rolls down the slope

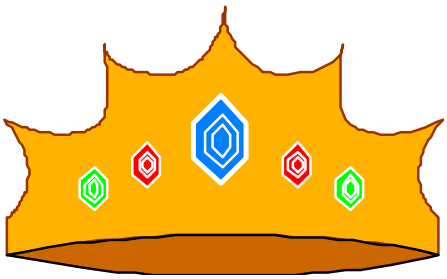
→ Conclusion

→ If possible, test the cages on differing slopes, and ask the children to consider what factors determine whether the cage breaks or not (strength of cage, angle of slope, amount of bounce on ball, etc)

⇒ Possible follow-on activities

None

Jewellery



Have you ever wanted to wear expensive jewellery, or to put a crown on your head? Now's your chance!

Think about the sort of jewellery you are going to make. Will it go on your arm, on your finger, round your neck? … What shape will it be? What colours will you need?

For level 2, how can you use K'NEX rods and connectors to make a crown that will fit comfortably on your head. What patterns will there be on the crown?

For level 3, how can you make the coloured LED light up? Where will the light go on your crown? Can you fasten the battery pack on as well?

Levels of difficulty

Level 1 ✓5 Make some simple jewellery to wear

Level 2 ✓5 As level 1, plus a crown to wear on your head

Level 3 ✓5 As level 2, plus a jewel on the crown that lights up

Equipment needed: **K'NEX** Discovery set
For level 3: Battery pack
Wire with crocodile clips
Coloured LED

☺ Handy hints

L1 3 ways to connect rods and connectors

N3 Electrical circuits

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R3 Model is not strong enough

T1 Crocodile clips won't attach

T3 LED won't light up

For teachers

Key topics: Electricity **Designing skills** **Making skills**

Educational objective

A project for younger children to design and make familiar objects. At level 3, an introduction to a simple electrical circuit

☑Cross-curricular links

☑ Art - shape and colour

√ Before starting

√ Ask the children to think of different types of jewellery

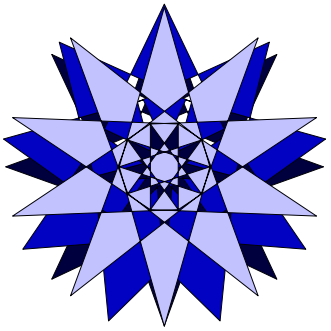
→ Conclusion

→ Hold a fashion show

⇒ Possible follow-on activities

⇒ Look at different sorts of jewellery worn by different people around the world

Kaleidoscope



Patterns can be interesting …but when you see them reflected again and again and again they can be absolutely fascinating! Can you build a kaleidoscope, which can create moving reflected patterns?

A kaleidoscope depends upon three mirrors arranged in a prism shape. How could you make a frame to hold the mirrors? Can you put one set of three mirrors next to a second set of three mirrors, to make your kaleidoscope longer?

For level 2, how could you make a pattern to view through your kaleidoscope? Will you use K'NEX rods and connectors, or something else? How will you fasten the pattern on?

For level 3, see if you can find a way to turn the pattern you are using around and around slowly.

Levels of difficulty

Level 1	Make a simple kaleidoscope
Level 2	As level 1, with a pattern on one end which can be viewed
Level 3	As level 2, and the pattern can be rotated whilst you are viewing it

Equipment needed: **K'NEX** Discovery set
6 mirror panels

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
N7 Mirror panels

☹ Troubleshooting tips

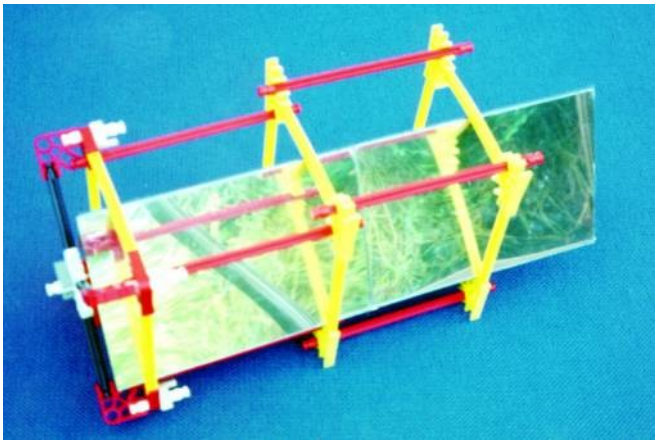
R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough

For teachers

Key topics: Light **Designing skills** **Making skills**

Components used in sample level 3 model below

Connectors: White 1 Yellow 8 Red 8 Red 1 Grey 1 Tan 4
Rods: Red 8 Yellow 12 Blue 4 White 5
Mirror panel 6



Educational objective

To make a simple kaleidoscope, and to use it to carry out experiments into how light travels

☑Cross-curricular links

☑ Art - patterns
☑ Maths - symmetry

√ Before starting

None

→ Conclusion

→ Draw the pattern which is being put behind the kaleidoscope, and also draw the reflected pattern which is seen through it, together with the lines of symmetry on the reflected pattern

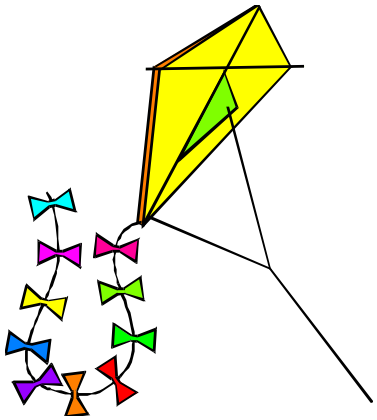
→ Ask the children to explain how the reflected pattern is seen, in terms of light from a light source striking the pattern, and then being reflected from one or more mirrors until it reaches the eye

⇒ Possible follow-on activities

⇒ Periscope challenge

Kite

If it's a windy day … then a K'NEX kite is just what you need! Can you make one?



Kites come in all sorts of shapes and sizes. What shape will your kite be? What K'NEX rods and connectors will you need to make your shape?

For level 2, how are you going to fasten the plastic sheet on to make the 'skin' of the kite? How will you make the tail and tie it on?

For level 3, choose a windy day, and launch the kite into the air downwind. If it won't fly first time, try improving your design - is the string fastened on in the best place, for instance?

Levels of difficulty

Level 1	✓5	Make a simple kite frame
Level 2		As level 1, plus a plastic sheet for the skin and a tail
Level 3		As level 2, and the kite really flies!

Equipment needed:	**K'NEX** Discovery set
	1m length of string
For level 2:	Plastic sheet
For level 3:	Long length of string

☺ Handy hints

L1 3 ways to connect rods and connectors

N1 String

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R3 Model is not strong enough

! Warning !

NEVER fly kites near overhead cables or buildings

For teachers

Key topics: Forces **Designing skills** **Making skills**

Components used in sample level 3 model below

Connectors: Yellow 2 Grey 8

Rods: Grey 1 Red 4

String

Educational objective

To design a kite, test it, and then make improvements until it flies

☑Cross-curricular links

☑ Geography - wind

√ Before starting

√ Make sure it is a windy day, otherwise children will be frustrated

√ Look at pictures or examples of different sorts of kite

→ Conclusion

→ Compare the different sorts of kites

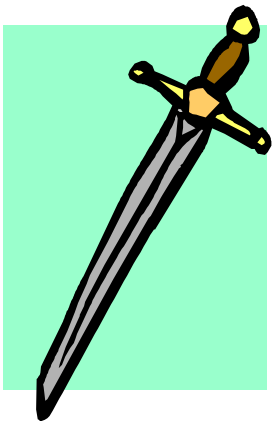
→ Ask the children what factors they discovered are important in designing a successful kite

→ If you have one, attach a spring balance to the end of the string of a flying kite, to test the force generated

⇒ Possible follow-on activities

⇒ Investigate the origins of kites

K'Nexcalibur



In days of old when men were bold
And K'NEX was not invented
They made their swords from steel so cold
But they were always getting dented
Can you make a sword out of K'NEX that is stronger than steel?

Levels of difficulty

Level 1	✓5	Make a simple sword
Level 2		Make a sword that can cut a sheet of paper in half
Level 3		As level 2, but 3 sheets of paper at the same time

Equipment needed: **K'NEX** Discovery set
For level 2: Sheets of A4 photocopier paper

How long will your sword be? Will it have a handle to hold? How will you attach the handle to the blade? Can you make it very strong?

For level 2, get someone to hold a piece of paper for you, and try and cut it in half. If your sword breaks, can you make the place where it broke stronger, and try again?

For level 3 you will need a really strong sword. Can you make a double-edged sword, reinforced along the blade?

☺ Handy hints

L1 3 ways to connect rods and connectors
L2 Strong 2-D structures

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R3 Model is not strong enough

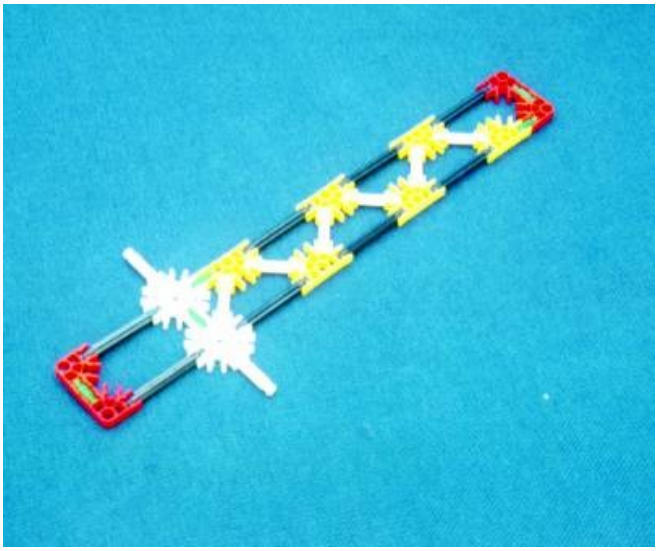
! Warning !

The swords are NOT for fighting with!

For teachers

Key topics: Structures **Designing skills**
Forces **Making skills**

Components used in sample level 3 model below
Connectors: White 2 Yellow 6 Red 4
Rods: Blue 8 White 8 Green 5



Educational objective

To design, build and test a strong structure

☑Cross-curricular links

☑ History - swords

√ Before starting

√ Explain the above warning to the children

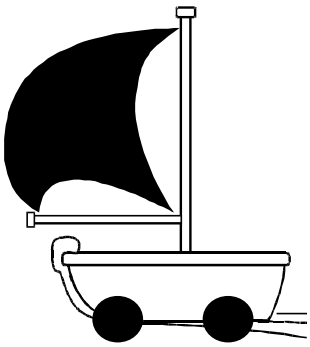
→ Conclusion

→ Compare the designs used for different swords, and discuss which designs are the strongest, and why

⇒ Possible follow-on activities

⇒ Write a story about the sword and its owner

Land yacht



Yachts usually sail on the sea … but on beaches and flat areas you can sometimes see land yachts when it is windy. Could you build one out of K'NEX, that really sails?

What shape will you yacht be? Where will the mast go? How will you fasten the wheels on so that they spin freely?

For level 2, what shape will you use for your sail? How will you attach it to the mast?

For level 3, you may need to test your model with different types of sail before it works. Be Patient!

Levels of difficulty

Level 1	✓5	Make a boat shape with wheels
Level 2		As level 1, with a sail made from plastic sheet
Level 3		As level 2, and the yacht will travel at least 1m in a wind

Equipment needed:	**K'NEX** Discovery set
For level 2:	Plastic sheet
Test area (level 3):	*A flat smooth area. If there is no wind, consider using a powerful electric fan*

☺ Handy hints

L1 3 ways to connect rods and connectors
L5 Wheels and tyres
N4 Plastic sheet

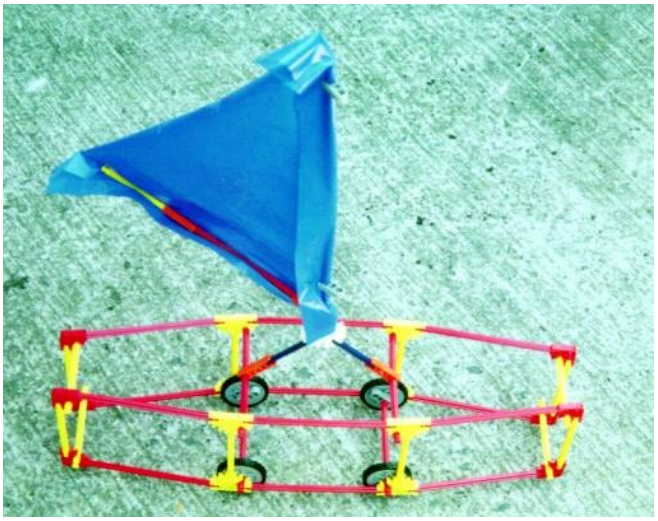
☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R3 Model is not strong enough
R4 Wheels won't turn around easily

For teachers

Key topics: Forces **Designing skills**
Mechanisms **Making skills**

Components used in sample level 3 model below
Connectors: White 1 Yellow 8 Red 8 Orange 5 Grey 4
Rods: Red 19 Yellow 13 Blue 2
Small wheel/tyre 4 Plastic sheet



Educational objective

A project to show that the force of the wind can create motion in a vehicle

☑Cross-curricular links

☑ Geography - wind

√ Before starting

None

→ Conclusion

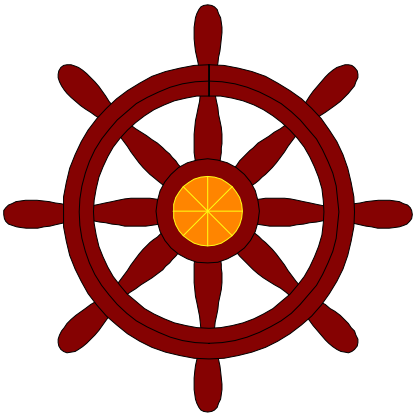
→ Get the children to explain what causes the yacht to move long

→ Ask the children to predict the factors that determine whether the yacht runs in a straight line or not (eg angle of sail). Then carry out tests to see whether their predictions are correct

⇒ Possible follow-on activities

⇒ Project on the effects of different forces on real yachts

Lifeboat



Lifeboats are designed to be launched in all weathers, to save the lives of people in trouble at sea. Can you make a model of a lifeboat, that won't sink even in a storm?

Levels of difficulty

Level 1	✓5	Make a simple model of a boat
Level 2		As level 1, that will float on water without capsizing or sinking
Level 3		As level 2, with a mast 0.5m high

Equipment needed:	**K'NEX** Discovery set
For level 2:	Plastic sheet
Test area (level 2):	*A shallow trough of water*

What shape is a boat? Will your boat be long and thin, or short and fat? What rods and connectors will you need to make your boat?

For level 2, how will you fasten the plastic sheet to your boat, to make it float?

For level 3, make some waves in the water with your hand. Watch how the boat moves. If it sinks or starts to take on water, how can you improve your design to prevent this happening?

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
N4 Plastic sheet

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
T7 Waves make the boat capsize

For teachers

Key topics: Forces **Designing skills** **Making skills**

Components used in sample level 3 model below
Connectors: Yellow 6 Red 4 Orange 2 Grey 8
Rods: Red 13 Yellow 9

Educational objective

A project to investigate the stability of boats

☑Cross-curricular links

☑ Geography - the sea

√ Before starting

√ Write to the Royal National Lifeboat Institute for a copy of their schools' pack

→ Conclusion

→ Test the different boats that the class have made, and ask the children to identify the factors that aid stability

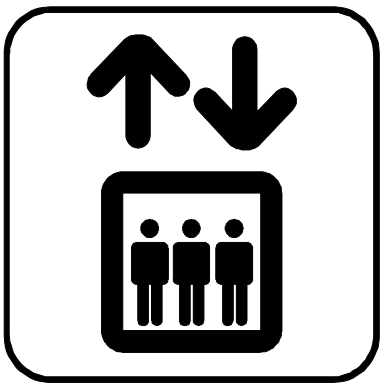
→ Set the children a task to see who can build the tallest mast on their boat without it capsizing

⇒ Possible follow-on activities

⇒ Project on lifeboats

Lift

Tall buildings use lifts to take people quickly up and down to each floor. Can you make a lift, that can carry people from the ground to the second floor?



Levels of difficulty

Level 1	Make a block of flats with two floors
Level 2	As level 1, with a simple lift that goes from the ground to the first floor, operated by a handle
Level 3	As level 2, plus a folding door that can be opened and closed

Equipment needed:	**K'NEX Giant** set
For level 2:	1m length of string

What shape is your block of flats going to be? How can you make it as strong as possible?

For level 2, where will the lift run up and down? How can you use a handle to make it move up and down?

For level 3, how can you add a door which folds up to open?

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L4 Strong 3-D structures
L5 Wheels and tyres
L6 Making rods turn with wheels or connectors
L7 Pulleys
L8 Handles
N1 String

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily

For teachers

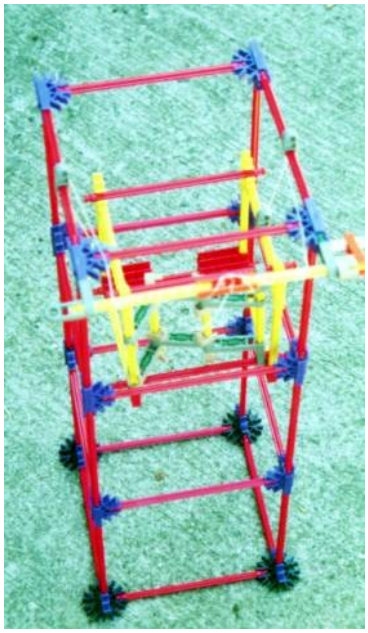
Key topics: Structures **Designing skills** **Mechanisms** **Making skills**

Components used in sample level 3 model below

Connectors: Blue 4 Purple 28 Yellow 4 Red 14 Orange 2 Grey 19 Tan 13

Rods: Red 40 Yellow 13 White 1 Green 8

String 2



Educational objective

To design and build a model of a familiar object, which requires structural and mechanical knowledge

☑Cross-curricular links

None

√ Before starting

√ Try and visit a building which has a lift, or look at a cut-away picture of one

→ Conclusion

→ Ask the children what will happen if we put more and more weight into their lift, and then try and take it to the second floor. Then do so, to see if their predictions were correct, and discuss the reasons why the lift will eventually fail to lift the weights

⇒ Possible follow-on activities

⇒ Project on different types of housing

Lighthouse

Lighthouses help ships to know exactly where they are when they are sailing near the coast, and also warn where there are dangerous rocks and currents. Could you build a working model of a lighthouse, with a light that flashes on and off?

Lighthouses have to be tall and strong. How could you make a tall tower with K'NEX? How can you make the walls very strong, so they won't bend or break in a storm?

For level 2, how can you fix your light bulb on at the top of the tower? How will you connect it to the battery pack?

For level 3, what extra wires will you need to connect the light bulb to your switch?

Levels of difficulty

Level 1	✓5	Make a model of a lighthouse tower
Level 2	✓5	As level 1, with a light on the top
Level 3		As level 2, plus a way to make the light flash on and off

Equipment needed:	**K'NEX** Discovery set
For level 2:	Battery pack
	Wires with crocodile clips
	Light bulb
For level 3:	Push-button switch

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L4 Strong 3-D structures
N3 Electrical circuits

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
T1 Crocodile clips won't attach
T2 Light bulb won't light up

For teachers

Key topics: Electricity **Designing skills**
Structures **Making skills**

Components used in sample level 3 model below

Connectors: Blue 8 Purple 8 Green 24 Orange 8
Rods: Red 24 Yellow 24 Blue 8 Green 8
Battery pack Wires Light bulb Switch

Educational objective

A project to make a simple electrical circuit with a practical purpose, and also to build a strong structure

☑Cross-curricular links

☑ History - history of lighthouses

√ Before starting

√ Look at a picture of a lighthouse, and explain why lighthouses have flashing lights

→ Conclusion

→ Draw the electrical circuit

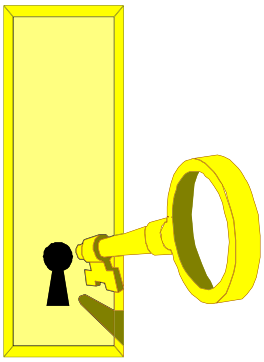
→ Pretend there is a ship sailing through the classroom. Ask each pair of children to think of a special way to flash their light, so that each lighthouse flashes with a different pattern (eg one short flash followed by two long ones)

⇒ Possible follow-on activities

⇒ Write a story about one day when the lighthouse was needed

Locks

Locks are used to keep things safe, such as houses and boxes. Could you build a K'NEX lock, that only you know how to open?



Levels of difficulty

Level 1	✓5	Make a box with a lid
Level 2		As level 1, and a simple catch to keep it closed
Level 3		As level 2, plus the catch requires some sort of key to open it

Equipment needed: **K'NEX** Discovery set

Make your box, and then put a lid on it. How can you make hinges with K'NEX for the lid to swing on? Could you add a little lever which can be used as a catch to keep the lid closed?

For level 2, how could you make your catch more sophisticated, so that it needs a simple key to open it?

For level 3, how could you use a catch, where you have to turn one or more wheels to the right place before it will open?

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L6 Making rods turn with wheels or connectors
L11 Hinges

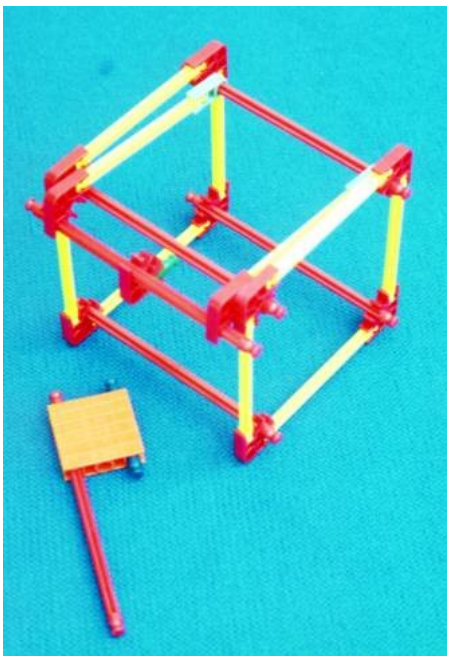
☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough

For teachers

Key topics: Mechanisms **Designing skills** **Making skills**

Components used in sample level 3 model below
Connectors: Red 11 Orange 6 Grey 2
Rods: Red 6 Yellow 10 Blue 1 Green 1



Educational objective

To encourage the children to put their mechanical ingenuity to the test, and build a unique model which meets a specific objective

☑Cross-curricular links

None

√ Before starting

√ Examine examples of locks around the school

→ Conclusion

→ Asks the children to see if they can open each other's locks

→ Get them to write a description and draw a diagram explaining how their lock works

⇒ Possible follow-on activities

None

Magic Wand

Can you do magic with K'NEX? The first step is to make your magic wand, and try it out. Then invent some magic tricks to show your friends.

Levels of difficulty

Level 1 ✓5 Make a simple magic wand

Level 2 ✓5 As level 1, plus the wand can be used for the 'magic trick' of picking up a magnet

Level 3 ✓5 As level 2, plus the wand can move a K'NEX model incorporating a magnet 'magically' when you move the wand under the table

Equipment needed:	**K'NEX** Discovery set
For level 2:	2 ring magnets
Test area (for level 3):	*Table with a thin top*

Make your wand, and say the magic word - is it 'Abracadabra!', or something else?

For level 2, attach one of the magnets to the end of your magic wand. Put the other magnet on the table, and wave your wand very closely over it. What happens? Is it really magic?

For level 3, make a small animal out of K'NEX, with a magnet on one its feet. Wave your wand under the table, right underneath your animal. What happens this time?

☺ Handy hints

L1 3 ways to connect rods and connectors

N6 Magnets

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R3 Model is not strong enough

T6 Magnets won't work

For teachers

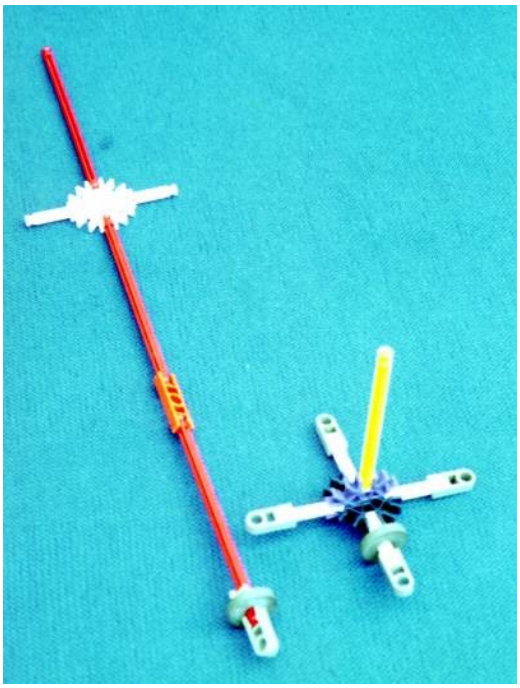
Key topics: Magnetism **Designing skills** **Making skills**

Components used in sample level 3 model below

Connectors: White 1 Blue 1 Purple 1 Orange 1 Grey 5 Tan 1

Rods: Red 3 Yellow 1 White 6

Magnets 3



Educational objective

An introduction to magnetism for younger children

☑Cross-curricular links

None

√ Before starting

√ Let the children examine the magnets, and see what happens when two magnets are brought together

√ Explain that we are going to make a magic wand, and use the magnets to make up some magic tricks

→ Conclusion

→ Get the children to demonstrate their magic tricks

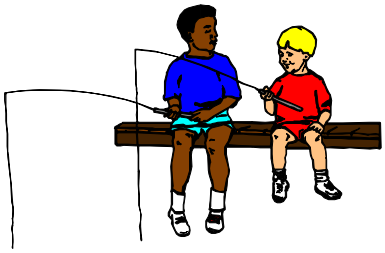
→ Ask if the tricks are really magic, and discuss magnetic forces

⇒ Possible follow-on activities

⇒ Get the children to decorate their wands with materials of their own choice (coloured paper, foil, etc)

⇒ Ask them to go around the school, and make a list of all the things they find that a magnet sticks to

Magnetic fishing



A robot steel fish has been seen swimming in a lake near your school. Where has it come from? How does it work? Scientists need to know, but they can't catch it, as it ignores the usual worms and things on fishing lines. Can you help, by making a fishing rod and line with a magnet on the end?

Levels of difficulty

Level 1 ✓5 Make a simple fishing rod and a model of a fish

Level 2 ✓5 As level 1, plus magnets on the fish and on a line, so that the fish can be 'caught'

Level 3 ✓5 As level 2, plus a reel to wind the fish in once it is caught

How long will your fishing rod be? How can you make it strong enough? What will your K'NEX fish look like?

For level 2, how can you fasten on the magnets to the fish and the fishing line? Will your fish be too heavy to pick up?

For level 3, how can you make a handle to wind in the fishing line once you have caught your fish?

☺ Handy hints

L1 3 ways to connect rods and connectors

L8 Handles

N6 Magnets

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R3 Model is not strong enough

T6 Magnets won't work

Equipment needed:	**K'NEX** Discovery set
For level 2:	2 ring magnets
	1m length of string
Test area:	*An empty tub or box to use as a 'fishing pool'*

For teachers

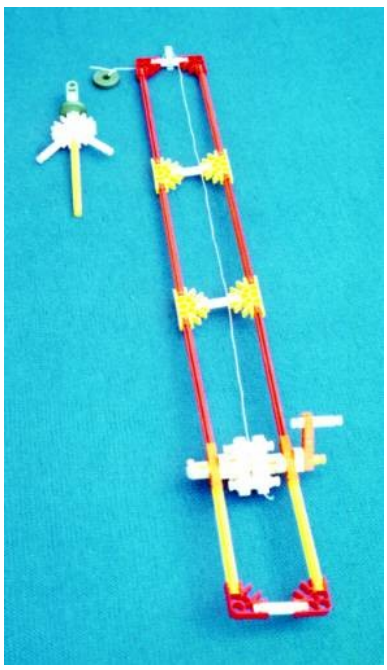
Key topics: Magnetism Designing skills Mechanisms Making skills

Components used in sample level 3 model below

Connectors: White 3 Purple4 Red 4 Orange 3 Grey 2 Tan 6

Rods: Red 6 Yellow 4 White 10

Magnets 2 String



Educational objective

A simple project which demonstrates that two magnets can attract each other

☑Cross-curricular links

None

√ Before starting

√ Discuss why fishing rods are used, and what they look like

→ Conclusion

→ Discuss why the fishing rod is able to pick up the fish

→ Experiment to find which small objects in the classroom can be picked up by the magnetic fishing rod

⇒ Possible follow-on activities

None

Magnetic roundabout

Have you ever ridden on the roundabout at a playground or a fair? Most roundabouts go round and round on a big metal pole, but we want you to make a roundabout that floats on magnets!

Levels of difficulty

Level 1	Make a simple roundabout, where the part that spins round is a white connector with four red rods in it
Level 2	As level 1, and put two ring magnets with poles opposed under the white connector, so that it 'floats' on the magnets
Level 3	As level 2, and put large wheels as weights on top of the roundabout

Equipment needed:	**K'NEX** Discovery set
For level 2:	2 ring magnets

How can you make a firm base for your roundabout, with a red rod sticking upright at the centre? Now put your roundabout onto the red rods, and check that it spins freely.

For level 2, take the roundabout off again, and put the two ring magnets on the red rod, with the poles opposing so they push each other part. Now put the roundabout back on top. Spin the roundabout, to check it spins freely. How much gap is there between the two magnets?

For level 3, put a large wheel and tyre onto the red rod so it rests on the roundabout. Does the roundabout still spin freely? What has happened to the gap? Now keep adding more wheels, until the weight is so great that the magnets are pushed together, and the roundabout won't spin easily.

☺ Handy hints

L1 3 ways to connect rods and connectors
N6 Magnets

☹ Troubleshooting tips

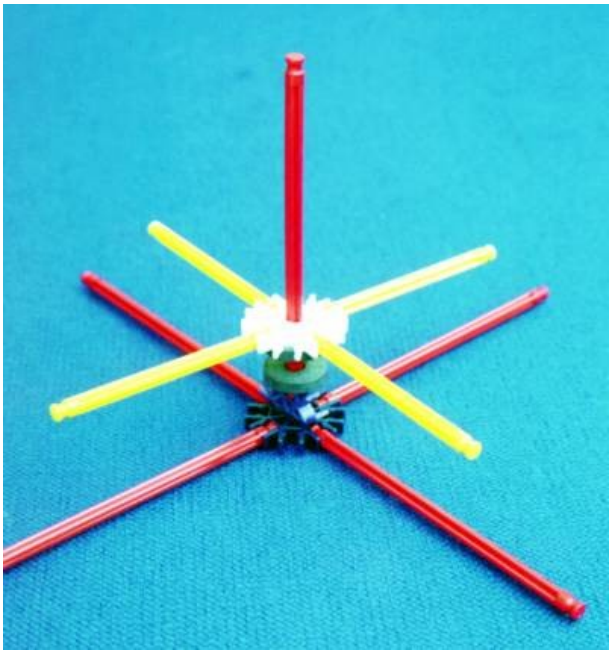
R1 Rods difficult to join to connectors
T6 Magnets won't work

For teachers

Key topics: Magnetism, Forces, Designing skills, Making skills

Components used in sample level 3 model below

Connectors: White 1 Blue 1 Purple 1
Rods: Red 5 Yellow 4
Magnets 2



Educational objective

An investigative experiment involving the forces of gravity, magnetism and friction

☑Cross-curricular links

None

√ Before starting

√ Before starting level 3, ask the children to predict what will happen as wheels are added as weights one at a time

→ Conclusion

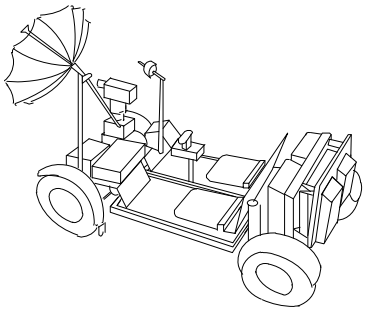
→ Ask why the gap between the magnets gets smaller (because when a wheel is added, the total weight is greater than the repulsive force between the magnets. The gap then closes, increasing the repulsive force, until it is again sufficient to support the weight)

→ Ask why the roundabout won't spin so easily once the magnets touch (because friction between the magnets opposes the motion)

⇒ Possible follow-on activities

None

Mars rover



"Hello, Houston? We have a problem. It is zero minus one hour and counting, and we have developed a malfunction with our Mars rover vehicle. Can you ship in a replacement soonest?"

Levels of difficulty

Level 1	✓5	Build a simple model of a Mars rover vehicle
Level 2		As level 1, with a motor, which will cross the landscape of Mars
Level 3		As level 2, which will steer round in a circle

Equipment needed:	**K'NEX** Discovery set
For level 2:	Battery motor
Test area (for level 2):	*A rough piece of ground, or a floor area with small objects on it, to test the vehicle's ability to climb over obstacles*

What shape will your Mars rover be? How many wheels will it have? How will the wheels be fastened to the body?

For level 2, how can you make the motor drive the wheels? Will the rover travel over rough ground like that found on Mars?

For level 3, how can you make the Mars rover steer around in a circle?

☺ Handy hints

L1 3 ways to connect rods and connectors
L5 Wheels and tyres
L6 Making rods turn with wheels or connectors
M2 Battery motors

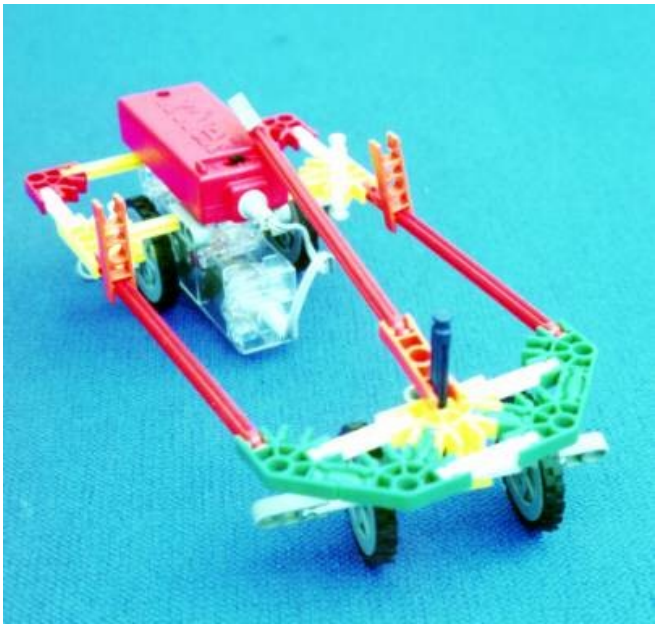
☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R3 Model is not strong enough
R4 Wheels won't turn around easily
S1 Rod won't go into motor
S2 Motor won't turn the wheels
S3 Can't connect my motor to my model

For teachers

Key topics: Mechanisms Designing skills
Earth & beyond Making skills

Components used in sample level 3 model below
Connectors: Yellow 4 Green 4 Red 2 Orange 2 Grey 7 Tan 2
Rods: Red 3 Yellow 3 Blue 1 White 9 Green 4
Small wheel/tyre 4 Battery mototr



Educational objective

To design a working vehicle which is capable of travelling over rough ground, and steering

☑Cross-curricular links

None

√ Before starting

√ Look at a picture or video of the surface of Mars, and if possible of the real Mars rover vehicle

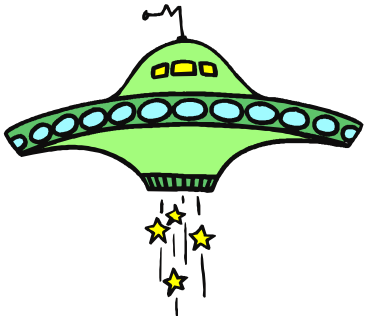
→ Conclusion

→ Discuss the equipment that a real Mars rover would have to carry in order to perform different experiments on the planet surface

⇒ Possible follow-on activities

⇒ Project on Mars

Martian



Some scientists believe that there was life on Mars many millions of years ago. Could you make a model of a Martian, and of the vehicle that he or she might have traveled in?

If there really were Martians, what do you think they looked like? A bit like people, or totally different? Did the lower gravity of Mars affect the way they developed? Were they less or more intelligent than humans?

For level 2, how does your Martian move about? On legs? On wheels? Like a fish? Like a bird? Or some other way?

For level 3, do think the Martians invented vehicles to travel in? If so, did they travel on land? Underground? On or under the sea? Through the 'air'? Through space???

Levels of difficulty

Level 1	✓5	Make a simple model of a Martian
Level 2		As level 1, that can walk (or travel some other way!) across the surface of Mars
Level 3		As level 2, plus a model of a Martian vehicle that the Martian can fit inside

☺ Handy hints

L1 3 ways to connect rods and connectors
L5 Wheels and tyres
L6 Making rods turn with wheels or connectors
M2 Battery motors

Equipment needed:	**K'NEX** Discovery set
For level 2:	Battery motor
Test area (level 2):	*A rough piece of ground, or a floor area with small objects on it, to simulate the surface of Mars*

☹ Troubleshooting tips

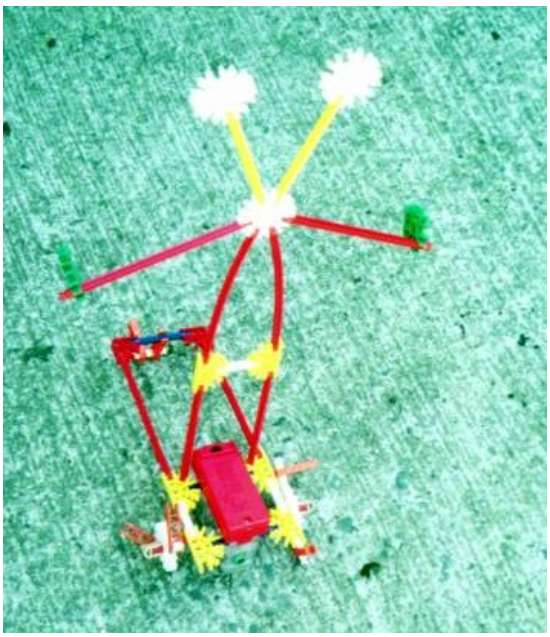
R1 Rods difficult to join to connectors
R3 Model is not strong enough
R4 Wheels won't turn around easily
S1 Rod won't go into motor
S2 Motor won't turn the wheels
S3 Can't connect my motor to my model

For teachers

Key topics: Earth & beyond Designing skills
Mechanisms Making skills

Components used in sample level 2 model below

Connectors:	White 5 Yellow 6 Green 2 Red 2 Orange 6 Grey 2 Tan 4
Rods:	Red 9 Yellow 2 Blue 3 White 7
	Battery motor



Educational objective

To consider how an intelligent species might have evolved on another planet. To design and build a model of one, and the vehicle they traveled in

☑Cross-curricular links

☑ History - evolution of mankind

√ Before starting

√ Look at pictures of Mars, and discuss differences between Earth and Mars

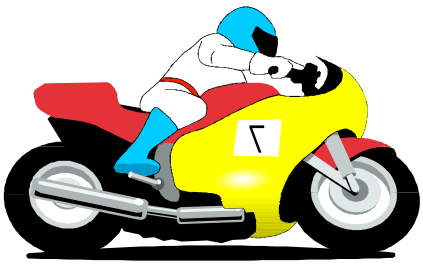
→ Conclusion

→ Ask the children to explain the features of their Martian and his/her vehicle

⇒ Possible follow-on activities

⇒ Project on Mars
⇒ Writing a story about mankind discovering that Martians still exist

Motorcycle



Traffic jams are everywhere, and cars are jamming the streets … but if you ride a motorcycle, your may complete your journey through the busy streets in half the time!

Levels of difficulty

Level 1	✓5	Make a simple model of a motorcycle
Level 2		As level 1, plus a spring motor to drive it
Level 3		As level 2, plus handle bars that steer

Equipment needed:	**K'NEX** Discovery set
For level 2:	Spring motor

What are the main features of a motorcycle? How could you build them into a K'NEX model? How big will your motorcycle be?

For level 2, how can you attach your spring motor? Will you motorcycle run on two wheels, or does it need two wheels at the back and one at the front?

For level 3, how can you add working handle bars to your model? Can they be fixed in one position, so that your motorcycle can race round in a circle?

☺ Handy hints

L1 3 ways to connect rods and connectors
L5 Wheels and tyres
L6 Making rods turn with wheels or connectors
M1 Spring motors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R3 Model is not strong enough
R4 Wheels won't turn around easily
S1 Rod won't go into motor
S2 Motor won't turn the wheels
S3 Can't connect my motor to my model

For teachers

Key topics: Mechanisms Designing skills Forces Making skills

Components used in sample level 3 model below

Connectors: Blue 2 Purple 2 Green 4 Orange 7 Grey 4 Tan 4
Rods: Yellow 2 Blue 1 White 4 Green 8
Small wheel/tyre 3 Spring motor

Educational objective

To build a working model of a motorcycle, with a working motor and steering

☑Cross-curricular links

☑ History - history of the motorcycle

√ Before starting

√ Look at a real example of a motorcycle

→ Conclusion

→ Ask the children to explain what happens when you pull back the motorcycle and then let go. Where does the force come from to make the motorcycle go along?

→ For level 3, ask them to explain why turning the handlebars to the left makes the motorcycle turn to the left (the friction between the front tyre and the ground)

⇒ Possible follow-on activities

⇒ Crash helmet project, to emphasise dangers to motorcycle riders

Mousetrap

Your town has been overrun by hungry mice, who are eating everything they can lay their paws on. We have found a nice new home for them in the country, but first we need your help to catch them. Please build a mousetrap for us that can catch a mouse without hurting it.

What does a mouse look like? How big is it? How can you make a K'NEX model of a mouse which is about the right size, and looks as much as possible like a real mouse?

For level 2, think about how you could catch the mouse without hurting it. Where will the mouse be held when it is caught? What happens to the trap after the mouse goes in, to prevent it escaping? Why does the mouse want to go into the trap? - you can use a yellow connector as a piece of cheese if you want!

For level 3, can you built some sort of lever which you pull or press to open the trap up again, to let the mouse out?

Levels of difficulty

Level 1	✓5	Make a model of a mouse
Level 2		As level 1, plus a mousetrap which can catch the mouse without hurting it
Level 3		As level 2, plus a release lever which can let the mouse out again when we have taken it to the country

Equipment needed: **K'NEX** Discovery set

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L11 Hinges

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough

For teachers

Key topics: Mechanisms **Designing skills** **Animals** **Making skills**

Components used in sample level 3 model below
Connectors: White 8 Green 1 Red 12 Orange 5 Grey 27
Rods: Red 8 Yellow 5 Blue 5 White 20 Green 16

Educational objective

A fascinating project which requires ingenuity and lateral thinking. The simplest models are often the best. Children can often do this project better than adults, as the latter tend to have preconceived ideas

☑Cross-curricular links

☑ Geography - habitats

√ Before starting

None

→ Conclusion

→ Compare all the different ways that have been used to achieve the objective

⇒ Possible follow-on activities

⇒ Project on mice and their place in the food chain

Netball

We have the netball - but no net! Can you design and build a netball net for us, and then show us how to score a goal in it?

Look at the netball. How wide is it? How can you make a hoop from K'NEX that the ball will just pass through?

For level 2, how could you make a stand for your hoop? Will it be strong and stable enough? How can you support the hoop so it stays horizontal, even if the ball touches it as it passes through?

For level 3, can you find a friend who has also made a net, and then organise and play a game of netball?

Levels of difficulty

Level 1	✓5	Make a hoop large enough for a netball to pass through
Level 2		As level 1, with a stand to hold it 0.5m from the ground, and then score a goal in it from 0.5m away without it breaking
Level 3		As level 2, and play a game of netball

Equipment needed:	**K'NEX** Discovery set Sponge ball of similar size to a netball

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L4 Strong 3-D structures

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough

For teachers

Key topics: Structures **Designing skills** **Making skills**

Educational objective

To build a strong, stable structure for a specific purpose, and then test it.

☑Cross-curricular links

☑ Physical education - netball

√ Before starting

√ Examine a real netball stand and hoop

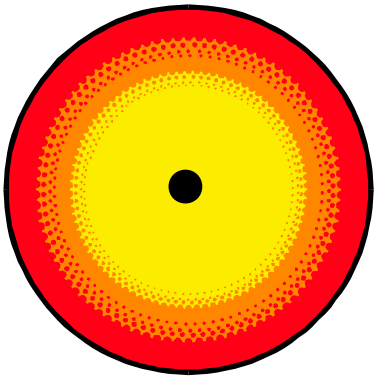
→ Conclusion

→ Compare the techniques that different children have used to achieve strength and stability in their models

⇒ Possible follow-on activities

None

Newton's disc



What colour do you get when you mix yellow and blue? How do you make purple? What colours do you have to mix to get white? Read on …

Levels of difficulty

Level 1 ✓5 Make a simple spinner, and put a disc of white card on the top

Level 2 ✓5 As level 1, crayon half the card in yellow, the other half in blue, and spin the disc

Level 3 ✓5 As level 2, and experiment with lots of different colours and patterns

Equipment needed:	**K'NEX** Discovery set
	Spinner stem
	Sheets of thin white card
For level 2:	Coloured crayons

Start with a K'NEX spinner stem, and put a white connector onto it. What rods could you add now to make a spinner? Will the rods need connectors on the other end joined together, to make the spinner better? Can you cut a piece of card the same size as your spinner, make a hole in the middle, and put it on top of your spinner?

Can you colour the white card half yellow and half blue? What happens to the colours when you spin it slowly, and when you spin it fast?

Now try different combinations of two, three and more colours. What happens when you crayon patterns onto the disc and spin it? What colour do you get if you make a quarter of the disc one colour, and three quarters another colour? Can you make the colour white when the disc is spun?

☺ Handy hints

L1 3 ways to connect rods and connectors

M4 Spinner stems

☹ Troubleshooting tips

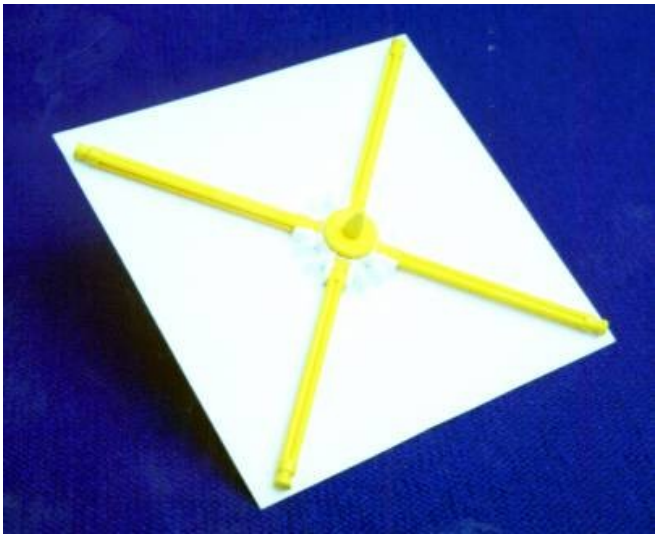
R1 Rods difficult to join to connectors

For teachers

Key topics: Light **Designing skills** **Making skills**

Components used in sample level 3 model below

Connectors:	White 1
Rods:	Yellow 4
	Spinner stem



Educational objective

To investigate the effects of colours mixing on a spinning disc

☑Cross-curricular links

☑ Art - colour

√ Before starting

None

→ Conclusion

→ Allow each pair of children to demonstrate their most interesting colour combinations and patterns

⇒ Possible follow-on activities

⇒ Try the same colour combinations by mixing paint, and by mixing coloured light

Obstacle football

If you think you can make the grade at soccer, we're putting obstacles in your way! Can you dribble past every one … and make your own football before you start?

How can you make a football out of K'NEX? How big will it be? How can you make it very strong? What rods and connectors should you use to make it as round as possible?

For level 2, test your ball on the course. If it breaks, how can you improve your design to make it stronger? If it doesn't roll very well, how can you make it rounder?

For level 3, keep practising!

Levels of difficulty

Level 1	Make a simple football
Level 2	As level 1, and dribble it around an obstacle course without it breaking
Level 3	As level 2, in less than a minute

Equipment needed: **K'NEX** Discovery set
Test area (level 2): 20 markers or poles about 2m apart, as an obstacle course

☺ Handy hints

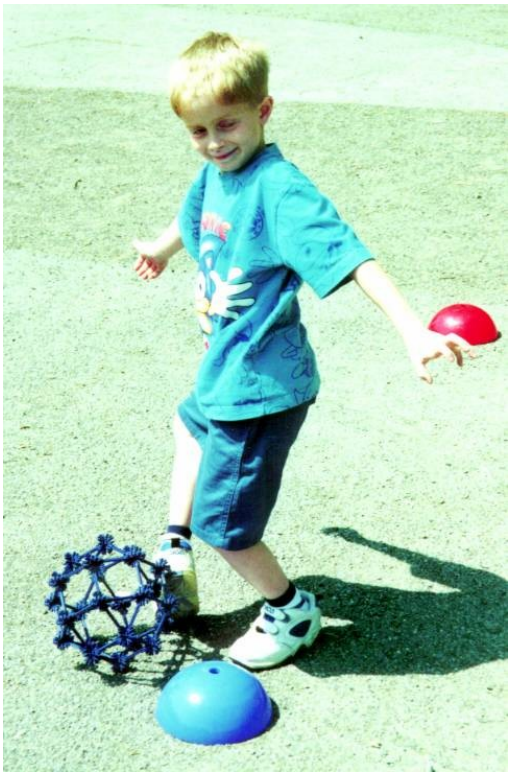
L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L4 Strong 3-D structures

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough

For teachers

Key topics: Structures **Designing skills** **Making skills**



Educational objective

To set an enjoyable task, which requires some real thought about strong structures to achieve it

☑Cross-curricular links

☑ Physical education - football

√ Before starting

None

→ Conclusion

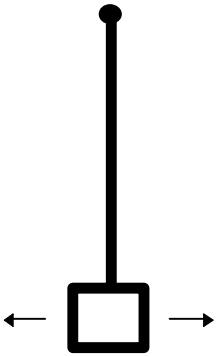
None

⇒ Possible follow-on activities

None

Pendulum

Pendulums could be found for many years inside clocks. It is the pendulum swinging inside a grandfather clock that causes the 'tick-tock' sound every second. But do pendulums always swing in a straight line? Read on…



Levels of difficulty

Level 1	Make a simple pendulum that swings in a frame
Level 2	As level 1, with a magnet at the bottom of the pendulum, and another magnet immediately below it on the frame, with poles opposed
Level 3	As level 2, and a sheet of white card underneath to plot the movement of the pendulum

Equipment needed:	**K'NEX** Discovery set Short length of string
For level 2:	2 ring magnets
For level 3:	Sheet of white card

First make a cubic frame, with 6 red rods, and a blue/purple connector at each corner. Then bring four more red rods to a point at the top, meeting at a blue/blue connector. Now make a pendulum from a grey rod with a grey connector on the top and a tan connector on the bottom. Fasten it to the blue/blue connector with a short piece of string, so that it swings freely.

For level 2, put a white connector at the centre of the frame at the bottom, and connect it to the corners with four yellow rods. Now put a ring magnet on the pendulum, and a second ring magnet on the white connector (opposing poles), with a green rod through the connector and magnet to stop it moving.

For level 3, place the whole model on top of a sheet of thin white card.

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
N6 Magnets

☹ Troubleshooting tips

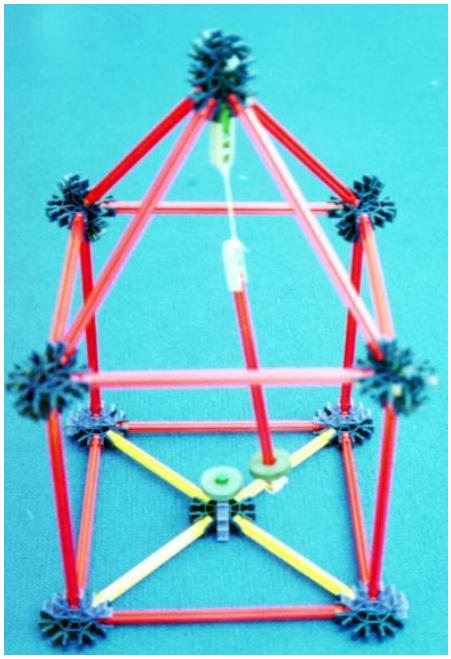
R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
T6 Magnets won't work

For teachers

Key topics: Magnetism **Designing skills**
Forces **Making skills**

Components used in sample level 3 model below

Connectors: Blue 15 Purple 4 Grey 2 Tan 1
Rods: Red 16 Yellow 4 Green 2
Magnet 2



Educational objective

To build a model of a pendulum, and then use it to investigate the forces of gravity and magnetism

☑Cross-curricular links

☑ History - history of clocks

√ Before starting

√ Try and find a picture or example of a clock containing a pendulum

→ Conclusion

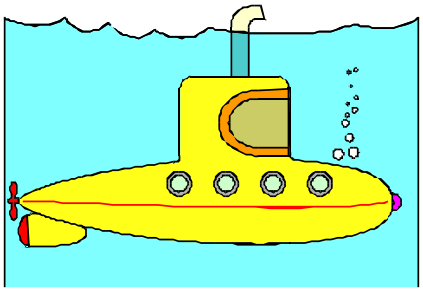
→ Ask the class to experiment with their pendulum, and draw on the card some of the paths that the pendulum has been made to follow, both with and without the magnets.

→ Then ask them to explain what is happening. Why does the pendulum swing in a straight line without magnets, but not when the magnets are there? Why does the pendulum 'bounce' off the fixed magnet? Why does the pendulum sometimes spin?

⇒ Possible follow-on activities

⇒ Magnetic roundabout project

Periscope



How do submarine commanders see what is happening without surfacing? What do you need to see over walls? Periscopes!

Levels of difficulty

Level 1	Make a simple mirror in a frame, and use it to look behind you
Level 2	Make a periscope with two mirrors which will enable you to look over a wall
Level 3	As level 2, plus a third mirror which will enable you to see the floor on the other side of the wall

Equipment needed:	**K'NEX** Discovery set 3 mirror panels
Test area:	*Wall about 30cm higher than the child*

How can you build a simple frame for your mirror? How will you attach your mirror to it?

For level 2, how can you set two mirrors at 45 degrees in frames, and join them together with a long 'tube'? Which way will the two mirrors need to face if you want to look over the wall?

For level 3, how could you add a third mirror to your model, so you look down the other side of the wall?

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L4 Strong 3-D structures
N7 Mirror panels

☹ Troubleshooting tips

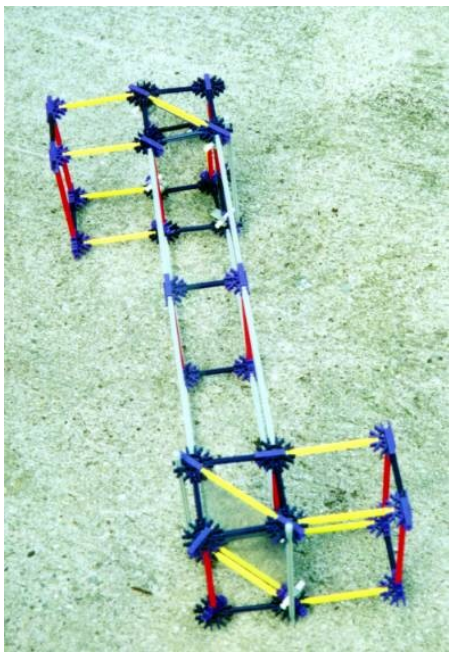
R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough

For teachers

Key topics: Light **Designing skills** **Structures** **Making skills**

Components used in sample level 3 model below

Connectors: Blue 16 Purple 40 Grey 8
Rods: Grey 12 Red 10 Yellow 12 Blue 22 White 8
Mirror panel 2



Educational objective

A project to investigate how light travels in straight lines, and how it is reflected in a mirror set at 45 degrees

☑Cross-curricular links

None

√ Before starting

√ Ask the children to consider how they might use mirrors to see over a wall, and allow them to experiment with the mirrors before starting

→ Conclusion

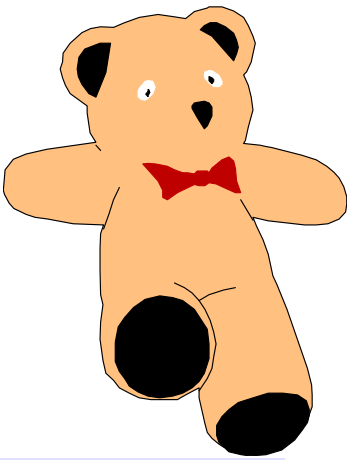
→ Get the children to draw a diagram of how light starts at a light source, strikes an object on the other side of the wall, and then is reflected by the mirrors so that it enters the eye

⇒ Possible follow-on activities

None

Pet home

We have a baby bear coming to live with us, but it hasn't got anywhere to sleep. Could you make a pet home for the baby bear to sleep in?



What shape will your pet home be? Will it be big enough for the bear to sit down in? Can you make it really strong?

For level 2, where will you put the door? How can you fasten the door to the house so that it opens and closes?

For level 3, what toys would you like to play with if you were a bear? Can you make those toys out of K'NEX?

Levels of difficulty

Level 1 ✓5 Make a simple pet home for a teddy bear

Level 2 ✓5 As level 1, with a door

Level 3 ✓5 As level 2, plus some toys for the bear to play with

Equipment needed: **K'NEX** Discovery set
Small teddy bear up to 20cm high (or cuddly animal)

☺ Handy hints

L1 3 ways to connect rods and connectors

L3 Making corners with blue and purple connectors

L9 Hinges

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

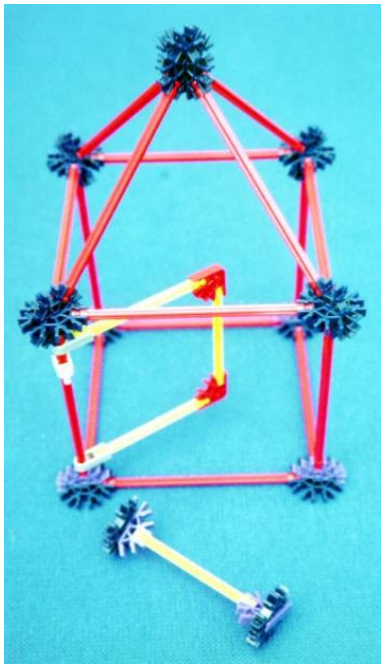
R2 Blue and purple connectors won't join together

R3 Model is not strong enough

For teachers

Key topics: Animals **Designing skills**
Structures **Making skills**

Components used in sample level 3 model below
Connectors: Blue 16 Purple 6 Red 2 Orange 2 Grey 1
Rods: Red 16 Yellow 4



Educational objective

A structures project for younger children, which stimulates their imagination

☑Cross-curricular links

☑ Geography - houses in different parts of the world

√ Before starting

✓ Ask the children to bring in a small teddy bear if they have one

→ Conclusion

→ Compare the different types of homes and toys that have been built

→ Encourage the bears to visit each other's houses and play with the toys

⇒ Possible follow-on activities

⇒ Teddy bears' picnic

Puppet show

Pinocchio was a puppet who came to life. We can't promise that your K'NEX puppets will come to life - but you can certainly have fun making them and putting on a puppet show!

Think what your puppet will look like. Will it be a person, or an animal, or something else? Will it have arms and legs and a head? How could you make these out of K'NEX? Where will you fasten the string?

For level 2, how can you make the arms and legs move when you pull a string? Will the tops of the string be tried to something that will make it easy for you to make your puppet move?

For level 3, how could you make a theatre out of K'NEX? What play are you going to perform?

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L4 Strong 3-D structures
N1 String

Levels of difficulty

Level 1	✓5	Make a simple puppet on a string
Level 2		Make two or more puppets whose arms and legs can be moved by strings
Level 3		As level 2, make a theatre, and put on a puppet show

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough

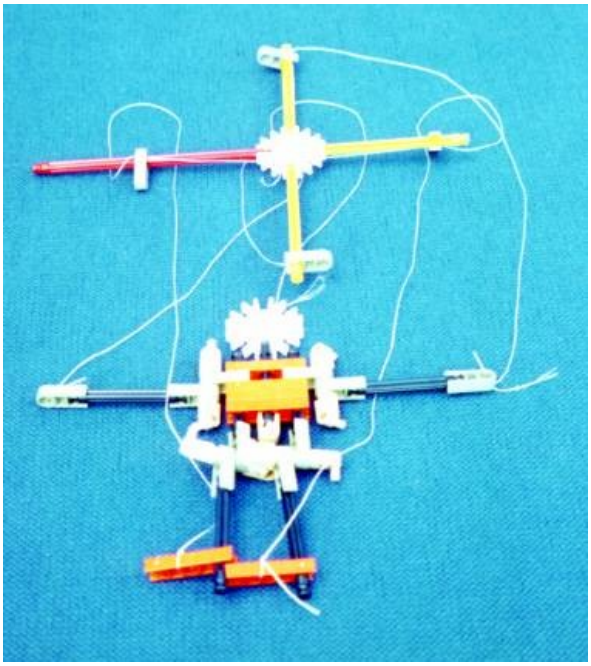
Equipment needed: **K'NEX** Discovery set
Lengths of string

For teachers

Key topics: Forces **Designing skills** **Making skills**

Components used in sample level 1 model below

Connectors: White 2 Orange 6 Grey 14 Tan 9
Rods: Red 1 Yellow 3 Blue 7 White 4
String 5



Educational objective

To design and build puppets whose body, arms and legs are moved by forces applied through lengths of string

☑Cross-curricular links

☑ English - theatre

√ Before starting

√ Consider whether you want to suggest a theme for the play that fits in with other work that the class is doing
√ Look at an example or picture of a real puppet

→ Conclusion

→ Ask the class to watch each other's puppet shows

⇒ Possible follow-on activities

⇒ Puppet show for the whole school

Railway

Railway engines were first powered by steam engines, and then later by diesel engines and electric motors. Can you make an electric-powered railway engine, that will run on a railway track?

What shape will your railway engine be? How will you attach the wheels? Will they be the right distance apart to fit on the track? How will the motor turn the wheels?

For level 2, test your first model. If it becomes de-railed when it reaches a curve, think how you can improve it. Might it work better going the other way? Will you have to make one set of wheels swivel, to follow the curve around?

For level 3, how can you make two trucks that will be easy to pull around? If the driving wheels of your railway engine slip when it tries to pull the train, how might you prevent this?

Levels of difficulty

Level 1	Make a railway engine that will run on a straight section of track
Level 2	As level 1, and it will also go around curves
Level 3	As level 2, and it will pull a train of two trucks

☺ Handy hints

L1 3 ways to connect rods and connectors
L5 Wheels and tyres
L6 Making rods turn with wheels or connectors
M2 Battery motors

Equipment needed:	**K'NEX** Discovery set Battery motor
Test area:	*An oval-shaped 'G' gauge railway track*

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R4 Wheels won't turn around easily
R5 Wheels slip on railway track
S1 Rod won't go into motor
S2 Motor won't turn the wheels
S3 Can't connect my motor to my model

For teachers

Key topics: Forces **Designing skills** **Mechanisms** **Making skills**

Educational objective

To build a powered vehicle to run on a railway track, which will probably need significant testing and improving before it meets the level 3 objective

☑Cross-curricular links

☑ History - history of railways

√ Before starting

√ If possible, look at a picture of a railway engine with wheels that swivel as it goes rounds curves

→ Conclusion

→ Ask the children to explain why a simple fixed-wheel railway engine becomes derailed at a curve (because the force from the engine is pushing in a straight line)

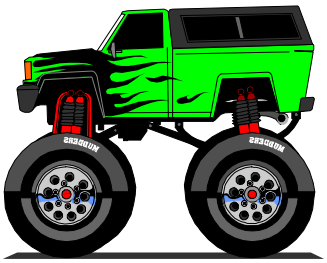
→ Ask why having one set of swivelling wheels helps (because the force of the swivelling wheel hitting the edge of the track turns it)

→ Ask why adding too many trucks to a train stops it moving (because the friction between the track and driving wheel on the engine is insufficient to overcome the inertia of the train)

⇒ Possible follow-on activities

⇒ Project on railways around the world, past, present and future

Remote control jumps



We're not asking you to jump blindfolded on a motorbike over 23 double decker buses … but how far can you jump by remote control?

Levels of difficulty

Level 1	Build a ramp that a remote control car can jump over
Level 2	As level 1, and the car will jump 0.5m
Level 3	As level 1, and the car turns over as it jumps

Equipment needed:	**K'NEX** Discovery set
Test area:	*A rugged remote control car, and a flat space to test it on*

How can you make a ramp for the car to jump from? What shape will it be? How steep? Will the surface be fairly smooth to run on?

For level 2, how can you improve your design so that the car will jump 0.5m? Can you make the surface of the ramp smoother? What is the best angle? How long a run-up should you take?

For level 3, how can you make the car turn over as it jumps? Do you need to change your ramp, or your run-up, or both?

☺ Handy hints

L1 3 ways to connect rods and connectors

L3 Making corners with blue and purple connectors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R2 Blue and purple connectors won't join together

R3 Model is not strong enough

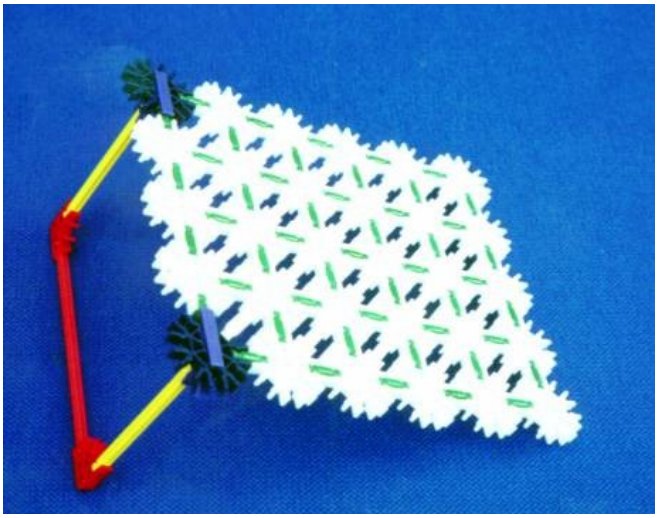
For teachers

Key topics: Forces **Designing skills** **Making skills**

Components used in sample level 3 model below

Connectors: White 28 Blue 2 Purple 2 Red 2

Rods: Red 1 Yellow 2 White 20 Green 49



Educational objective

A project to investigate the behaviour of a vehicle in motion

☑Cross-curricular links

None

√ Before starting

√ Test that the car's battery is fully charged

→ Conclusion

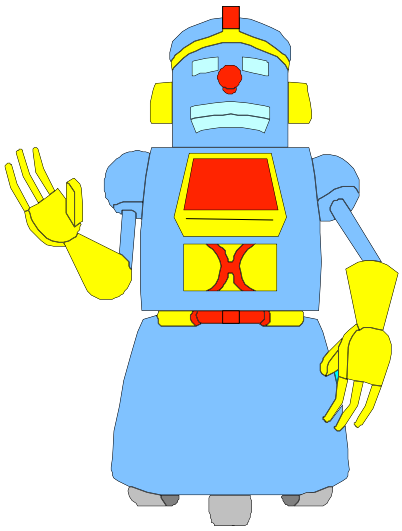
→ Set an obstacle course comprising all the jumps, and see who can jump every one in the fastest time

⇒ Possible follow-on activities

⇒ Project to investigate how remote control actually works

Robot

Most people's idea of a robot is that it looks and works very like a human. But in fact almost all robots used around the world look nothing like one! Could you make a robot out of K'NEX?



What shape will your robot be? How big? Will it need arms, legs and a head? What K'NEX rods and connectors will you need to make it?

For level 2, what is the best shape for this type of robot? How can you make sure it doesn't break or fall over when it runs into something?

For level 3, think about how humans pick up pieces of K'NEX. What type of pieces will your robot be able to pick up? How will it pick them up? Where will it put them once it has picked them up?

Levels of difficulty

Level 1	✓5	Make a simple model of a robot
Level 2		Make a robot with a motor which will travel around the room
Level 3		As level 2, and it will pick up pieces of K'NEX as it travels

Equipment needed:	**K'NEX** Discovery set
For level 2:	Battery motor
For level 3:	Thin card

☺ Handy hints

- L1 3 ways to connect rods and connectors
- L3 Making corners with blue and purple connectors
- L5 Wheels and tyres
- L6 Making rods turn with wheels or connectors
- M2 Battery motors

☹ Troubleshooting tips

- R1 Rods difficult to join to connectors
- R2 Blue and purple connectors won't join together
- R3 Model is not strong enough
- R4 Wheels won't turn around easily
- S1 Rod won't go into motor
- S2 Motor won't turn the wheels
- S3 Can't connect my motor to my model

For teachers

Key topics: Mechanisms Designing skills Humans Making skills

Educational objective

A challenging design project, which necessitates thinking about how the human body performs a routine task, and then building a machine to achieve a similar result. Requires a practical understanding of mechanics and structures

☑Cross-curricular links

None

√ Before starting

√ Ask the class to pick up pieces of K'NEX, and to describe how their bodies achieve this

→ Conclusion

→ Compare how the different models have achieved the objective

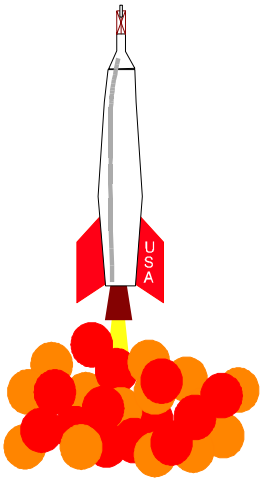
→ Ask the children to explain the strengths and weaknesses of their models

⇒ Possible follow-on activities

⇒ Write a story set in the future, when robots will do any task that they are asked to

Rocket

Rockets have to fly very, very fast to break away from the pull of the earth's gravity. Real rockets can be powered by solid fuel or liquid fuel. How will your K'NEX rocket be powered?



What shape is you rocket going to be? How tall? Can you use a design that will make it really strong? Will the rocket carry people, and if so, where will they go?

For level 2, what type of structure can you use to achieve the necessary strength and stability?

For level 3, what will your 'landing module' look like? It needs to be big enough to carry the astronauts, their supplies, and fuel for the rocket motor. How will the module land on the planet? How will it detach and re-attach to the rest of the rocket?

Levels of difficulty

Level 1	✓5	Make a simple model of a rocket
Level 2		As level 1, that can stand at least 1m tall
Level 3		As level 2, with a 'landing module' on the nose that can be detached to land softly on a planet

Equipment needed: **K'NEX** Discovery set

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L4 Strong 3-D structures

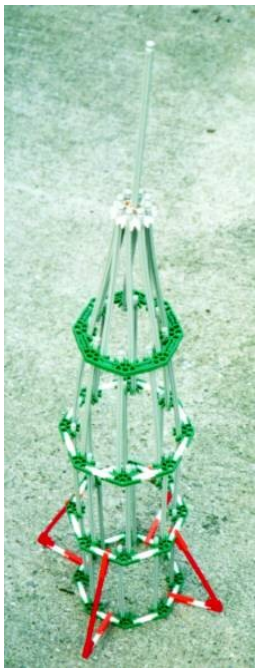
☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough

For teachers

Key topics: Structures Designing skills
Earth & beyond Making skills

Components used in sample level 2 model below
Connectors: White 1 Green 32 Red 4 Orange 8 Tan 2
Rods: Red 25 Yellow 4 White 28 Green 8



Educational objective

To design and build a strong and stable structure. In level 3, to add a lunar module with specific mechanical requirements

☑Cross-curricular links

None

√ Before starting

√ Look at photos or a video of a space rocket, if possible one with a landing module (eg from the Apollo moon landings)

→ Conclusion

→ Ask the class to add a 'skin' to the outside of their rocket structure, using sheet materials of their own choice

⇒ Possible follow-on activities

⇒ Project on the Apollo moon landings and future landings on planets

Rocking Horse

Have you ever sat on a rocking horse, and rocked happily backwards and forwards?
Have you ever thought about how rocking horses are made?

How could you make a horse out of K'NEX? How will you make the body? And the head? And the legs? Can you make it the right size and shape for your doll to sit on?

For level 2, what shape and size of saddle will you need? How can you fasten reins on to the horse's head?

For level 3, what shape will the rockers need to be? What K'NEX rods and connectors will be required?

Levels of difficulty

Level 1	✓5	Make a model of a horse for a doll to sit on
Level 2	✓5	As level 1, with reins and a saddle that can be taken on and off
Level 3		As level 2, and add rockers so that it rocks back and forth

☺ Handy hints

L1 3 ways to connect rods and connectors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R3 Model is not strong enough

Equipment needed: **K'NEX** Discovery set
Doll about 30cm high

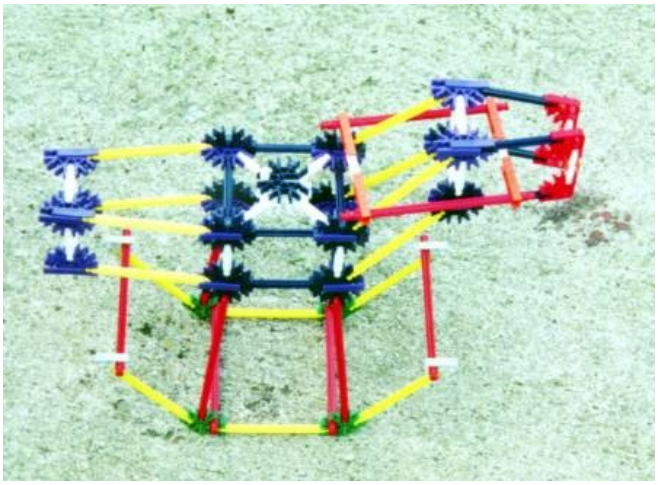
For teachers

Key topics: **Animals** **Designing skills** **Structures** **Making skills**

Components used in sample level 3 model below

Connectors: White 1 Blue 11 Purple 22 Green 4 Red 4 Orange 4 Light grey 4

Rods: Red 10 Yellow 14 Blue 12 White 19



Educational objective

To consider how a model of a horse could be designed and built, and also to make it rock

☑Cross-curricular links

None

√ Before starting

√ Look at a picture or real example of a rocking horse

→ Conclusion

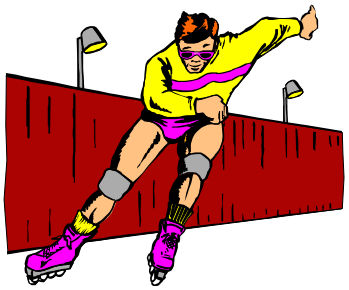
→ See which horse rocks for longest, and discuss why

⇒ Possible follow-on activities

⇒ Write a story about your rocking horse

Rollerblades

Rollerblading has hit town. Better get your skates on …but you'll have to build them first!



Levels of difficulty

Level 1	Build a simple rollerblade or roller skate that is the right size for your foot
Level 2	As level 1, and you can stand on it without it breaking
Level 3	As level 2, and you can skate 3m on it without it breaking

Equipment needed:	**K'NEX** Discovery set
For level 3:	3 lengths of string

How many wheels will each rollerblade have? Will they be in a line down the middle, or one at each corner? What shape will the rollerblade need to be to fit your foot?

For level 2, what design will best transfer your body weight through the wheels to the ground, without the model breaking?

For level 3, can you fasten the rollerblade to your foot with string? And then test it over 3m? If it breaks, how can you improve your design?

☺ Handy hints

L1 3 ways to connect rods and connectors
L4 Strong 3-D structures
N1 String

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R3 Model is not strong enough

For teachers

Key topics: Structures **Designing skills** **Mechanisms** **Making skills**

Educational objective

A difficult but satisfying project, to design a structure that will bear considerable weight without breaking

☑Cross-curricular links

☑ Physical education - individual sports

√ Before starting

√ Examine a real pair of rollerblades or roller skates

→ Conclusion

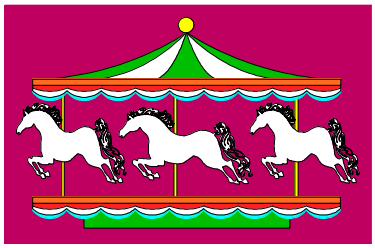
→ Compare the different designs which have met the objective

→ Test the different designs, to see who can travel the furthest on their rollerblade

⇒ Possible follow-on activities

⇒ Draw the rollerblade of the future

Roundabout



Round and round they go … up and down … never tiring. Can you make a fairground roundabout out of K'NEX? Will people sit on horses on your roundabout, or on something else?

Levels of difficulty

Level 1	✓5	Make a simple roundabout that spins
Level 2		As level 1, with a spring motor
Level 3		As level 2, with seats that hang down and lean outwards as the roundabout turns

What shape will your roundabout be? How can you make a frame for it to stand on as it turns? How big will it be? Where will the people sit?
For level 2, how can you make the spring motor turn the roundabout? Where will the motor fasten on to the frame?

For level 3, can you make a number of seats, that hang freely below the roundabout when it turns? What happens to the seats when the roundabout turns fast?

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L5 Wheels and tyres
L6 Making rods turn with wheels or connectors
M1 Spring motors

Equipment needed: **K'NEX** Discovery set
For level 2: Spring motor

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily
S1 Rod won't go into motor
S2 Motor won't turn the wheels
S3 Can't connect my motor to my model

For teachers

Key topics: Forces **Designing skills** **Mechanisms** **Making skills**

Educational objective

To build a model of a familiar mechanical object, and use it to investigate centripetal force.

☑Cross-curricular links

None

√ Before starting

√ Look at a picture of a fairground roundabout

→ Conclusion

→ Check that the seats hanging down from each model lean out as the roundabout turns fast (if not, suggest the children change the hinges where the seat is attached to the wheel), and discuss why this happens (centripetal force)

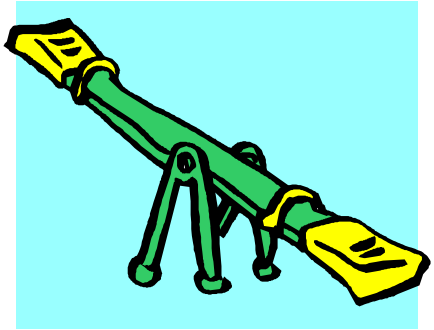
→ Then ask the children to carry out an experiment, to measure how far out the seats swing in relation to the number of turns that the spring motor has been wound up

→ Draw tables and graphs of the results

⇒ Possible follow-on activities

⇒ Find further examples of centripetal force in action

Seesaw



Has your local children's playground got a seesaw? What happens when a big child sits on one end and a smaller one on the other end? Can you make a model seesaw to find out?

Can you think what a seesaw looks like? Where do the children sit? What does it rest on in the middle? What colour will your K'NEX seesaw be?

For level 2, how can you make a seesaw which balances exactly? Will each end be symmetrical? What is the best design for a pivot which has little friction?

For level 3, how could you create 4 positions on each arm of the seesaw to add weights? We will need them for an experiment.

Levels of difficulty

Level 1	✓5	Make a simple seesaw
Level 2		Make a large seesaw, that balances perfectly about a central pivot
Level 3		As level 2, plus four positions along each arm of the seesaw where K'NEX connectors can be added as weights

Equipment needed: **K'NEX** Discovery set

☺ Handy hints

L1 3 ways to connect rods and connectors

L12 Pivots

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R3 Model is not strong enough

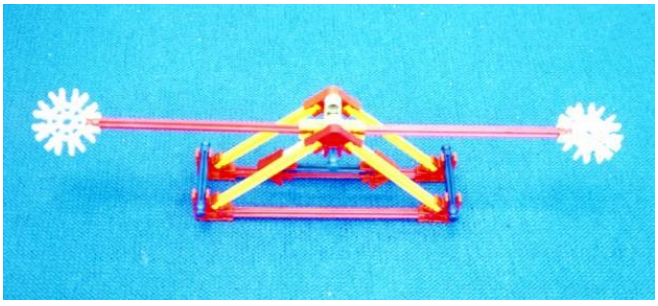
For teachers

Key topics: Forces **Designing skills** **Making skills**

Components used in sample level 2 model below

Connectors: White 2 Yellow 1 Red 8 Grey 2

Rods: Red 4 Yellow 4 Blue 4 White 2



Educational objective

To carry out an investigative experiment into balanced and unbalanced forces, using a type of lever.

☑Cross-curricular links

None

√ Before starting

√ Look at a picture of a real seesaw

→ Conclusion

→ Ask the children to predict what will happen if they put equal weights on each end; unequal weights on each end; and equal weights at different distances from the pivot

→ Then ask them to try out different combinations, and draw a table of the results

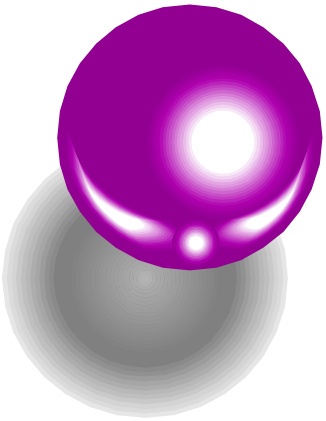
→ Finally get them to determine whether their predictions were accurate

⇒ Possible follow-on activities

⇒ Similar experiment with different types of lever

Shadows

Does your shadow follow you everywhere, or like Peter Pan, has it got a life of its own? Would you like to do an experiment with shadows?



Choose different types of K'NEX rods and connectors, and hold them up to make shadows. How can you make the shadows bigger and smaller?

For level 2, think about the shadows that animals and people make. Could you build a K'NEX model that would make a similar shadow? Try out your model, and make the shadow even more realistic if you can.

For level 3, make a stand for you model so that it can sit on the table to make its shadow. What happens to the shadow when you move and turn the model?

Levels of difficulty

Level 1	✓5	See what shadows K'NEX rods and connectors make
Level 2	✓5	See if you can make a K'NEX model create a shadow which looks like a person or an animal
Level 3		As level 2, and build a stand on which your model can stand, so it can be moved along and turned around

☺ Handy hints

L1 3 ways to connect rods and connectors

L3 Making corners with blue and purple connectors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R2 Blue and purple connectors won't join together

R3 Model is not strong enough

Equipment needed: **K'NEX** Discovery set

Test area: Bright light (eg an overhead projector) shining onto a lightly coloured screen or wall in a darkened room. Table in front of the screen or wall to put models on.

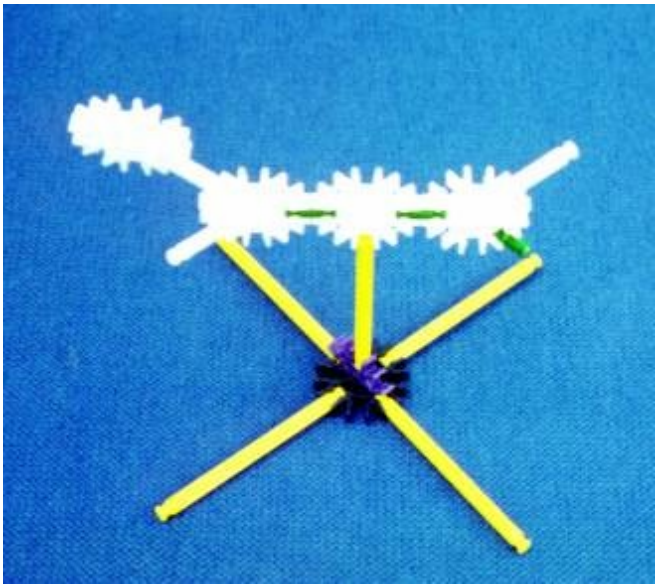
For teachers

Key topics: Light **Designing skills** **Making skills**

Components used in sample level 3 model below

Connectors: White 4 Blue 1 Purple 1

Rods: Yellow 5 White 3 Green 3



Educational objective

An investigative experiment into the formation of shadows

☑Cross-curricular links

None

√ Before starting

√ Check that the position of the light source, screen and table are suitable for the experiment

→ Conclusion

→ Ask the children to predict what will happen to the shadow when their model is moved: towards the screen; towards the light; to the left or right; turned clockwise; turned anti-clockwise. Then ask them to check their predictions.

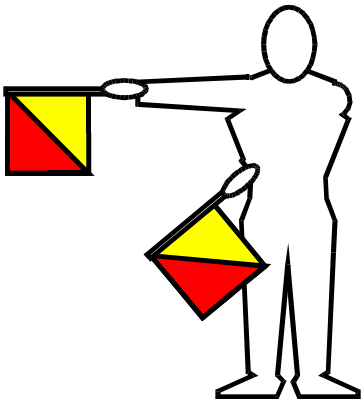
→ Ask them to create a table which shows the width of the shadow and the height of the shadow for 10 different distances of the model to the screen. Then plot a graph showing the results.

⇒ Possible follow-on activities

⇒ Introduce mirrors, and experiment with creating more than one shadow from the same object

⇒ Introduce coloured lights, and experiment with making different coloured shadows

Semaphore



Semaphore used to be used before the days of telephones and radio to send messages over a distance. Two flags are used in different positions to spell out the letters in the message. Could you make a semaphore system with K'NEX?

How can you make a 30cm tall model of person that will stand upright? Will the arms be strong enough to hold things in?

For level 2, what colours and shapes are available to you in the K'NEX set? Will there be any patterns which make it easier to remember your 26 codes? For example, all vowels might be red.

For level 3, you will probably have to write down the code for each letter, so that your friend will be able to decode your message. What is the farthest distance away your friend can be and still receive messages? Can he or she send you a message back again?

Levels of difficulty

Level 1	Make a model of a person with arms outstretched at least 30cm tall which will stand upright
Level 2	Decide what combination of rods and connectors the person will hold in his or her hands to signal the 26 letters of the alphabet, and prepare these
Level 3	As level 2, and send a secret message using these signals to a friend

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L4 Strong 3-D structures

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough

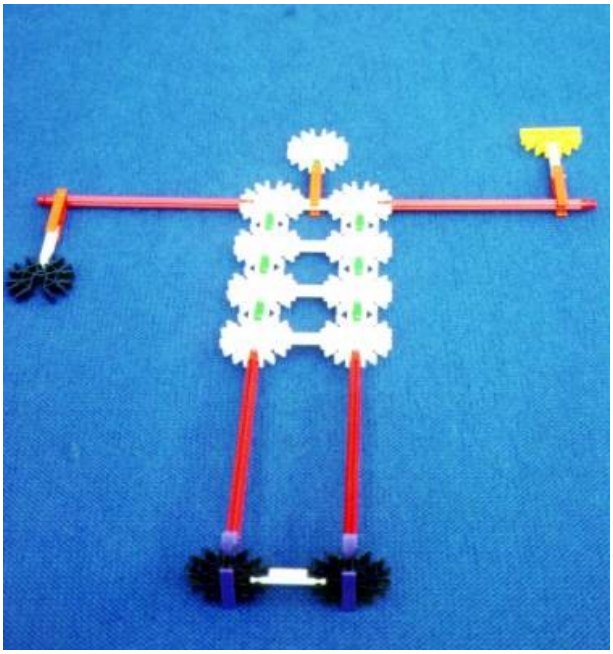
Equipment needed: **K'NEX** Discovery set

For teachers

Key topics: Designing skills

Making skills

Components used in sample level 3 model below
Connectors: White 9 Blue 3 Purple 2 Yellow 1 Orange 3
Rods: Red 4 White 7 Green 7



Educational objective

To create a letter-by-letter code, and use it to send messages

☑Cross-curricular links

☑ IT - communication

√ Before starting

√ Give the class details of a letter-by-letter code such as semaphore or Morse code

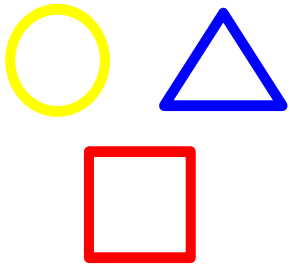
→ Conclusion

→ Tell half the children a short message that you would like sent, and see if the other half receive it correctly

⇒ Possible follow-on activities

⇒ Experiment making Morse code with sounds or lights

Shape & colour trail



Younger children love to follow trails. Do you think you could make a simple K'NEX colour and shape trail, for younger children in your school or home?

Levels of difficulty

Level 1	✓5	Make 5 2-D shapes out of K'NEX, using as many different colours as possible (Square, triangle, rectangle, star, etc)
Level 2		As level 1, plus 5 3-D shapes (cube, ball, etc) using as many colours as possible
Level 3		As level 2, and hang the 10 shapes up all around your school to make a trail

Equipment needed:	**K'NEX** Discovery set
For level 3:	10 lengths of string
	Clipboards and pencils (for the trail)

What 2-D (flat) shapes do you know? Can you make five of them out of K'NEX? Can you use different rods and connectors in each shape, so that as many colours as possible are used?

For level 2, can you think of 5 3-D shapes that could be made with K'NEX? They could be geometric shapes (eg a cube), or shapes of familiar objects (eg a house).

For level 3, where could you hang the shapes to make an interesting trail?

☺ Handy hints

L1 3 ways to connect rods and connectors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

For teachers

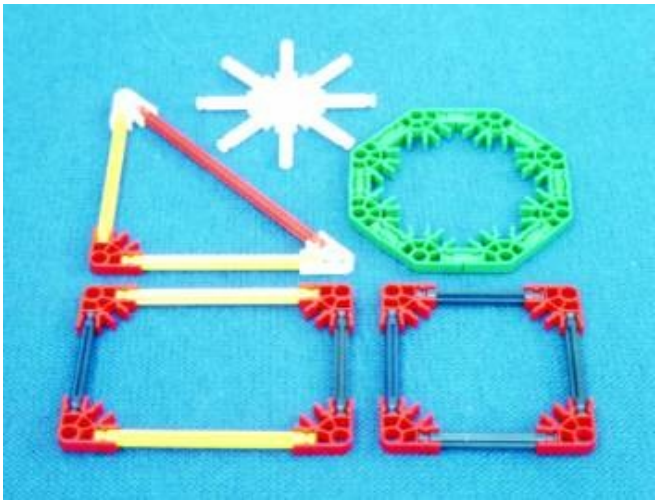
Key topics: Designing skills

Making skills

Components used in sample level 1 models below

Connectors: White 1 Green 8 Red 9 Light grey 2

Rods: Red 1 Yellow 4 Blue 6 White 8 Green 8



Educational objective

To create shapes using as many colours as possible

☑Cross-curricular links

☑ Maths - 2-D and 3-D shapes, symmetry

☑ Art - colour

√ Before starting

√ If necessary, remind the children of some of the shapes that they have seen in the past

→ Conclusion

→ Ask the class to run a shape and colour trail for some younger children. The younger ones should be asked to name the colours and draw the shapes, and (if they can write) write down the name of the colours and the names of the shapes.

⇒ Possible follow-on activities

⇒ Make other trails around the school, such as a materials trail

Shopping trolley

Whoever designs a shopping trolley that will always steer the way you want it to go will make a fortune. Could you become an inventor, and design the perfect shopping trolley?

Have you ever pushed a shopping trolley, or sat in one? What shape was it? Where did the wheels fasten on? Could you make one out of K'NEX - the bigger the better?

For level 2,think how you could make a strong horizontal handle to push it by, just like on real shopping trolley.

For level 3, how could you make your front wheels swivel? Will they swivel independently (as on a real shopping trolley), or will the swivel together? Can you push your trolley by the handle, and steer it in any direction?

Levels of difficulty

Level 1	✓5	Make a simple trolley with four wheels
Level 2	✓5	As level 1, with a handle to push it by
Level 3		As level 2, with swivel wheels on the front so that the trolley goes in whatever direction you wish

Equipment needed: **K'NEX** Discovery set
Test area: *A slalom course a bit like the inside of a supermarket*

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L5 Wheels and tyres

☹ Troubleshooting tips

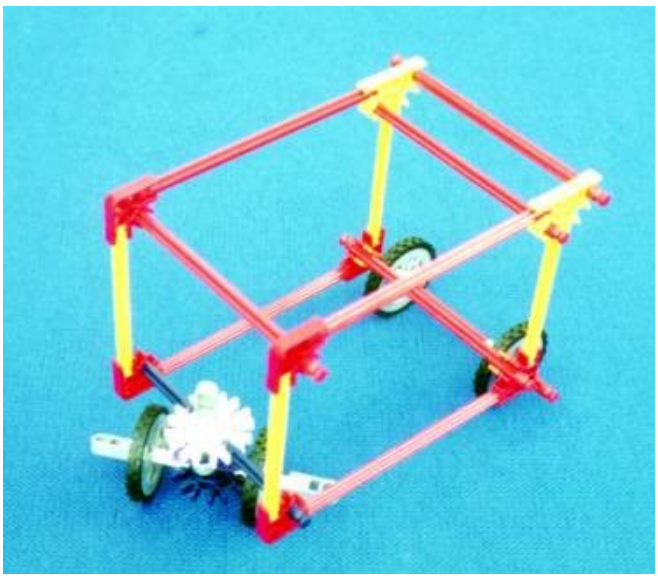
R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily

For teachers

Key topics: Mechanisms **Designing skills** **Making skills**

Components used in sample level 3 model below

Connectors: White 1 Blue 1 Purple 1 Yellow 2 Red 6 Orange 2 Grey 6
Rods: Red 7 Yellow 4 Blue 2 White 3
Small wheel/tyre 4



Educational objective

An interesting design project, which involves the evaluation of a familiar object, and the design, building and testing of an improved version

☑Cross-curricular links

None

√ Before starting

√ Try and borrow a real shopping trolley from a local supermarket

→ Conclusion

→ Ask the children to test their trolleys on the course, both empty and full

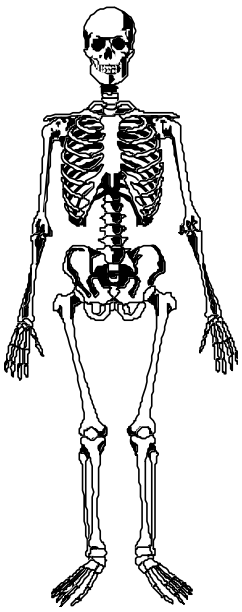
→ Ask them to draft a letter to their local supermarket manager, explaining how their new design is better than the old one, and why the supermarket should start to use it

⇒ Possible follow-on activities

⇒ Visit to a local supermarket

Skeleton

What is inside your hand? Inside your arm? Inside your leg? Inside your head? Do you think you could make a K'NEX model of your own skeleton?



Levels of difficulty

Level 1	Make 2 skeleton hands
Level 2	As level 1, and attach them to 2 skeleton arms, with joints that work
Level 3	As level 2, and attach them to a skeleton body, skeleton legs and a head

Feel the bones inside your hand. Where are the joints? Where are the straight lengths of bone? Which way can the joints bend? How could you make a similar model out of K'NEX?

For level 2, how do your wrist and elbow bend? How will the joints in your model bend in the same way? Can you make your model arms a similar length to your real arms?

For level 3, what shape are the bones in the main part of your body? In your legs and feet? In your head? How can you make something simlar out of K'NEX?

☺ Handy hints

L1 3 ways to connect rods and connectors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R3 Model is not strong enough

Equipment needed: **K'NEX** Giant set

For teachers

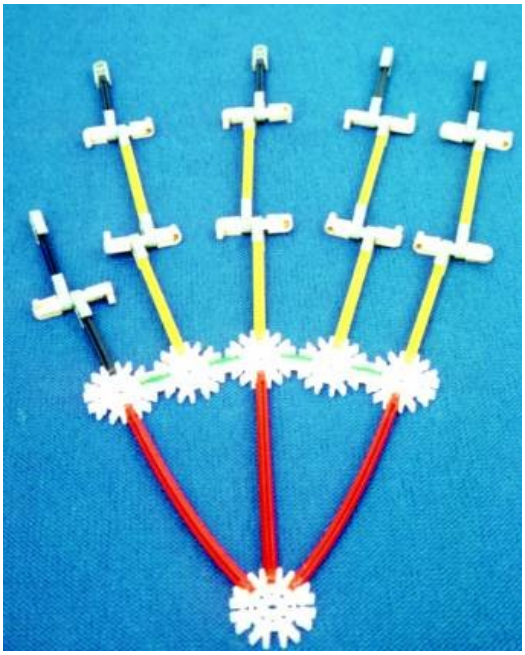
Key topics: Humans **Designing skills**

Structures **Making skills**

Components used in sample level 1 model below

Connectors: White 6 Grey 23 Tan 24

Rods: Red 3 Yellow 8 Blue 6 White 9 Green 4



Educational objective

To investigate and understand the structure and functions of each part of a human skeleton, and to model these

☑Cross-curricular links

None

√ Before starting

√ Consider showing the children a picture of a human skeleton

→ Conclusion

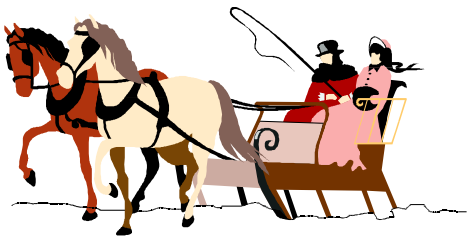
→ Ask the children to do certain physical tasks (stand up, sit down, lie down, etc), which they must do and their skeletons must do

→ Ask them where the main body organs can be found in their skeleton (heart, lungs, brain, etc)

⇒ Possible follow-on activities

⇒ Investigate the skeletons of different animals

Sleigh



Dashing through the snow … in a one-horse open sleigh … but first we need a sleigh! Could you make one out of K'NEX?

Have you ever been on a sleigh ride in the snow? What shape was the sleigh? Can you make one out of K'NEX that will slide easily down a slope?

For level 2, could you make two small models of people? Where will they go in the sleigh? Will they be sitting down?

For level 3, put your sleigh on the board, and increase the angle of the slope until the sleigh starts to slide. Can you think of anyway that you can improve your sleigh, to make it slide easier?

Levels of difficulty

Level 1	✓5	Make a simple sledge or sleigh with runners
Level 2	✓5	Make two people to sit in it
Level 3		Test the sleigh on a slope, and improve it so that there is minimum friction between the runners and the ground

Equipment needed:	**K'NEX** Discovery set
Test area	*A smooth plywood board or other fairly smooth surface which can be set at different angles of slope*

☺ Handy hints

L1 3 ways to connect rods and connectors

L3 Making corners with blue and purple connectors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R2 Blue and purple connectors won't join together

R3 Model is not strong enough

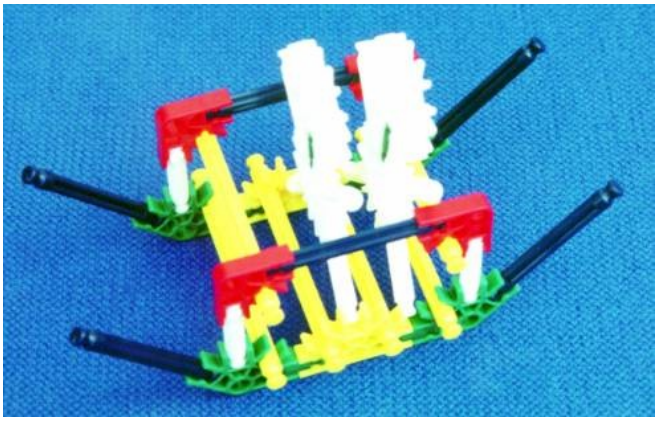
For teachers

Key topics: Forces **Designing skills** **Making skills**

Components used in sample level 3 model below

Connectors: White 4 Yellow 2 Green 4 Red 4

Rods: Yellow 6 Blue 6 White 12 Green 2



Educational objective

To build a sleigh, and use for an experiment with friction

☑Cross-curricular links

None

√ Before starting

None

→ Conclusion

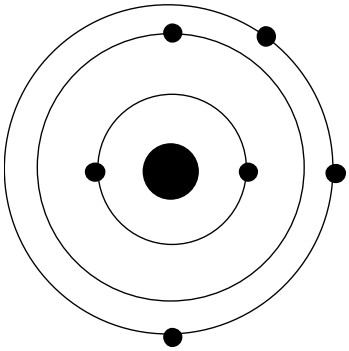
→ Test each sleigh the class has made, and see which starts to move on the least angle of slope. Ask the class to think of the factors that might affect this (eg shape of runners, centre of gravity).

→ Ask each pair to carry out an experiment in which they add small weights one at a time to their sleigh, and then lift one end of the board until the sleigh starts to slide. The results (weight and angle) should be recorded in a table and in a graph.

⇒ Possible follow-on activities

None

Solar system



Does the earth go round the sun, or does the sun go round the earth? How many of the planets can you name? Could you make a simple model of the solar system?

Levels of difficulty

Level 1	Make a circle out of K'NEX to represent the sun
Level 2	As level 1, and put the circle flat on a stand, with arms coming out from the stand that can spin round
Level 3	As level 2, and add a model of a planet at the end of each arm.

Equipment needed: **K'NEX** Discovery set

How can you make a circle out of K'NEX? It won't be quite spherical, but it doesn't matter. Make the sun as big as possible, otherwise you will find it impossible to make the planets small enough later on!

For level 2, how could you make a stand for the arms to spin on? Will it be stable enough not to fall over? How long will each arm need to be?

For level 3, can you make a model of a planet at the end of each arm? How big will each planet model need to be? How far should each planet be from the sun?

☺ Handy hints

L1 3 ways to connect rods and connectors

L3 Making corners with blue and purple connectors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R2 Blue and purple connectors won't join together

R3 Model is not strong enough

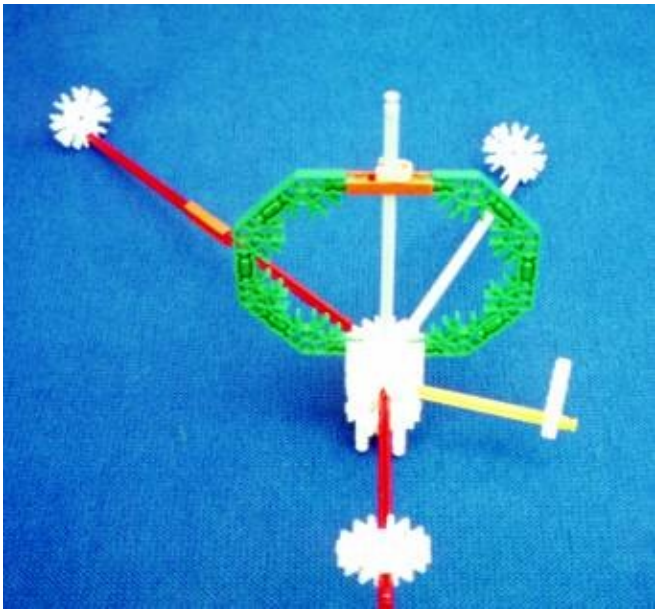
For teachers

Key topics: Earth & Beyond Designing skills Making skills

Components used in sample level 3 model below

Connectors: White 10 Green 8 Orange 2 Tan 3

Rods: Grey 2 Red 3 Yellow 1 White 4 Green 8



Educational objective

To make an approximate model of the solar system

☑Cross-curricular links

None

√ Before starting

√ Provide a map of the solar system, which shows the names of the planets, their distances from the sun, and the diameters of the sun and all the planets

→ Conclusion

→ Ask the children to name their planets and show how they orbit the sun

→ Ask how close they have managed to make the relative size of each planet and the sun

→ Explain that the real planetary orbits are elliptical, not circular (this can be done with K'NEX, but is quite difficult)

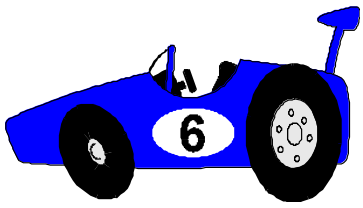
→ Ask them to show where the Moon would be found, and how it moves

⇒ Possible follow-on activities

⇒ Watch a video of the solar system

⇒ Visit to a planetarium

Speed trials



The British Grand Prix starts tomorrow. In the last practice lap, the world champion's car spins off and is wrecked. Can you help, by building a brand new Grand Prix racing car for him?

Levels of difficulty

Level 1	✓5	Make a simple racing car
Level 2		As level 1, with a spring motor
Level 3		As level 2, that will travel at least 3 metres

Equipment needed:	**K'NEX** Discovery set
For level 2:	Spring motor

What is the best shape for a racing car? Where will the wheels go? Where does the driver sit?

For level 2, how can you make the spring motor drive the wheels? How will the motor fasten on to the body?

For level 3, test your car. Will it travel 3 metres? If not, can you improve your car to make it travel further? What would happen if you tested it on a different surface?

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L5 Wheels and tyres
L6 Making rods turn with wheels or connectors
M1 Spring motors

☹ Troubleshooting tips

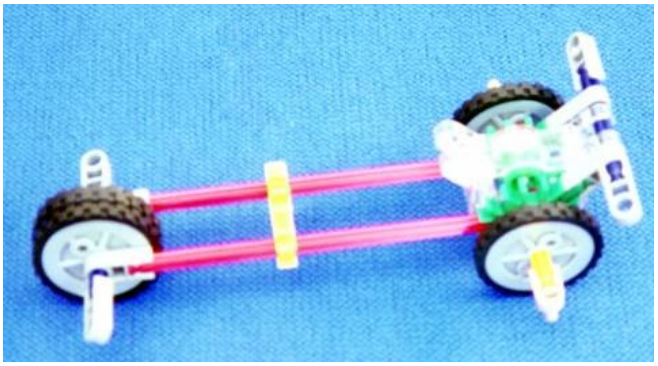
R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily
S1 Rod won't go into motor
S2 Motor won't turn the wheels
S3 Can't connect my motor to my model

For teachers

Key topics: Forces Designing skills Mechanisms Making skills

Components used in sample level 3 model below

Connectors: Yellow 1 Green 2 Grey 8 Tan 4
Rods: Red 2 Yellow 1 Blue 1 Green 2
Small wheel/tyre 4 Spring motor



Educational objective

To make a working model of a racing car, and to use it for an experiment into the forces that affect the speed of a car

☑Cross-curricular links

None

√ Before starting

√ Look at pictures of old cars and new cars, to see how much importance is now attached to reduced air resistance

→ Conclusion

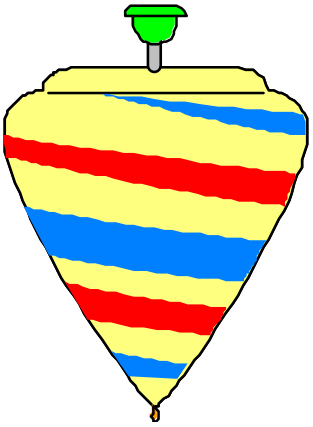
→ Test the level 2 cars. Hold a competition to see which car can travel the furthest across a hall floor. Discuss the best features of the winning design.

⇒ Possible follow-on activities

None

Spinning tops

Round and round and round they go… Faster and faster… Colours that blend as they spin…See for yourself with the Spinning Tops Challenge!



What will your top look like? What colour connector will you need to put on the spinner base? What colour rods will you attach to it? How long will it spin for?

For level 2, how could you use three different colours in the spinning part of your top?

For level 3, what design of top spins for longest? Can you make three tops of the best design all stay spinning at the same time?

Levels of difficulty

Level 1 ✓5 Make a simple spinning top

Level 2 ✓5 As level 1, with three different colours that blend as the top spins

Level 3 ✓5 Make three tops, and have them all spinning at the same time

☺ Handy hints

L1 3 ways to connect rods and connectors

M4 Spinner stems

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

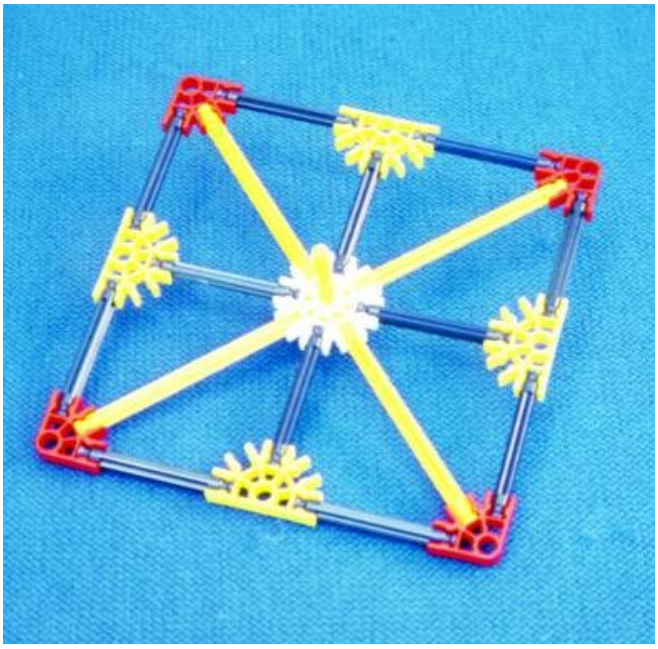
Equipment needed: **K'NEX** Discovery set
3 K'NEX spinner stems

For teachers

Key topics: Designing skills
Making skills

Components used in sample level 2 model below

Connectors: White 1 Yellow 4 Red 4
Rods: Yellow 4 Blue 12
Spinner stem



Educational objective

A simple project to make an object, test it, and as a result of the testing improve it

☑Cross-curricular links

☑ Art - colour

☑ Maths - symmetry

√ Before starting

None

→ Conclusion

→ Ask what colours are formed when the different colours blend

→ Count the number of different designs that have been made and colours that have been used

⇒ Possible follow-on activities

None

Spotlight

The spotlight is on YOU … to make a K'NEX model that can throw light on anything!

What shape is your torch? How could you make a frame out of K'NEX that will hold the torch?

For level 2, how can you make a strong stable base? How might you fasten the torch holder onto the base so that the torch can point in any direction?

For level 3, how could add a mechanism to your model that will enable the torch to be pointed up or down at a set angle, as well being moved around?

Levels of difficulty

Level 1	✓5	Make a K'NEX holder for a torch
Level 2	✓5	As level 1, and fasten the holder onto a base so the torch can be turned around to point in any direction
Level 3		As level 2, and add a means by which the torch can be pointed at a set angle downwards or upwards as well

☺ Handy hints

L1 3 ways to connect rods and connectors

L3 Making corners with blue and purple connectors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R2 Blue and purple connectors won't join together

R3 Model is not strong enough

Equipment needed:	**K'NEX** Discovery set Hand torch
Test area:	*Table in a darkened room*

For teachers

Key topics: Light **Designing skills**

Mechanisms **Making skills**

Components used in sample level 2 model below

Connectors: White 8 Blue 8 Purple 8 Red 8 Orange 1 Grey 8 Tan 4
Light grey 2

Rods: Grey 1 Red 4 Yellow 8 Blue 18 White 5 Green 18
Torch

Educational objective

To build a mechanism that will point a beam of light in any vertical or horizontal direction

☑Cross-curricular links

☑ Art - lighting in theatres

√ Before starting

√ Look at an example of a spotlight used to illuminate a stage

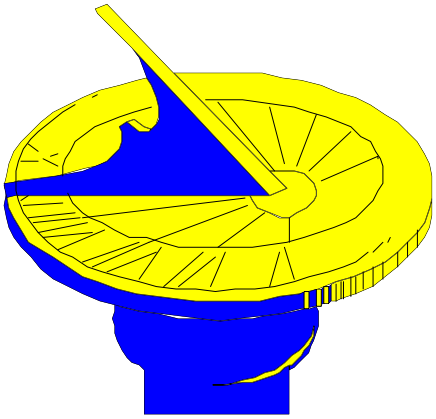
→ Conclusion

→ Stand all the models around the edges of a table in a darkened room. Ask the children to make their beam of light follow a model of an 'actor' as he or she moves across the table

⇒ Possible follow-on activities

⇒ Use the models to provide the lighting for a puppet show

Sundial



How did people know what time it was before clocks were invented? They sometimes used sundials, in which the sun cast a shadow on a dial marked out with the daylight hours. Could you make one?

First find a sunny day! Then think how you could make an octagon (an eight-sided 2-D shape) out of K'NEX. How can you make a rod stick up from the middle at an angle of 45 degrees?

For level 2, how can you make a stand that will hold the sundial about 1m up in air? Will it have feet to give it stability?

For level 3, cut your card to match the octagon shape. See how the shadow falls. How can you mark out where the shadow will be for each daylight hour?

Levels of difficulty

Level 1	✓5	Make an octagonal flat surface, with a K'NEX rod sticking out from the middle at a 45 degree angle
Level 2		As level 1, plus a stand to make it about 1m from the ground
Level 3		As level 2, with a sheet of card on the flat surface marked out to show where the shadow is at each daylight hour

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L4 Strong 3-D structures

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough

Equipment needed:	**K'NEX** Discovery set
For level 3:	Sheet of thin card

For teachers

Key topics: Earth & beyond Designing skills
Structures Making skills

Components used in sample level 3 model below

Connectors: White 5 Blue 1 Purple 1 Red 3 Grey 8
Rods: Red 25 Yellow 4
Thin card

Educational objective

To make an instrument that will measure time. To determine how the sun's position relative to the earth creates different shadows

☑Cross-curricular links

☑ Maths - measuring

√ Before starting

√ Ask the class to stand outside in the sun to create shadow of themselves, and to predict what will happen to their shadow as the day draws on

→ Conclusion

→ Set up the sundials in a place where there will be in the sun (if any!) all day, and put the rod that sticks up (the gnomon) pointing South. Then ask the children to mark out on each hour the position of the shadow and its length, and write down the hour by it.

⇒ Possible follow-on activities

⇒ Discuss why the gap between the hours is larger and the shadows are longer at the beginning and end of the day, using a model of the sun and the earth spinning round

Suspension bridge

Suspension bridges are often used to cross rivers and sea channels which are too wide for any other sort of bridge. Could you make one out of K'NEX?

K'NEX is strong enough to make a free-standing 2m bridge, but for this challenge you are only allowed to make a 2-D structure for the roadway. What rods and connectors will you use? Will you need to reinforce the roadway with diagonals to make it stronger?

For level 2, how will you make two strong towers? How tall do you think they should be? Can you make them stable, so they don't fall over easily?

For level 3, how many lengths of string will you need? Where will you fasten them onto the roadway and onto the tower? Will you need to 'anchor' the ends of the roadway?

Levels of difficulty

Level 1	Make a 2m roadway out of a single layer of K'NEX rods and connectors
Level 2	As level 1, plus two towers to support the bridge and place them on either side of a 1m gap
Level 3	As level 2, and support the roadway from the towers using string, to make a suspension bridge

Equipment needed:	**K'NEX** Giant set
Test area:	*1m gap between two tables*

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L4 Strong 3-D structures

☹ Troubleshooting tips

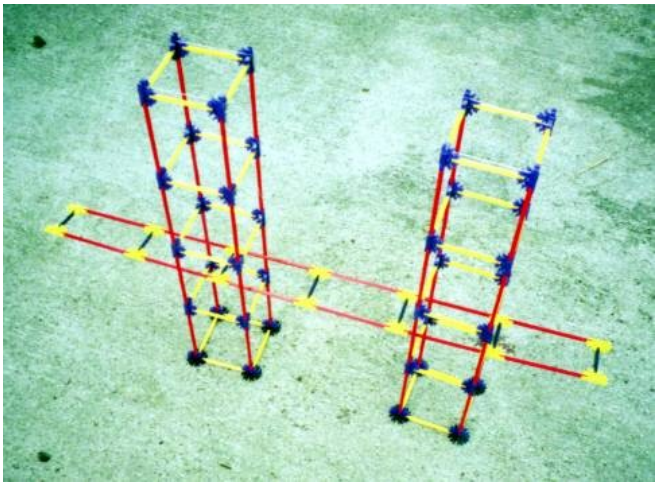
R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough

For teachers

Key topics: Structures **Designing skills**
Forces **Making skills**

Components used in sample level 2 model below

Connectors:	Blue 8 Purple 72 Yellow 14
Rods:	Red 44 Yellow 48 Blue 7
	String 4



Educational objective

A challenging project, to build a strong structure with similar design problems to a real-life structure

☑Cross-curricular links

☑ Geography - rivers and sea

√ Before starting

√ Provide the class with a picture of a suspension bridge

→ Conclusion

→ Compare the different models that have been built, and ask the children what problems they had to overcome

→ Test which bridge can support the most weight in the centre, and discuss what causes each bridge to fail when it is loaded

→ Ask the children to improve their models so they span a wider gap

⇒ Possible follow-on activities

⇒ Project on different types of bridges and when they might be used

Swing

Our children's playground needs a new swing. Could you make one for us?

Levels of difficulty

Level 1 ✓5 Make a simple swing

Level 2 ✓5 Make a swing large enough for a small doll to swing on

Level 3 ✓5 As level 2, with feet on the swing so the doll can swing really high!

Equipment needed: **K'NEX** Discovery set
Doll about 30cm high

How does a swing work? Can you make one out of K'NEX? How will you make the seat? How will you make it swing?

For level 2, what size do you need to make your swing so the doll can sit on it? Will your swing be strong enough to take the doll's weight? Will the doll need a harness to keep it in its seat?

For level 3, push your doll to make the swing go quite high. If your swing falls over, how can you put feet on it to make it more stable?

☺ Handy hints

L1 3 ways to connect rods and connectors

L3 Making corners with blue and purple connectors

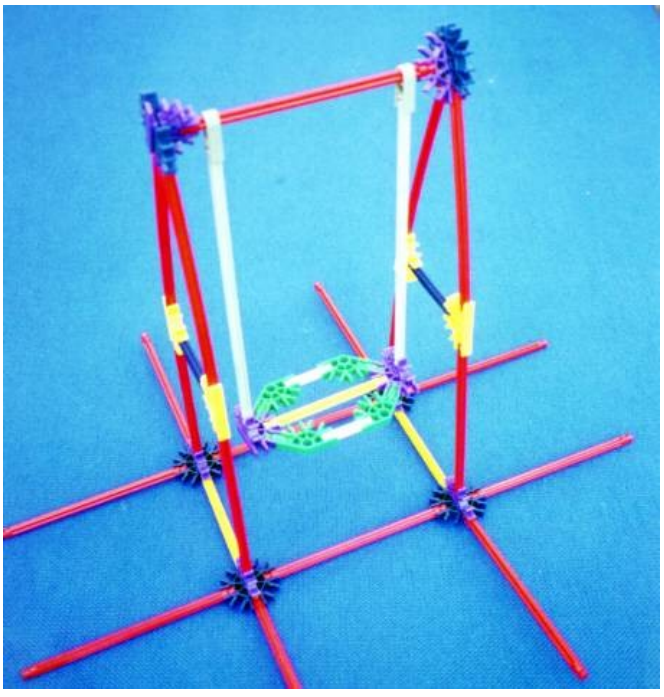
L9 Hinges

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R2 Blue and purple connectors won't join together

R3 Model is not strong enough



For teachers

Key topics: Forces **Designing skills**
Mechanisms **Making skills**

Components used in sample level 3 model below

Connectors: Blue 6 Purple 10 Yellow 4 Green 4 Grey 2

Rods: Grey 2 Red 18 Yellow 3 Blue 2 White 2 Green 4

Educational objective

A project for younger children involving pushes and pulls, and simple structures

☑Cross-curricular links

None

√ Before starting

√ Look at a picture of a swing, or visit a playground

→ Conclusion

→ Ask the children to think of two ways they can make the doll swing (pushing and pulling)

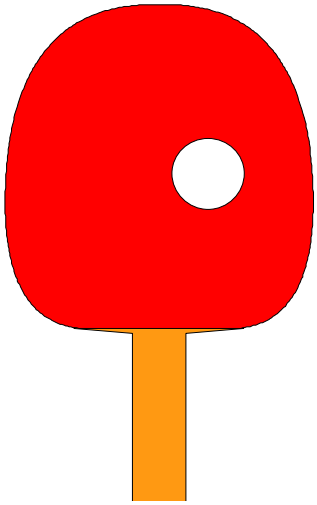
→ Compare the different ways the models have been built to give them strength and stability

⇒ Possible follow-on activities

⇒ Make models of some other simple items of playground equipment

Table tennis

To play table tennis you need to have a good eye for a ball, fast reflexes and a high degree of concentration. But first you need a table tennis bat and a net…



How will you make your bat? What part of the bat will hit the ball? How will you hold the bat? Will the bat be strong enough if you hit the ball hard?

For level 2, how long will your net have to be to reach across the table? How can you make it stand upright?

For level 3, find a friend and have a go! If your bat breaks or won't hit the ball straight, how could you improve it?

☺ Handy hints

L1 3 ways to connect rods and connectors

N2 Correx/Cardboard panels

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R2 Blue and purple connectors won't join together

R3 Model is not strong enough

Levels of difficulty

Level 1	Make a table tennis bat
Level 2	As level 1, plus a table tennis net
Level 3	As level 2, and play a rally of five shots with your bat over the net with a friend

Equipment needed:	**K'NEX** Discovery set Sheet of Correx or cardboard 17cm square Table tennis ball
Test area:	*A large table*

For teachers

Key topics: Designing skills

Making skills

Components used in sample level 3 model below

Connectors: White 2 Green 16 Grey 14

Rods: Red 2 Blue 16 White 7

17cm panel

Educational objective

To design and make an item of sports equipment, and use it to play a game

☑Cross-curricular links

☑ Physical education - games

√ Before starting

√ Look at an example of a real table tennis bat

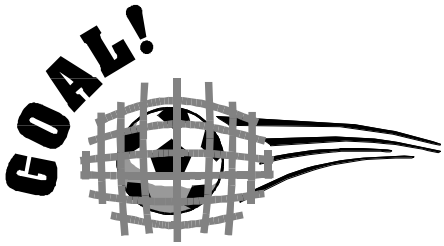
→ Conclusion

→ Compare the different designs

⇒ Possible follow-on activities

⇒ Table tennis tournament using K'NEX bats

Table-top football



Football's coming home…to the table top. We have the technology - all we need now are some teams!

Levels of difficulty

Level 1	Make a football player who can 'kick' the ball
Level 2	As level 1, plus 9 other players, a goalkeeper and a net
Level 3	As level 2, make a scoreboard, and play a football match against another team

Equipment needed:	**K'NEX** Discovery set Table tennis ball
Test area:	*Table top*

What colour will your team be? How can you make a football player that can stand up on a table top? How will the player kick the ball? Does the ball go in the right direction? How will you move the player along the table top?

For level 2, how will you make your goalkeeper? What will your net look like?

For level 3, what will your team be called (we liked K'NExeter City!)? Where will your players stand to start the match? How will your scoreboard keep the score? What will the rules be?

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
N3 Electrical circuits

☹ Troubleshooting tips

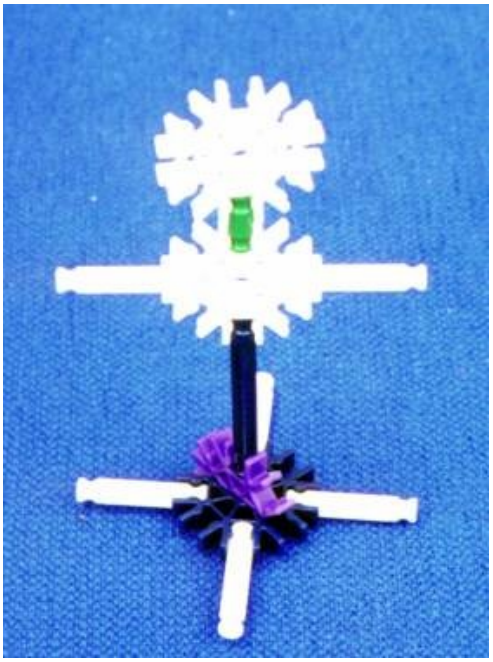
R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough

T1 Crocodile clips won't attach

For teachers

Key topics: Designing skills
Making skills

Components used in sample level 1 model below
Connectors: White 2 Blue 1 Purple 1
Rods: Blue 1 White 6



Educational objective

To design and build models that will perform a specific function, and to invent the rules for a new game

☑Cross-curricular links

None

√ Before starting

√ If possible, let the class play with a table-top football game such as Subbuteo™

→ Conclusion

→ Compare the different models made

⇒ Possible follow-on activities

⇒ Hold a table-top football tournament

Tennis

It's Wimbledon fortnight. Make yourself a tennis racquet, and join in the fun!

Think about your tennis racquet. What shape will the part be that hits the ball? What sort of handle will it have?

For level 2, how can you use K'NEX to make a strong flat surface? How can you make a strong handle, and attach it effectively?

For level 3, test your racquet until you are sure that it won't break, and that the ball can be hit the way you want it to go. Now find another player (they can use an ordinary tennis racquet if they want) … and away you go!

Levels of difficulty

Level 1	✓5	Make a simple tennis racquet
Level 2		Make a tennis racquet which can hit a ball over the net
Level 3		As level 2, and complete a rally of five shots with another player

☺ Handy hints

L1 3 ways to connect rods and connectors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R3 Model is not strong enough

Equipment needed:	**K'NEX** Discovery set Sponge tennis ball
Test area:	*Tennis court, or a short tennis net set up on a playground*

For teachers

Key topics: Designing skills

Making skills

Components used in sample level 3 model below

Connectors: White 25 Green 14

Rods: Red 4 Blue 16 White 51

Educational objective

To design and build an item of sports equipment, and to play a game with it

☑Cross-curricular links

☑ Physical education - tennis

√ Before starting

√ Look at a real tennis racquet

→ Conclusion

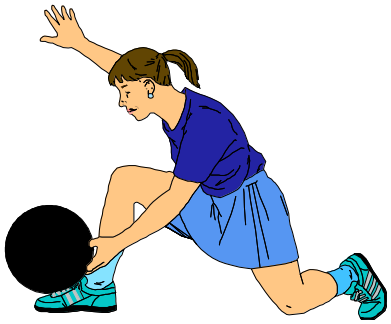
→ Compare the different designs

⇒ Possible follow-on activities

⇒ Hold a tennis tournament

Ten-pin bowling

You'll be bowled over by this game. First make ten skittles … then away you go!



How can you make a skittle that will stand up well? Don't make it too stable, or you won't be able to knock it over!

For level 2, make sure that all your skittles are exactly the same.

For level 3, what shape are you going to make when you place your 10 skittles? A diamond? A triangle? How far away will you roll the ball from? What will the rules of your game be?

Levels of difficulty

Level 1 ✓5 Make a skittle which will stand upright
Level 2 ✓5 Make ten skittles
Level 3 ✓5 As level 2, and play a game with them

Equipment needed:	**K'NEX** Discovery set Tennis ball
Test area:	*Smooth floor*

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough

For teachers

Key topics: Designing skills
Making skills

Components used in sample level 3 model below
Connectors: White 1 Blue 1 Purple 1
Rods: Red 1 White 4

Educational objective

To design and make the equipment for a game, invent some rules, and then play

☑Cross-curricular links

None

√ Before starting

√ Discuss possible rules for the game

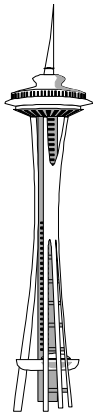
→ Conclusion

None

⇒ Possible follow-on activities

⇒ Hold a ten-pin bowling tournament (children v. parents at a school fete?)

Tower of strength



To celebrate the Millennium, we want to build a Millennium Tower, the tallest in the UK. But first we need your help to make a scale model, with an eye-catching design, and great strength. Can you help?

Levels of difficulty

Level 1	✓5	Make a tower 0.5m high
Level 2		Make a tower 1m high
Level 3		Make a tower 2m high

Equipment needed: **K'NEX** Giant set

What will be the best design for your tower? Can you make it really strong? Can you make a base to stop it falling over as it gets bigger?

For level 2, can you come up with a pattern that you can continue higher and higher? Does it help if the pattern is symmetrical?

For level 3, have you got enough K'NEX to reach 2m? If not, would it be possible to make the tower thinner at the top than it is at the bottom?

☺ Handy hints

L1 3 ways to connect rods and connectors

L3 Making corners with blue and purple connectors

L4 Strong 3-D structures

☹ Troubleshooting tips

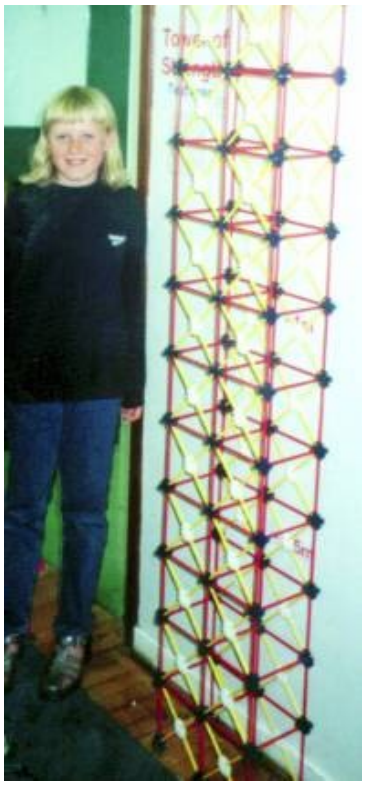
R1 Rods difficult to join to connectors

R2 Blue and purple connectors won't join together

R3 Model is not strong enough

For teachers

Key topics: Structures **Designing skills** **Making skills**



Educational objective

A project to design and build a classic tower structure. Demonstrates very clearly the strengths of K'NEX as a structural system

☑Cross-curricular links

None

√ Before starting

√ Look at some pictures of different types of tower.

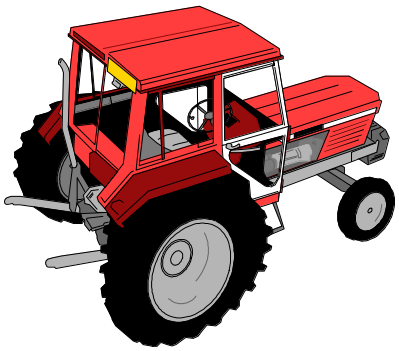
→ Conclusion

→ Test the towers by putting books on the top, to see which is the strongest.

⇒ Possible follow-on activities

⇒ Project on towers around the world

Tractor



Until this century, farmers used horses or oxen to pull carts and help plough the fields. Now tractors are used to do this … and for lots of other purposes as well. Could you make one?

Levels of difficulty

Level 1	✓5	Make a simple model of a tractor
Level 2		As level 1, powered by a battery motor
Level 3		As level 2, with a plough on the back, and the plough the sand in a sandpit

Equipment needed:	**K'NEX** Discovery set
For level 2:	Battery motor
Test area (level 3):	*Sandpit*

What does a tractor look like? What type of wheels does it need? Where does the driver sit?

For level 2, how can you make the motor drive the wheels? How will the motor be fastened to the body?

For level 3, what is the purpose of a plough? How can you make one out of K'NEX? How will it attach to the back of the tractor? Does it work when tested in a sandpit?

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L5 Wheels and tyres
L6 Making rods turn with wheels or connectors
M2 Battery motors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily
S1 Rod won't go into motor
S2 Motor won't turn the wheels
S3 Can't connect my motor to my model

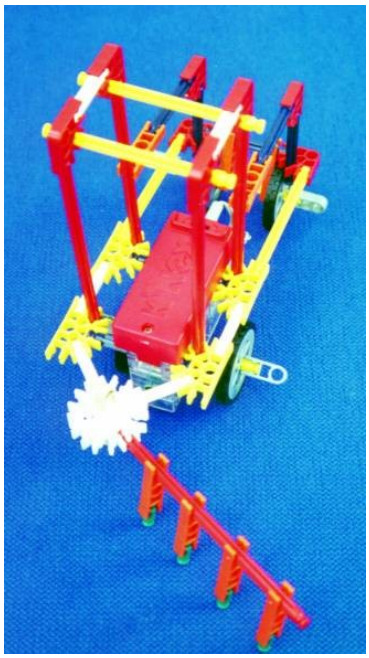
! Warning !

For teachers

Key topics: Forces **Designing skills** **Mechanisms** **Making skills**

Components used in sample level 3 model below

Connectors: White 2 Yellow 4 Red 8 Orange 8 Grey 4 Tan 2
Rods: Red 5 Yellow 5 Blue 7 White 5 Green 4
Small wheel/tyre 4 Battery motor



Educational objective

To build a working model of a familiar mechanical object. To experiment with how a pulling force can be used to plough sand

☑Cross-curricular links

☑ Geography - farming and land use

√ Before starting

√ Discuss ploughing - how it works and why it is needed, and look at a picture of plough

→ Conclusion

→ Compare the different designs for tractors and ploughs

→ See whose tractor can plough the sandpit deepest and in a straight line

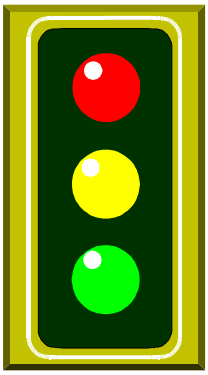
⇒ Possible follow-on activities

⇒ Project on how farmland can be used (pasture, arable, etc)

DON'T get sand into your K'NEX motor!

Traffic lights

When you drive or cycle through a town, there seem to be traffic lights everywhere! Have you ever tried to make a set?



Levels of difficulty

Level 1	✓5	Light up a red LED, then a yellow one, and finally a green one
Level 2		As level 1, with your lights attached one above the other in the correct sequence on a traffic light stand
Level 3		As level 2, make a simple car and road layout, and drive around, stopping at any traffic light on red

Equipment needed:	**K'NEX** Discovery set Battery pack Wires with crocodile clips Red LED Yellow LED Green LED

Look at your battery pack and wires. How do the crocodile clips work? How can you attach the wires from the battery pack to one of the LEDs so that the electricity can go round in a circuit? Does the LED light up? Now try it with the other two LEDs.

For level 2, how can you make a stand to hold your traffic lights. What colour LED should be at the top? And at the bottom?

For level 3, make a simple car. Then with the rest of the class, make a road layout with K'NEX rods and connectors, and put traffic lights at some of the junctions. Drive around with your car … and don't forget to stop at any red lights!

☺ Handy hints

L1 3 ways to connect rods and connectors
L5 Wheels and tyres
N3 Electrical circuits

☹ Troubleshooting tips

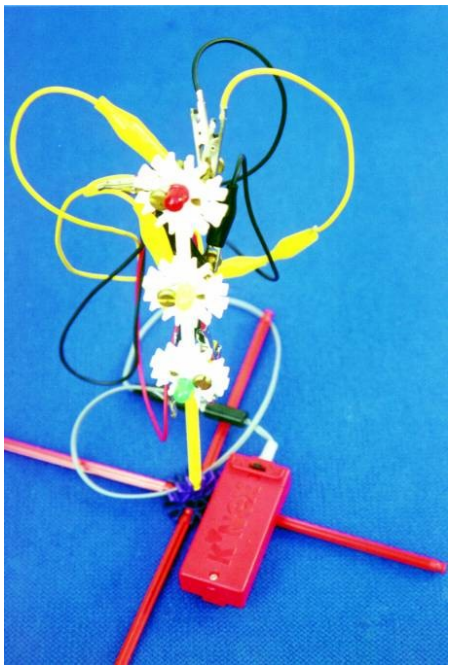
R1 Rods difficult to join to connectors
R4 Wheels won't turn around easily
T1 Crocodile clips won't attach
T3 LED won't light up

For teachers

Key topics: Electricity **Designing skills** **Making skills**

Components used in sample level 3 model below

Connectors: White 3 Blue 1 Purple 1
Rods: Red 4 Yellow 1 White 2
Battery pack Wires LED 3



Educational objective

A good introduction to simple electrical circuits for younger children

☑Cross-curricular links

☑ Geography - transport

√ Before starting

√ Visit a set of traffic lights, and watch them change

→ Conclusion

→ Set up the road layout with sufficient junctions so that every traffic light made can stand at the corner of a junction.

→ Split the class in two, half to operate the traffic lights, and half to drive the cars. Help the traffic light operators work out the sequence of the light changes at a junction, and then away you go!

→ After a little while, swap the car drivers and traffic light operators around

⇒ Possible follow-on activities

⇒ Using the road layout for an exercise in road safety

Umbrella

It never rains but it pours … and we've forgotten to bring our umbrella! Could you make one for us?

What shape is an umbrella? How can you make one out of K'NEX? How big will it be? How can you attach the handle to the spokes?

For level 2, how can you create an opening and closing mechanism? If it doesn't work well, can you improve it?

For level 3, how can you attach your plastic sheet, so it doesn't become detached when you open and close your umbrella? Now open it up, stand underneath it, give a friend a jug of water …. are you really sure you want to do this challenge?

Levels of difficulty

Level 1	✓5	Make a simple umbrella shape
Level 2		Make an umbrella 'skeleton' that can be opened and closed
Level 3		As level 2, turn it into an umbrella with a plastic sheet, and test it!

Equipment needed:	**K'NEX** Discovery set
For level 3:	Plastic sheet
Test area (level3):	*A jug of water and a floor space which doesn't matter if it gets wet*

☺ Handy hints

L1 3 ways to connect rods and connectors

L3 Making corners with blue and purple connectors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R2 Blue and purple connectors won't join together

R3 Model is not strong enough

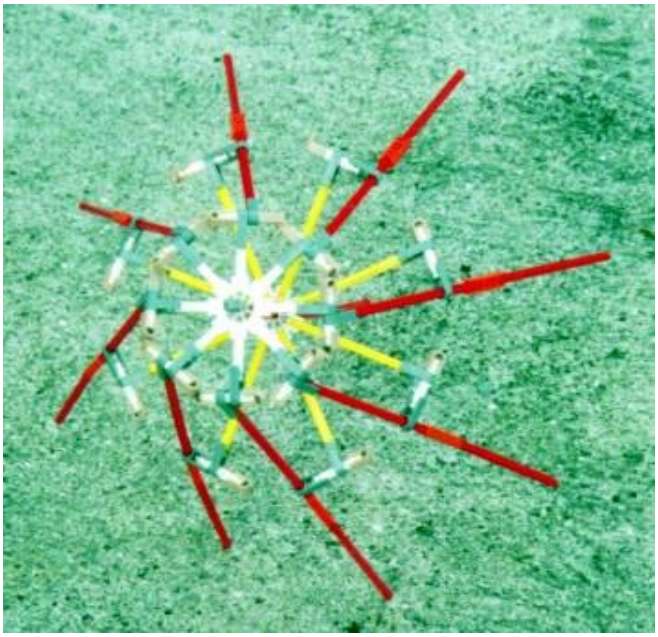
For teachers

Key topics: Mechanisms Designing skills Making skills

Components used in sample level 2 model below

Connectors: Orange 10 Grey 32 Tan 24

Rods: Red 19 Yellow 8 White 24



Educational objective

To design and build a model of a familiar object, and in doing so solve the mechanical problem of an opening/closing mechanism.

☑Cross-curricular links

☑ Geography - weather

√ Before starting

√ Study an example of a real umbrella

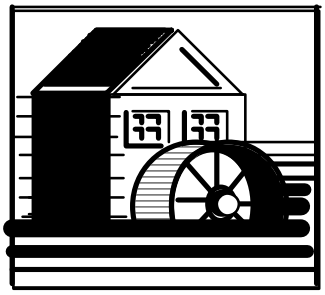
→ Conclusion

→ Compare the different approaches used for the opening and closing mechanism

⇒ Possible follow-on activities

⇒ Project on weather

Water wheel



Water has been used as a source of power for many centuries. In the olden days, many water wheels were built, and used for purposes such as grinding corn. Could you make a model of a water wheel?

What shape is a water wheel? How could you make one out of K'NEX? What shape will your building be? How can you attach the wheel to it?

For level 2, how can you improve your water wheel so that it can be turned by running water? Will it be an 'undershot' wheel (the water flows under the wheel) or an 'overshot' wheel (the water flows over the top of the wheel and down into the buckets). How much water do you need to make the wheel turn?

For level 3, how can you make the wheel turn an axle inside the building? Can you then make the axle turn a millstone?

Levels of difficulty

Level 1	Make a simple model of a water wheel on the side of a model building
Level 2	Make a water wheel that can be turned with running water
Level 3	As level 2, and the wheel turning makes a millstone go round and round

Equipment needed: **K'NEX** Discovery set
Test area (level 2): *Source of running water, and waterproof area to test the waterwheel*

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L5 Wheels and tyres
L6 Making rods turn with wheels or connectors
L7 Pulleys
L9 Making gear wheel from rods and components

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily

For teachers

Key topics: Forces **Designing skills** **Mechanisms** **Making skills**

Components used in sample level 3 model below
Connectors: White 7 Blue 5 Purple 13 Orange 49 Grey 5 Tan 4
Rods: Grey 1 Red 12 Yellow 12 Blue 24 White 1 Green 18

Educational objective

An interesting project to make the force of running water turn a wheel, and (for level 3) a millstone

☑Cross-curricular links

☑ Geography - rivers and streams

√ Before starting

√ Look at pictures of water wheels and millstones, and if possible visit a working water wheel

→ Conclusion

→ See which design is most efficient, in that it works with the smallest flow of water

→ Ask the children to draw diagrams of their models, showing how the force of the water causes the various components to turn

⇒ Possible follow-on activities

⇒ Make a landscaped model to site the waterwheel in, with a mill stream to provide the water

Weather vane

Is it windy today? How do you know which way the wind is blowing? It could be very important to know if you are about to take off in an aeroplane!

Have you ever seen a weather vane? It has an arrow on the top which always points downwind, and often a model on top of the arrow such as a cockerel. How can you make an arrow out of K'NEX? Are you going to put a model on the arrow? Can you make a base, on which the arrow will spin round freely?

For level 2, how can you make a stand beneath the base? Will it stand up in a strong wind? How can you add indicators to show the four directions of the compass?

For level 3, test your model in a strong wind. Does the arrow point downwind? If not, how can you change the arrow to 'catch' the wind in the right way?

Levels of difficulty

Level 1	Make a simple model of a weather vane that can spin on a base
Level 2	As level 1, and put it on a stand, with indicators to show North, East, West and South
Level 3	As level 2, and test the design in a strong wind so that the weather vane always points downwind

Equipment needed:	**K'NEX** Discovery set
Test area:	*Outside on a windy day, or inside using a powerful desktop fan*

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L4 Strong 3-D structures
L6 Making rods turn with wheels or connectors

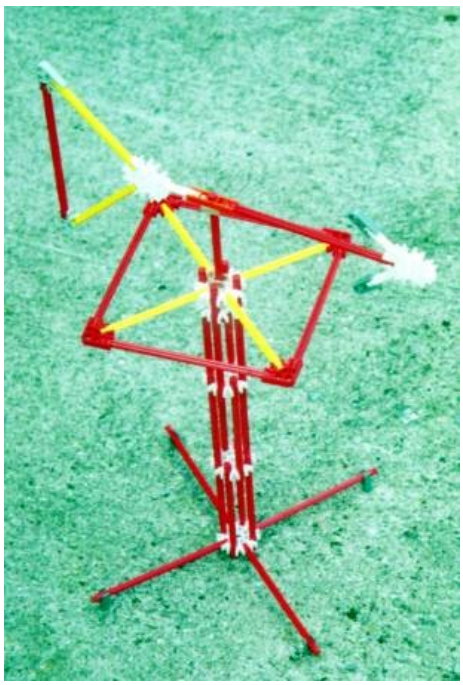
☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily

For teachers

Key topics: Forces **Designing skills** **Making skills**

Components used in sample level 3 model below
Connectors: White 7 Orange 1 Grey 6 Grey 3 Light grey 2
Rods: Red 23 Yellow 6 White 3



Educational objective

A project to determine how the force of the wind can be applied to the turning of an arrow

☑Cross-curricular links

☑ Geography - compass directions, wind

√ Before starting

√ Look at a picture of a weather vane

→ Conclusion

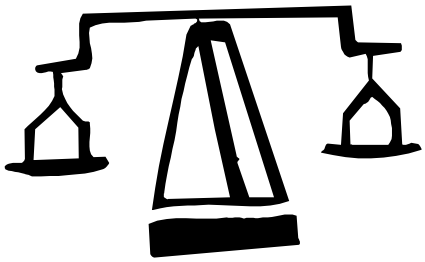
→ Check that all weather vanes really do point downwind

→ See which weather vane needs the least wind to operate correctly

⇒ Possible follow-on activities

⇒ Project on wind

Weighing machine



Have you ever made a cake, and had to weigh the ingredients? What sort of scales did you use?

Levels of difficulty

Level 1	✓5	Make a simple set of scales, and use them to weigh different numbers of K'NEX connectors
Level 2		As level 1, and attach a spring under the arm at one side, so that putting a weight on the other end stretches the spring
Level 3		As level 2, calibrate the scales using weights, and then weigh some K'NEX connectors

Equipment needed:	**K'NEX** Discovery set Set of weights
For level 2:	Spring
For level 3:	Thin card, for calibrations

What will your scales look like? How can you make a 'pivot' in the centre, and attach an arm to it? Do your scales balance when there is no weight on them? Can you put a pan at each end of the arm, one to hold the weights, the other to hold the objects you are weighing? Do your scales work?

For level 2, how can you attach a spring to your model, so that putting weight on one end of the arm extends the spring at the other?

For level 3, attach an upright piece of card to one side of the spring end. Mark with a pencil where the arm is when there is no weight on the other end. Then add small equal weights one at a time, and each time put a new pencil mark. Can you use your scales to weigh K'NEX connectors now?

☺ Handy hints

L1 3 ways to connect rods and connectors
L12 Pivots
N5 Springs

☹ Troubleshooting tips

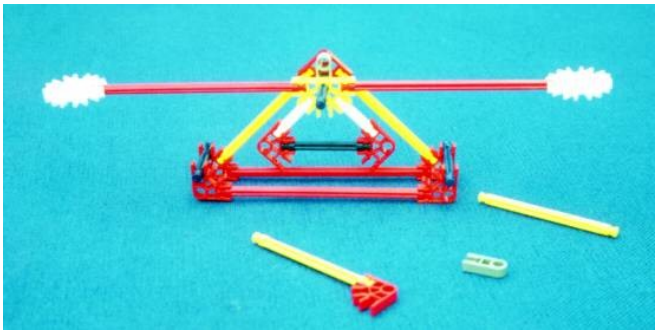
R1 Rods difficult to join to connectors
R3 Model is not strong enough

For teachers

Key topics: Forces **Designing skills** **Making skills**

Components used in sample level 1 model below

Connectors: White 2 Yellow 1 Red 8 Grey 2
Rods: Red 4 Yellow 4 Blue 4 White 2



Educational objective

A project on balanced and unbalanced forces, and the effects of stretching a spring

☑Cross-curricular links

☑ Maths - measuring

√ Before starting

√ Look at different ways of measuring weight

→ Conclusion

→ Draw a diagram of the scales, showing the forces involved

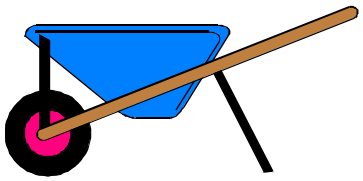
→ Ask each pair of children to weigh a number of white connectors, and compare their results

→ For older children, record the results in a table and graph, and calculate the mode, median and mean

⇒ Possible follow-on activities

⇒ Make some scales in which the compression of a spring is used to measure the weight

Wheelbarrow



Have you ever helped with gardening? Did you use a wheelbarrow? They can be very useful to carry all sorts of things - soil, weeds, grass, cuttings, bricks … Why do you think is it easier to push things in a wheelbarrow than to carry them in your arms?

Levels of difficulty

Level 1	✓5	Make a simple model of a wheelbarrow
Level 2		As level 1, that can carry a book
Level 3		As level 1, that can carry a house brick

Equipment needed:	**K'NEX** Discovery set
For level 2:	Small book
For level 3:	House brick (or similar)

What shape is a wheelbarrow? Where does the wheel go? Where can you put the objects you are carrying? What sort of handles does it have?

For level 2, is your wheelbarrow large enough to carry the book? Will it take the weight without breaking or bending too much?

For level 3, if your wheelbarrow breaks, how could you make it stronger?

☺ Handy hints

L1 3 ways to connect rods and connectors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R3 Model is not strong enough

For teachers

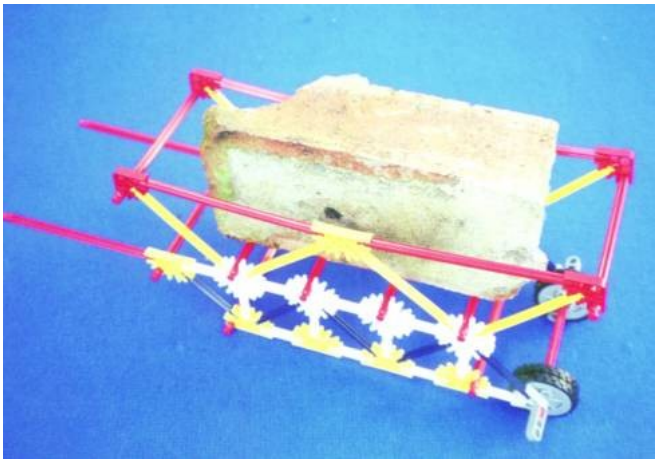
Key topics: Forces **Designing skills** **Mechanisms** **Making skills**

Components used in sample level 3 model below

Connectors: White 8 Yellow 12 Red 4 Grey 4

Rods: Red 16 Yellow 8 Blue 10 White 24

Small wheel/tyre 4



Educational objective

To build a working model, and use it to carry out an experiment with levers

☑Cross-curricular links

None

√ Before starting

√ Look at a real wheelbarrow if possible

→ Conclusion

→ Compare the different designs

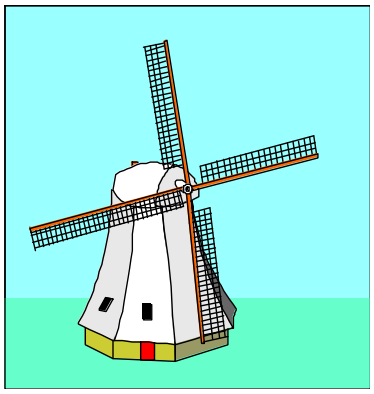
→ With the house brick in the wheelbarrow, try lifting the brick with the fingers at different positions along the handle. Is it easier to lift as your finger moves towards the end of the handle? Why is this? (the wheelbarrow is acting as a lever)

→ If you have a spring balance, use to this to measure the force needed to lift the brick at different positions along the handle

⇒ Possible follow-on activities

⇒ Look at different types of levers, and where they are used

Windmill



You have been stranded on a desert island in the middle of the Pacific ocean. The only plant growing on the island is fuji-wuji grass, a sort of wheat. Could you build a windmill, which can crush the wheat grains to make flour, so you can bake bread to eat? And could you also build a large hammer in the windmill, which goes up and down when the wind blows? You will need this to crush the straw left over from the wheat into strawboard, to make a raft to escape on.

Levels of difficulty

Level 1	✓5	Make a windmill, with sails that will go round and round when you turn a handle
Level 2		As level 1, with a moving grindstone which turns above a fixed grindstone when the sails turn
Level 3		As level 2, plus a hammer that goes up and down when the sails turn

Equipment needed: **K'NEX** Discovery set

Why not start by making a 3-D frame for your windmill? Then you can make the sails, and think about how to attach them to the frame so that they turn easily. Now make a handle, which can turn the sails for you.

If you are moving on to level 2, think about how you can change the vertical rotary motion of the sails into a horizontal rotary motion for the grindstones. Also, how can you make the sails turning up in the air turn a grindstone which is near the ground?

For level 3, you will need to think about how the rotary motion in your windmill can be turned into an up-and-down (linear) motion for the hammer.

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L5 Wheels and tyres
L6 Making rods turn with wheels or connectors
L7 Pulleys
L8 Handles

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily

For teachers

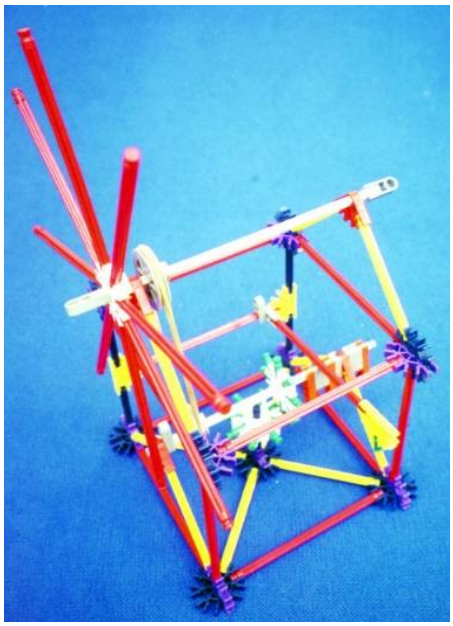
Key topics: **Forces** **Designing skills** **Mechanisms** **Making skills**

Components used in sample level 3 model below

Connectors: White 2 Blue 9 Purple 9 Yellow 3 Red 4 Orange 3 Grey 10 Tan 4

Rods: Grey 2 Red 20 Yellow 12 Blue 5 Green 17

Small wheel 2 Rubber band



Educational objective

To show that the force of a wind blowing in a straight line can be converted to rotary motion, and that pulleys, gears, cams and levers can be used to transfer that rotary motion

☑Cross-curricular links

☑ History - use of windmills

√ Before starting

√ Find examples of gears, levers, cams and pulleys. Look at some pictures of windmills, and find out why windmills were used

√ If possible, look at a picture showing the internal workings of a windmill which was used to grind corn

√ Visit a local working windmill (if you have one!)

→ Conclusion

→ Ask the children to draw a diagram of the windmill. This should include arrows to show how the wind blowing causes the sails to turn, and all other moving parts.

→ Then (for levels 2 and 3) ask them to write underneath their diagram an explanation of how the force from the wind is transmitted through the moving parts to grind the corn and make the hammer move up and down.

⇒ Possible follow-on activities

⇒ Discuss where windmills are best sited and why

Wheelchair

Have you ever seen someone going along in a wheelchair? Did the person in the wheelchair propel themselves, or was there someone pushing them, or did the wheelchair have a motor? Was it easy for them to travel along, or were there lots of obstacles in the way?

What shape is a wheelchair? Where do the wheels go? Where does the person sit? Can you make one large enough for your doll?

For level 2, think about how your wheelchair can be pushed round a corner. Will it have swivel wheels on the front, or can you think of another way of steering it?

For level 3, push your wheelchair around the school. If you find anywhere that the wheelchair can't go, write down what it is and where it is on a piece of paper. How do you think the obstacle could be removed or circumvented?

Levels of difficulty

Level 1	✓5	Make a simple model of a wheelchair for a large doll
Level 2		As level 1, plus swivel wheels on the front to go around corners
Level 3		As level 2, and use it to carry out a wheelchair accessibility survey in your school

☺ Handy hints

L1 3 ways to connect rods and connectors
L3 Making corners with blue and purple connectors
L5 Wheels and tyres

☹ Troubleshooting tips

R1 Rods difficult to join to connectors
R2 Blue and purple connectors won't join together
R3 Model is not strong enough
R4 Wheels won't turn around easily

Equipment needed:	**K'NEX** Discovery set
	Large doll

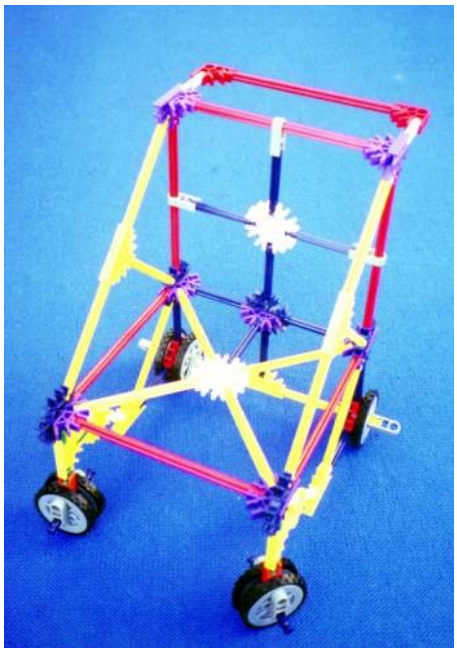
For teachers

Key topics: Forces **Designing skills** **Mechanisms** **Making skills**

Components used in sample level 3 model below

Connectors: White 2 Blue 5 Purple 9 Yellow 9 Red 6 Orange 2 Grey 11

Rods: Red 7Yellow 14 Blue 9 White 6 Green 6 Small wheel/tyre 8



Educational objective

To consider the problems experienced by a wheelchair-based person

☑Cross-curricular links

None

√ Before starting

√ Ask a wheelchair user to come into school, to demonstrate their wheelchair, and talk about some of the access problems they experience

→ Conclusion

→ Ask each pair of children to carry out the accessibility survey, and compare the results

→ Hold a discussion on how each obstacle or access problem can be overcome (ramps, lifts, moving furniture, etc)

⇒ Possible follow-on activities

⇒ Ask them to consider wheelchair accessibility everywhere they go for the next week (shops, etc)

Yacht

What could be more fun than sailing across the sea in a yacht on a sunny day? Have you ever been on a yacht, or watched one sailing? Could you make a model of a yacht that really sails?

What shape will your yacht be? Where will you put the mast? What rods and connectors will you need?

For level 2, what shape sheet will you need to cut out? How can you attach it to the hull? Does it let in any water when you test it?

For level 3, what shape will your sail be? How can you attach it to the mast? If it doesn't catch the wind and make the yacht move, how can you improve it? If your boat capsizes when the wind blows, how can you prevent this?

Levels of difficulty

Level 1	✓5	Make a simple model of a yacht without sails
Level 2		As level 1, and put plastic sheet around the hull so that it floats
Level 3		As level 2, and add a sail so that it moves along when the wind blows

☺ Handy hints

L1 3 ways to connect rods and connectors

N4 Plastic sheet

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R3 Model is not strong enough

T7 Boat capsizes too easily

Equipment needed:	**K'NEX** Discovery set
For level 2:	Plastic sheet
Test area (level 2):	*Trough of shallow water*

For teachers

Key topics: Forces **Designing skills** **Making skills**

Components used in sample level 3 model below

Connectors: Yellow 6 Red 4 Orange 5 Grey 4

Rods: Red 15 Yellow 9

Plastic sheet 2

Educational objective

To design and build a working model of yacht, that will use the force of the wind to sail along. To consider the need for stability in boats, and experiment with ways of improving stability

☑Cross-curricular links

None

√ Before starting

√ Look at pictures or a video of a yacht sailing (or the real thing!)

→ Conclusion

→ Compare the different models, and in particular how the problems of capsizing have been overcome

→ Test which yacht is the most efficient (ie needs the least wind to sail)

⇒ Possible follow-on activities

⇒ Trip in which the children can experience sailing a dinghy

Year 2000

2000

The year 2000 has been and gone! What new inventions would you like to see being used in the 21st century, both at home and at school? Can you make a model of one of them, and explain how it works?

Levels of difficulty

Level 1	✓5	Design and build a model of a new means of transport for the 21st century (car, plane, boat, bike, bus, etc)
Level 2		Design and build a model of a new invention that would be really useful in home or school
Level 3		As level 2, with a motor

Equipment needed:	**K'NEX** Discovery set
For level 3:	Spring motor or Battery motor

What is your favourite way to travel? How would you like to travel in the 21st century? Faster? Slower? More comfortably? In a vehicle which doesn't create pollution? Make your own model, and show us!

For level 2, think of any tasks that you have to do or an adult has to do at home or at school that are really boring. What could you invent that would do the job automatically, or make it much easier for a person to do?

For level 3, you can add a motor to your new invention if you like !

☺ Handy hints

- L1 3 ways to connect rods and connectors
- L3 Making corners with blue and purple connectors
- L5 Wheels and tyres
- L6 Making rods turn with wheels or connectors
- L7 Pulleys
- L8 Handles
- M1 Spring motors
- M2 Battery motors

☹ Troubleshooting tips

- R1 Rods difficult to join to connectors
- R2 Blue and purple connectors won't join together
- R3 Model is not strong enough
- R4 Wheels won't turn around easily
- S1 Rod won't go into motor
- S2 Motor won't turn the wheels
- S3 Can't connect my motor to my model

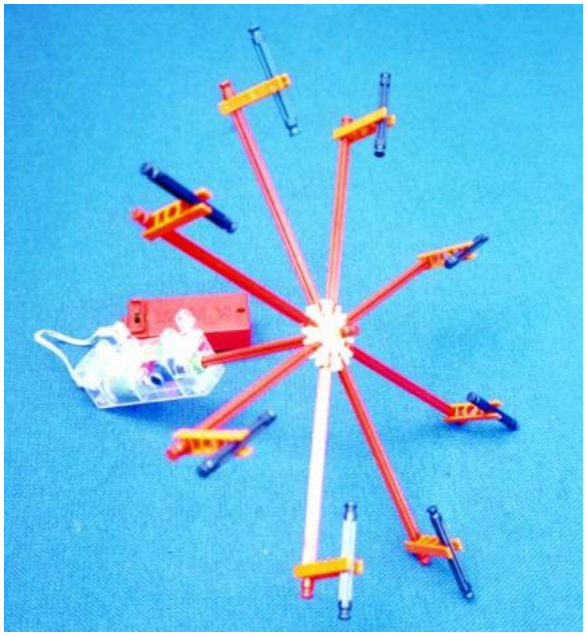
For teachers

Key topics: Designing skills

Making skills

Components used in sample level 3 model below

Connectors: White 1 Orange 8 Tan 2
Rods: Red 9 Blue 8
Battery motor



Educational objective

To set an open-ended design-and-make objective, that will challenge the imagination

☑Cross-curricular links

None

√ Before starting

√ Give some examples of inventions that have significantly changed people's lives

→ Conclusion

→ Ask the children to explain and demonstrate their inventions to the class

→ Patent the best ideas as quickly as possible!

⇒ Possible follow-on activities

⇒ Project on major inventions and how they have affected people's lives

Zoo

What animals might you find in a zoo? Big ones? Small ones? Reptiles? Mammals? Insects? Put them all in your K'NEX Zoo!

What is your favourite zoo animal? What part of the world does it come from? Could you make a model of it out of K'NEX?

For level 2, think what other animals live in the same sort of place. Could you make a model of one of them too?

For level 3, how could you make your animals a really comfortable place to live in at you zoo. Are they used to having trees or plants around? Do they live in hills or on the plains? Where will they find water to drink? Where will they sleep at night?

Levels of difficulty

Level 1 ✓5 Make an animal for your zoo

Level 2 ✓5 As level 1, and make a model of another animal that lives in a similar habitat

Level 3 ✓5 As level 2, and make a habitat at a zoo for both the animals to live in happily

☺ Handy hints

L1 3 ways to connect rods and connectors

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R3 Model is not strong enough

Equipment needed: **K'NEX** Discovery set

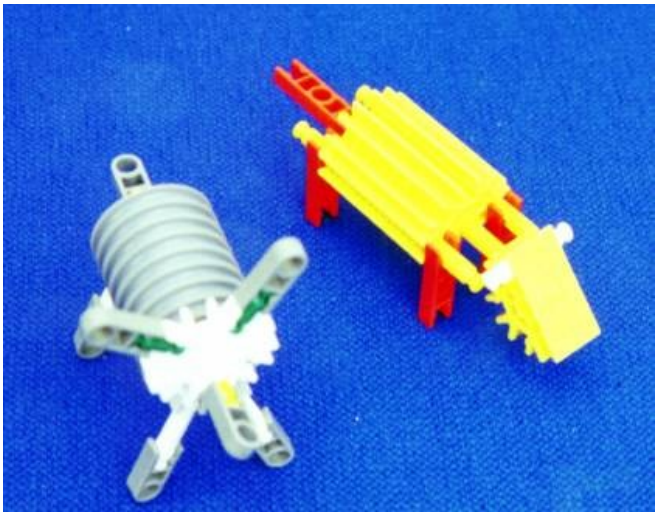
For teachers

Key topics: Animals **Designing skills** **Making skills**

Components used in sample level 2 models below

Connectors: White 1 Yellow 11 Orange 5 Grey 8 Light grey 2

Rods: Yellow 4 White 4 Green 2



Educational objective

To model two familiar animals and their habitat

☑Cross-curricular links

☑ Geography - habitats

√ Before starting

√ Ask for suggestions of animals and where they live

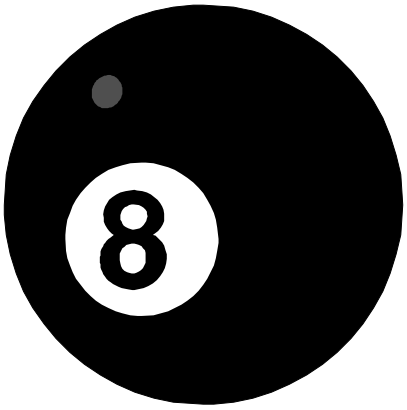
→ Conclusion

→ Ask the children to explain their habitats to each other

⇒ Possible follow-on activities

⇒ Visit a zoo

8-ball pool



Can you play pool? The 8 ball is the black ball, which has to be potted last. We challenge you to a game … but you will have to make your own cue first!

What shape will you cue be? Will it be strong enough to move the ball? Will the ball go in the direction you want it to?

For level 2, how can you use K'NEX to make a real cue shape? What shape will the tip be, that actually strikes the ball?

For level 3, find a friend, set the balls up in the triangle, toss a coin to see who starts … and away you go!

Levels of difficulty

Level 1	✓5	Make a simple cue of any shape, which can strike the ball
Level 2		Make a cue which is similar in shape to a snooker or pool cue
Level 3		As level 2, and play a game of pool with it

Equipment needed:	**K'NEX** Discovery set Pool ball or snooker ball
Test area (level 3):	*Pool table and set of pool balls*

☺ Handy hints

L1 3 ways to connect rods and connectors

L11 Making shafts for sports equipment

☹ Troubleshooting tips

R1 Rods difficult to join to connectors

R3 Model is not strong enough

For teachers

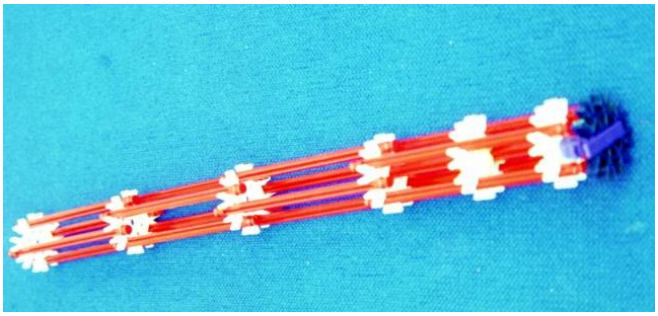
Key topics: Designing skills

Making skills

Components used in sample level 3 model below

Connectors: White 6 Blue 1 Purple 1 Tan 2

Rods: Red 17



Educational objective

To design and build an item of sports equipment, and play a game with it

☑Cross-curricular links

None

√ Before starting

√ Examine a real pool cue or snooker cue

→ Conclusion

→ Hold a tournament

⇒ Possible follow-on activities

None

Section C.1 Handy Hints

L1 3 ways to connect rods and connectors

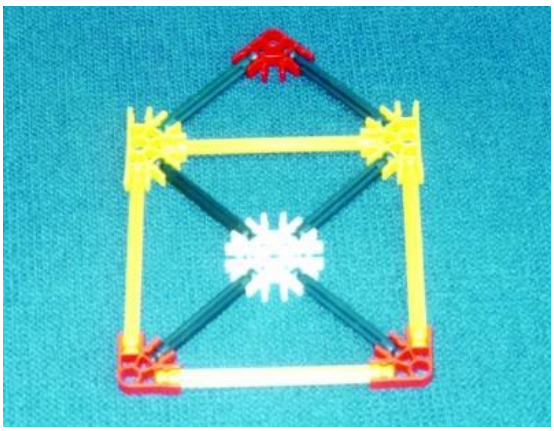
There are only three ways to connect K'NEX rods to K'NEX connectors: **End-on, Side-on,** and **Through the hole in the middle**. All three are shown in the picture.

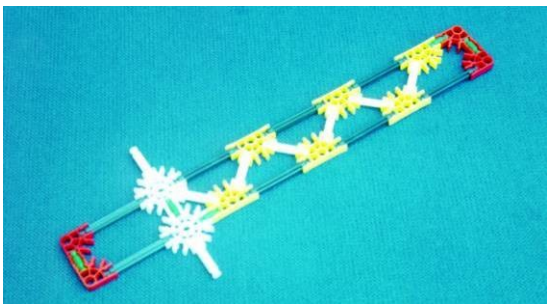
To make an **End-on** connection, put the connector on the table, position the rod over the side of the slot in which you wish it to go, and push down gently. If it won't connect easily, reposition the rod, and try again. You don't need a lot of strength to make End-on connections.

To make a **Side-on** connection, hold the connector in one hand, the rod in the other, and push the edge of the rod into one of the slots. You will need to push quite hard - young children may find this type of connection difficult. Note that you can only make this type of connection where there are *ridges* along a rod - so Side-on connections can't be used with the short green rods, or right at the end of any rod.

To make a connection **Through the hole in the middle**, simply put the rod through the hole. Note that a few special-purpose connectors don't have a hole in the middle.

L2 Strong 2-D structures



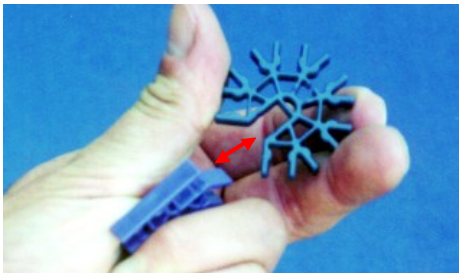


K'NEX is first-class for building very strong 2-D structures. Not only are K'NEX connections very strong, but squares made out of K'NEX rods can always be *reinforced* with longer rods across a diagonal.

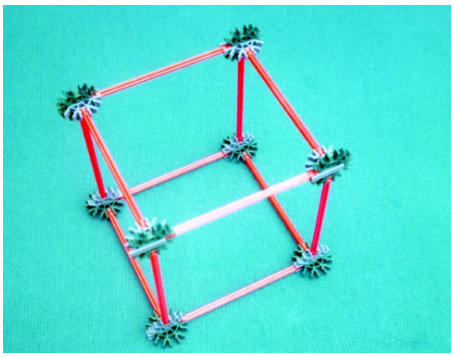
Try not to use orange connectors when making 2-D structures. Use yellow and red connectors instead, as these can be joined horizontally and diagonally as well as vertically, to make your model stronger.

Sometimes there is a need to make a 2-D structure which is quite long, and very strong across its width. An example is a *sword blade*. For these, we would recommend making two sides with yellow connectors, blue rods top and bottom, and white rods zig-zagging along in between.

L3 Making corners with blue & purple connectors



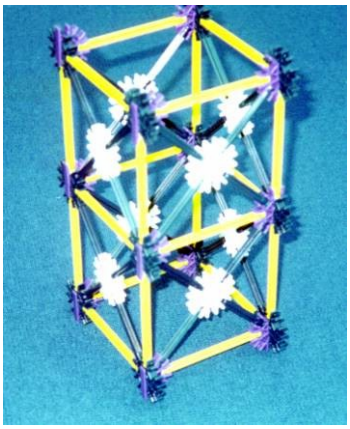
Blue and purple connectors have slots in. This means you can connect two purple connectors to each other; two blue connectors to each other; or a blue connector to a purple connector. To do this, put one slot inside the other slot, and push until you hear a click.



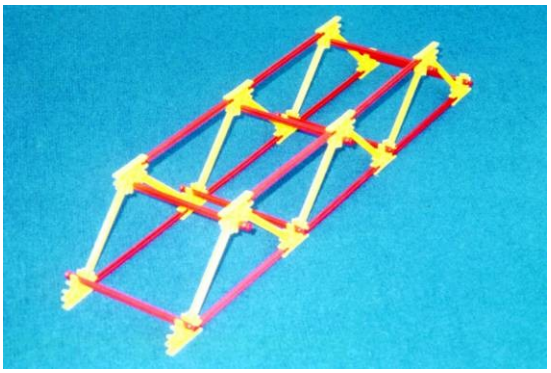
Using blue and purple connectors together like this is very useful if you are making a 3-D K'NEX model which needs **corners**. For instance, in making a box for your mousetrap.

Younger children may find connecting blue and purple connectors together quite difficult. You may prefer to join them together yourself before they start their Challenge.

L4 Strong 3-D structures



K'NEX is first-class for making strong 3-D structures. We would in most cases recommend using blue and purple connectors to make the corners, and a combination of grey/red rods, red/yellow or yellow/blue rods to make the frame, as one or more **cubes**. One approach is to use four of the longer rods to make the square face of each cube, and four of the shorter rods to reinforce each face.



The only exception to this approach is *Bridge spans.* We would recommend making each side of a bridge span with yellow connectors, red rods top and bottom, and yellow rods zig-zagging along in between (similar to the sword blade in Hint L2 - 2-D shapes). The two sides can then be joined using red rods connected side-on to the yellow connectors. We would *not* recommend using blue and purple connectors in a bridge span, because the bottom of a bridge span is in tension, and the connectors may pull apart.

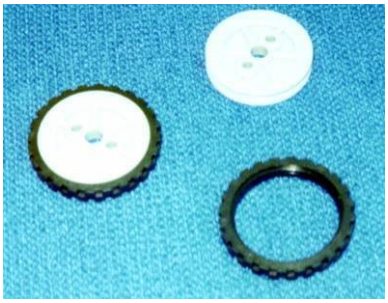
Note that both of the above approaches make use of the fact that **triangles** give great strength to structures. This is because any downwards force on the top point of a triangle is spread down the two sides, and ends up as a lengthways force on the bottom rod.

L5 Wheels and tyres

All the larger K'NEX sets come with wheels and tyres. You can use wheels on their own if you need a pulley, or a wheel for a railway engine. Otherwise, you will need to put the tyres onto the wheels, for instance to make a car. Younger children may need an adult to help them put the tyres on.

To use a wheel, simply put a rod through the hole in the middle, and it will spin freely. One way to stop the wheel falling off the rod is to put a grey connector on the end of the rod (see picture).

Note that there are two sizes of wheels, and that the larger wheel comes with a choice of two sizes of tyres.

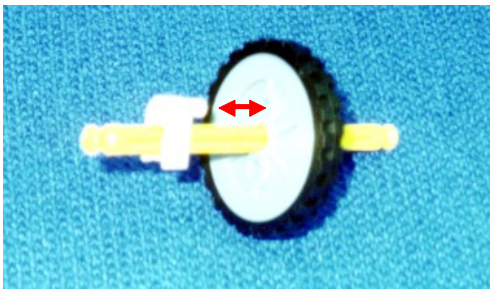


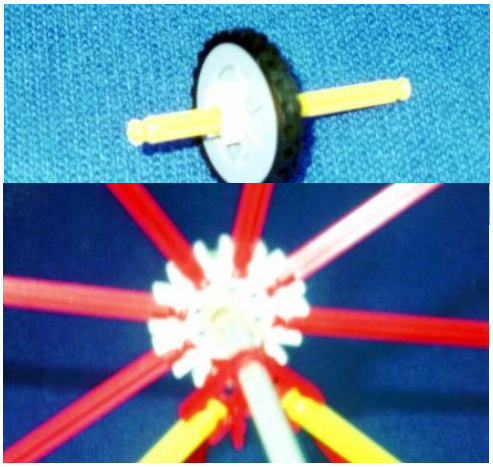
L6 Making rods turn with wheels or connectors

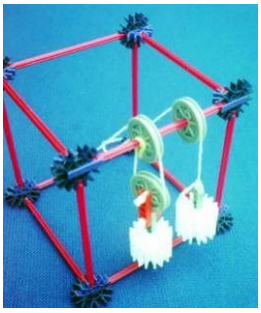
Sometimes you want your wheel to turn at the same time as the rod turns (maybe because you are using a motor to turn the rod). This can be achieved by attaching a tan connector Side-on to the rod, and sliding it along so that the small projection on the tan connector slots into one of the small holes in the wheel. Younger children may need helping in putting tan connectors on and taking them off.

You can also use tan connectors with connectors. In this case the small projection in the tan connector slides into one of the small triangular holes near the centre of the connector. An example where this approach is useful is in a windmill, where the sails may be made from 8 red rods on a white connector, and you want the sails to turn a rod that passes through the hole in the middle of the white connector.

In either case, make sure that that the rod which is attached to your wheel or connector can spin freely. The ends of the rod should always be put through holes in the centre of the supporting connectors, not attached via End-on connections.





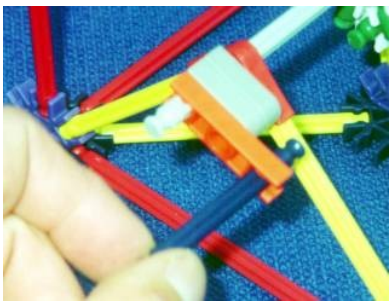


L7 Pulleys

K'NEX wheels without tyres can be used very effectively as pulleys.

Two pulleys and a rubber band may be used to make one rod turn another rod in a model such as a windmill. Some K'NEX sets include a rubber band which is ideal for this purpose. See Hint L6 to ensure that that your pulleys turn the rods on which they are placed.

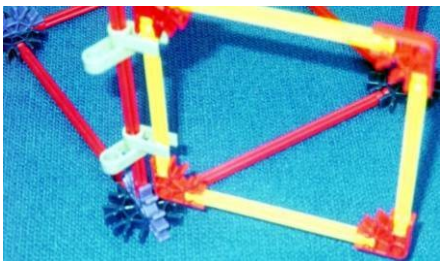
One or more pulleys may also be used with a length of string, for instance in a block and tackle, or a crane.



L8 Handles

Handles are required in K'NEX models from time to time, to make it easy to turn a rod by hand, or to wind string around a rod.

There are many different ways to make handles from K'NEX . The photo opposite shows just one of these.

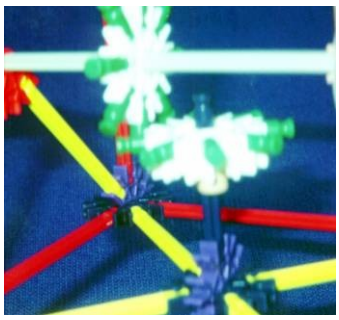


L9 Hinges

Hinges can be made in many different ways with K'NEX. One of the simplest is to attach a grey connector to the end of a rod, and then to put another rod through the hole in the grey connector.

L10 Making gear wheels from rods and connectors

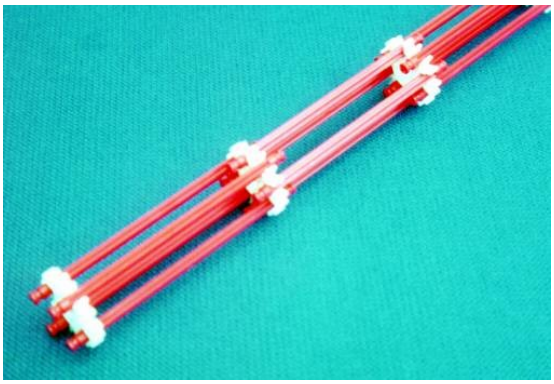
A gear wheel may be made by putting 8 green rods into the 8 slots on a white connector. Two such wheels may then be used in combination, either to transfer motion between two parallel rods, or between two rods at right angles to each other (eg to drive the grindstone in a windmill).



One such gear wheel may also be used with a series of rods connected in parallel, to form a 'rack and pinion'. This can be very useful in a model which needs to translate a rotary motion into a linear (straight line) motion (eg the Digger).

L11 Making shafts for sports equipment

One popular way to make shafts for sports equipment such as golf clubs is to take a number of white connectors; connect four red rods side-on to them at equal intervals; push the connector to one end of the red rods; and attach another white connector at the end in the same way. Four more rods may then be added into the four vacant slots, then a further white connector, and so on (see photo).

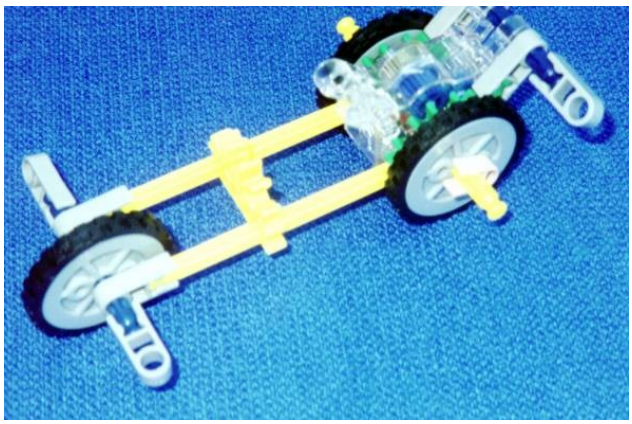


L12 Pivots

If you need to make a pivot with two arms that balance (eg for a seesaw or scales), you will need to ensure that you put a *counterbalance* at the centre of the arms. This is necessary so that, when you push down one arm and release it, the arm returns to its original position.

M1 Spring motors

The K'NEX Spring motor is a well-designed pull-back-and-let-go motor. It is enclosed in a transparent case, so that you can see that pulling back winds up a spring, and letting go releases the spring, via a series of gear wheels. Spring motors are very good for models where you want a motor to turn a rod quite fast, but you don't need a lot of power, such as a racing car.



To use a spring motor, first push a rod (quite hard) through the hole in the middle. There is an arrow on the case of the motor, which shows the direction of travel. Turn the rod the *opposite* way to the arrow a number of times, and then let go to see the motor spin the rod.

Connecting a spring motor to your model can be achieved by putting rods through the four holes on the edge of the case (see picture opposite for one way to do it). It may take a bit of practice before you become proficient at this.

Now read Hint L6 if you want to make your spring motor turn wheels or connectors.

M2 Battery motors

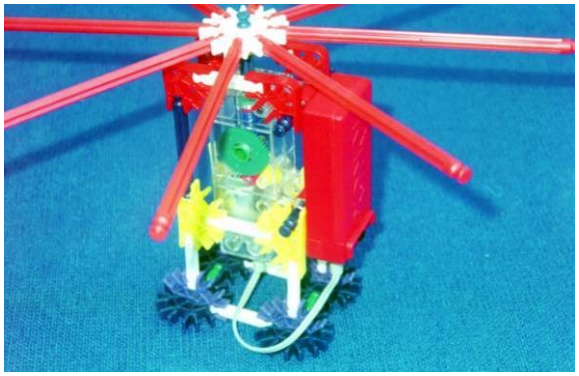
The K'NEX Battery motor is a well-designed electric motor attached to a 3v power pack. The power pack has a three-way switch allowing the motor to be run in either direction. It takes two AA batteries (not supplied).

The motor is enclosed in a transparent case, so that you can see how the motor drives the rods through a series of gear wheels. Battery motors are very good for models where you don't need the motor to turn a rod very fast, but you do need quite a lot of power, such as a Ferris wheel.

To use a battery motor, first push a rod (quite hard) either through the hole in the middle, or into the hole at the end. Experiment by turning on the switch on the battery pack to turn the rod in each direction.

Connecting a battery motor to your model can be achieved by putting rods through the four holes at the edge of the case (see picture opposite for one way to do it). The battery pack may also be attached in a similar way. It may take a bit of practice before you become proficient at this.

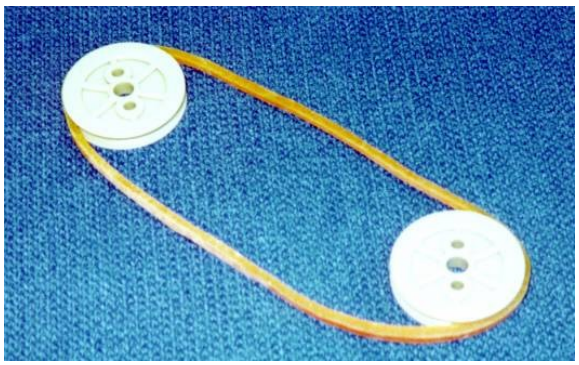
Now read Hint L6 if you want to make your battery motor turn wheels or connectors.



M3 Rubber bands

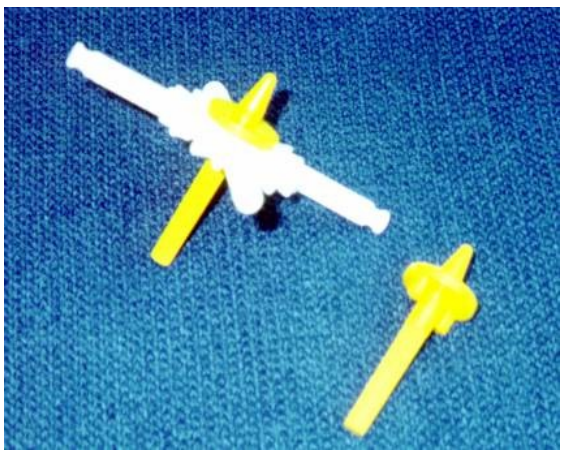
Large rubber bands may be found in some K'NEX sets. They are the correct length and width for using two K'NEX small wheels as pulleys. We also use them for various projects, such a *Guitars.*

If you don't have K'NEX rubber bands, any long thick rubber bands could be used.



M4 Spinner stems

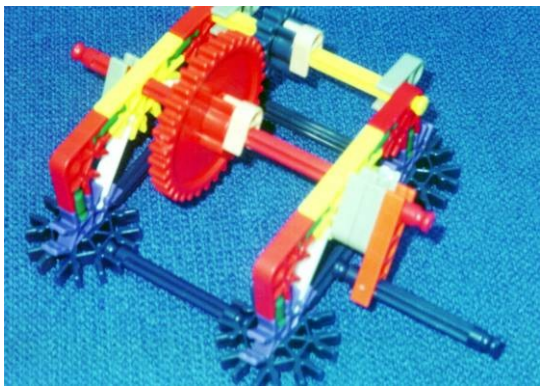
Spinner stems may be found in K'NEX spinner sets. They are designed so that they slide into a white connector, and lock into it. Different rods may then be connected to the white connector, to make different types of spinner.



M5 Gear wheels

Large red and small blue gear wheels are available in some of the specialised K'NEX sets. They are very useful if you want one rod to turn another rod running parallel to it at a slower or faster speed.

The gear wheels should be attached to each rod with a tan connector (see Hint L6), so that the rod and gear wheel turn together.



M6 Chain

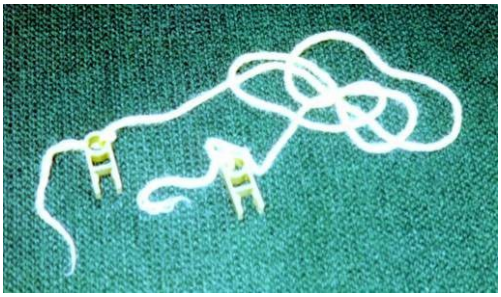
Chain links are available in some K'NEX sets such as the Discovery set. The links may be snapped together to make a chain of any length. Make sure you get all the links the same way round. The chain may then be linked to a rod around a small wheel with a tyre on.

Chain is very useful for transferring rotary motion from one part of a model to another. It has two advantages over pulleys and rubber bands, in that the chain doesn't slip, and that a chain can be created in any length.

Chain is also very useful for making caterpillar tracks on vehicles such as the Bulldozer.

See later in section C for specifications of Add-on components and where to obtain them.

N1 String

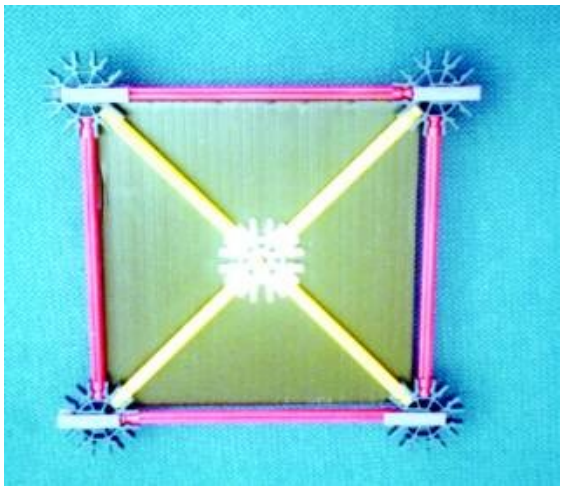


String is required for quite a number of the challenges in this book, particularly those with Key Topics such as Forces and Mechanisms. String is very useful to transfer a ‘pulling’ force from one part of the model to another, or for transferring a ‘turning’ force (eg from a handle - see Hint L8) into a ‘pulling’ force.

If you are using string with younger children, they may find it difficult tying knots in the string to attach it to their model. One solution is to tie each end of the string through the hole in a grey connector, so that all they have to do is fasten the grey connector on in the right place.

You will probably find that after using string a number of times, it becomes tangled or frayed, and will need replacing.

N2 Correx/Cardboard panels



Panels made from cardboard or Correx are very useful for purposes such as putting walls on buildings made from a K’NEX frame.

There is no ‘correct’ way to attach such panels to your K’NEX model. Indeed, in the classroom you may prefer to ask the children to select their own materials and fastening methods, as a valid task within the National Curriculum.

One way that does work fairly well is to make a small hole in the centre of each panel, put a butterfly clip through the hole, and then fasten the clip through the hole in a white connector (see photo opposite).

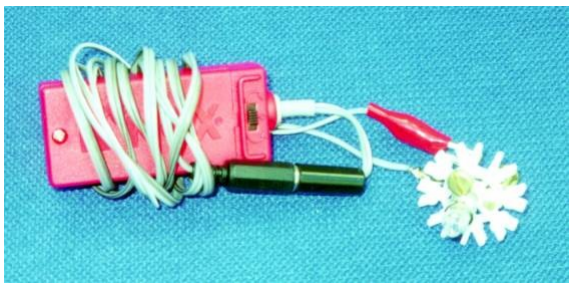
This approach has the advantage of using re-usable components, and also does not get the K’NEX sticky, which is a drawback of methods such as using double-sided sticky tape.

N3 Electrical circuits

A number of challenges in this book require electrical circuits. As a minimum these require a battery pack and at least two lengths of wire. In addition, they may require electrical components such as additional lengths of wire, switches, light bulbs, coloured LEDs and buzzers.

A specification for each of these components may be found Section C. Some hints in their use are as follows:

Battery packs. We find that battery packs using long-life batteries last for a considerable time, but nevertheless each pack should be tested before being given to a child, to avoid possible frustration.



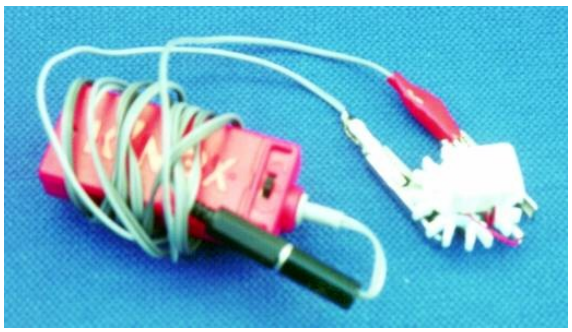
Wires. We use wires with crocodile clips on the end, which the children can clip onto the terminals on lights, LEDs, switches and buzzers. If you use crocodile clips with plastic sleeves, it may be worth slipping the sleeves off the clips for younger children, so they can see exactly where to press the clip to open it. Younger children also find large crocodile clips easier to use than smaller ones.

Light bulbs. Mirror panels can usefully be used with light bulbs to reflect the light, and coloured acetate sheet or coloured plastic objects placed over the light can be used provide different colours.

LEDs. LEDs (Light Emitting Diodes) are very good if you need a bright coloured light which needs very little power (eg for traffic lights). However, they do have a major drawback - ***they only work when they are connected the right way round in an electrical circuit.*** We would recommend you explain and demonstrate this to the children before the project starts, to avoid possible frustration. It is also not usually possibly to connect a number of LEDs in *series* (ie one after the other) in a circuit, as the voltage to each becomes too low for them to light up - connect them in *parallel* (ie each with its own wires to the battery) instead.

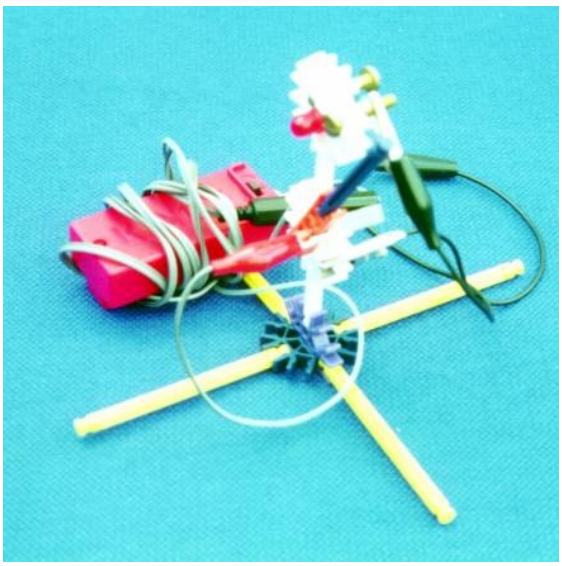
Buzzers. Buzzers can add an extra level of interest to an electrical project. 20 loud buzzers going off at once in a small classroom can though be somewhat irritating!

Like the LEDs, some buzzers only work when they are connected the right way round in a circuit. They may also need to be connected in parallel, rather than in series with other components.



Switches. The push-button switches shown in section C are only one of many ways of making switches for use in the electrical challenges in this book. It is educationally very useful to vary the types of switches the children experience.

In a number of the Challenges the children are asked to make their own switches. One way to achieve this is to clip two or more crocodile clips onto K'NEX rods or connectors, and devise a way to make the clips touch together when (say) a lever is pulled or a handle is turned.



N4 Plastic sheet

A number of challenges in this book require plastic sheet.

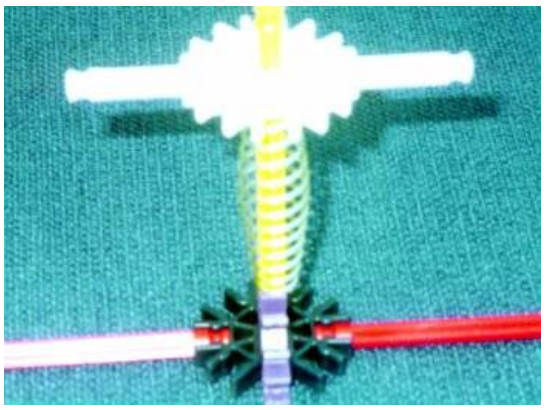
There are a variety of ways of attaching plastic sheet to K'NEX models. One good way is to stretch the plastic sheet over a connector, and then make a Side-on connection with a rod, so that the sheet is held tightly between rod and connector.

N5 Springs

Springs can be useful in models which require a lever to automatically returned to its original position when released.

It is recommended that any spring used is actually pushed onto a K'NEX rod, resting on a connector beneath it. This will ensure that the spring expands and contracts in a straight line.

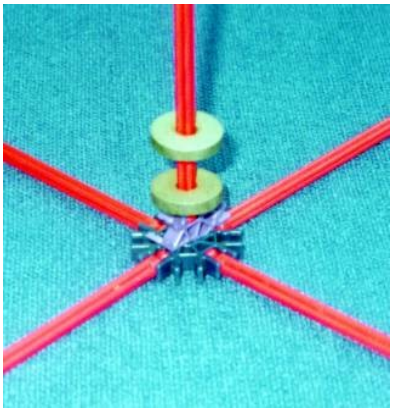
If the spring needs to expand, this will necessitate attach both ends of the spring to a connector. This can usually be done by pulling a short length of wire from each, and attaching around one of the segments at the centre of the connector.



N6 Magnets

Ring magnets can usually be used in models simply by sliding them onto a rod.

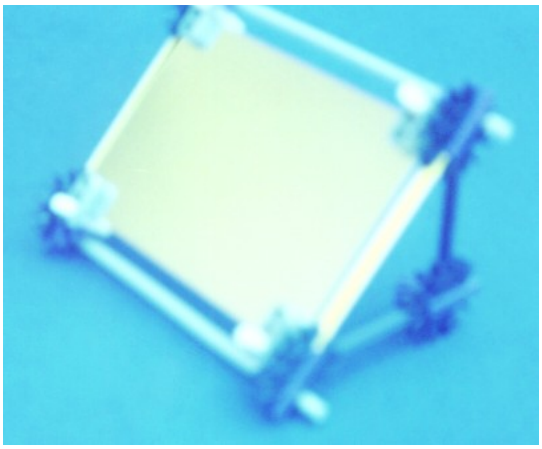
In some models (eg Fishing rod) the ring magnet may be attached to one end of a piece of string.



N7 Mirror panels

Mirror panels should usually be first built into a frame to hold them, and then the frame attached to the model.

If your mirror panels do not exactly match the length of any rod, then a frame with a sliding end may be used (see photo). The sliding end can be pushed up tight to hold the mirror panel, whatever its length.



Section C.2 Troubleshooting Tips

R1 Rods difficult to join to connectors

If you are finding that the K'NEX End-on connections are too difficult, you are probably not positioning the rod correctly over the slot before you push the pieces together. Look at the second photo for Hint L1. Try putting the connector on a table-top before you try and join the rod to it.

If you are finding Side-on connections are too difficult, you may be trying to join the connector too close to the end of the rod, where there are no ridges. Try attaching the connector near the centre of the rod, and then sliding it to the right position. If you are still having problems, look at the photo and information for Hint L1.

R2 Blue and purple connectors won't join together

Make sure you have put the slot on one connector inside the slot on the other connector. Make sure you push hard enough to hear a click. If you are still having problems, look at the photos for Hint L3.

R3 Model is not strong enough

This is a very common problem. There are lots of ways to make your model stronger. These include:

a) Check that all connections in your model have been made correctly. If there is a rod anywhere which is not correctly snapped into a connector, this will reduce the strength.

b) Use **squares** in your model, not rectangles. Squares in K'NEX can always be joined across a diagonal for greater strength.

c) If you are making a **2-D model**, see Hint L2.

d) If you are making a **3-D model**, see Hint L4.

e) If you are still having problems, try using shorter rods. A model using grey rods will bend much more than a model using red rods.

R4 Wheels won't turn around easily

This may be due to:

a) Using a tan connector to join the wheel to the rod when you don't need to, because what you require is a free-spinning wheel

b) Connecting the wheel to a rod with a tan connector, but not allowing the rod to spin freely in the holes in the middle of the connectors that support it (see Hint L6).

R5 Wheels slip on railway track

If the driving wheels on your railway engine slip rather than drive the engine along:

a) Try adding more weight directly above the wheels

b) If this does not work, find two small thin rubber bands, and put them around the driving wheels to increase the friction

S1 Rod won't go into motor

If you can't get the rod through the hole in a Spring or Battery motor, push harder! Don't be afraid you might break something.

S2 Motor won't turn the wheels

If your motor is turning, but the wheel on the rod connected to the motor isn't, there may be one of the following problems.

If the rod isn't turning:

a) On the Spring or Battery motor, you haven't pushed the rod right through the hole in the middle. You must do so, or the rod will slip.

b) On the Battery motor, if you are using the hole at the end, you have not pushed the rod in hard enough.

If the rod is turning, but the wheel isn't:

c) You have probably not used a tan connector to join the rod to the wheel (see Hint L6)

S3 Can't connect my motor to my model

See photos by Hints M1 and M2 for possible ways of doing so.

S4 Chain won't turn

Check that the chain is the right tension - not too tight, and not to loose. If this doesn't work, check that you have connected all the links of the chain in the same direction.

T1 Crocodile clips won't attach

If you can't manage to fasten the crocodile clips onto the terminals, try pulling the plastic sleeve off the clip, so you can see the clip clearly. If you are still not able to clip it on, because your fingers aren't strong enough, get an adult to help.

T2 Light bulb won't light up

There are a number of possible reasons for this:

a) There is a *short circuit*. Check that components (eg crocodile clips) are not touching when they shouldn't be.

b) You haven't connected the wires correctly. Start by using two wires. Connect the first from one terminal on the battery to one of the terminals on the light bulb, and the second from the other terminal on the battery to the other. If the bulb doesn't light up, go to Tip T5.

c) Now you know that the battery and light bulb work, go back to your original wiring. Remember the electricity has to go round in a circle through the light bulb for it to light up. Make sure that the wiring makes a complete circle (ie a circuit).

d) If you have a complete circuit, but the bulb still doesn't light, check what other electrical components you have in the circuit. One of them may be taking so much of the current that there is too little current left for the bulb. Try removing the other components one at a time until you cure the problem.

T3 LED won't light up

There are a number of possible reasons for this:

a) There is a *short circuit*. Check that components (eg crocodile clips) are not touching when they shouldn't be.

b) You haven't connected the wires correctly. Start by using two wires. Connect the first from the battery to one terminal on the LED, and the second from the battery to the other terminal on the LED. If the LED doesn't light up at first, use the 3-way switch on the battery pack to make the current flow the other way. If the LED still doesn't light up, go to Tip T5.

c) Now you know that the battery and LED work, go back to your original wiring. Remember the electricity has to go round in a circle through the LED for it to light up. Make sure that the wiring makes a complete circle (ie a circuit).

d) If you have a complete circuit, but the LED still doesn't light, check what other electrical components you have in the circuit. One of them may be taking so much of the current that there is too little current left for the LED. For instance, you may have two LEDs in the circuit, which means that neither of them will light up because the current is too low. Try removing the other components one at a time until you cure the problem, or connect the components in parallel (see Hint N3).

T4 Buzzer won't make a noise

There are a number of possible reasons for this:

a) There is a *short circuit*. Check that components (eg crocodile clips) are not touching when they shouldn't be.

b) You haven't connected the wires correctly. Start by using two wires. Connect the first from the battery to one terminal on the buzzer, and the second from the battery to the other terminal on the buzzer. If the buzzer doesn't sound at first, use the 3-way switch on the battery pack to make the

current flow the other way. If the buzzer still doesn't sound, go to Tip T5.

c) Now you know that the battery and buzzer work, go back to your original wiring. Remember the electricity has to go round in a circle through the buzzer for it to sound. Make sure that the wiring makes a complete circle (ie a circuit).

If you have a complete circuit, but the buzzer still doesn't sound, check what other electrical components you have in the circuit. One of them may be taking so much of the current that there is too little current left for the buzzer. Try removing the other components one at a time until you cure the problem, or connect the components in parallel (see Hint N3).

T5 Faulty battery pack or electrical component

Replace the batteries in the battery pack, and try again. If this doesn't work, try a separate battery pack, in case the internal wiring is faulty. If this still doesn't work, replace the electrical component (bulb, buzzer, etc) with a different one, and try again. Make sure you keep any defective battery packs or components to one side, to repair later.

T6 Magnets don't work

If your magnets don't work the way you expect, there may be a number of reasons:

a) the magnets have not got their poles facing the right way for your project. Try turning one of the magnets round.

b) the magnets are not close enough together

c) the magnets have lost some of their power (possibly by not being stored correctly - heating magnets or dropping them can reduce their power)

T7 Boat capsizes too easily

If your boat capsizes too easily, there may be a number of reasons:

a) The hull is too narrow. Broad-bottomed boats are more stable. Or what about a two-hulled boat - a catamaran?

b) The boat is top-heavy. Try reducing the height of the mast, reducing the weight of the mast, or reducing the weight of anything attached to the mast. If this still doesn't help, try putting some extra weight low down in the boat, so as to reduce the centre of gravity.

c) Your sail is creating a sideways force which is capsizing the boat. Try and ensure that all the force from the wind blows your sail forward, not to the side. Consider reducing the size of your sail if this is still a problem.

Section C.3 Add-on components

This section contains specifications for the Add-on Components required for some of the Challenges in this book.

Forces/Mechanisms Components

String

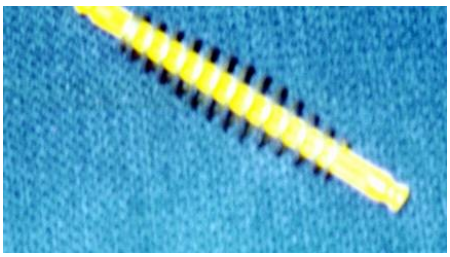
Lengths of string are provided in some of the larger K'NEX sets. If you do not have these, you can supply your own. In either case, we find that string has to be replaced fairly frequently, as it gets tangled and frays.

We have experimented with ordinary string and with nylon string, but we find the best for most projects is **Kite string**. This can be bought from model shops and some educational suppliers in long lengths (eg 60m) on a spool. It is ideal for K'NEX Challenges because it is very strong, but also thin and flexible enough to be used effectively.

We usually cut the string into 1 metre lengths for use on Challenges.

Springs

Springs can be compressed or stretched to provide forces in models. We recommend obtaining a variety of springs of different strengths, which are of sufficient internal diameter to fit snugly over a K'NEX rod.



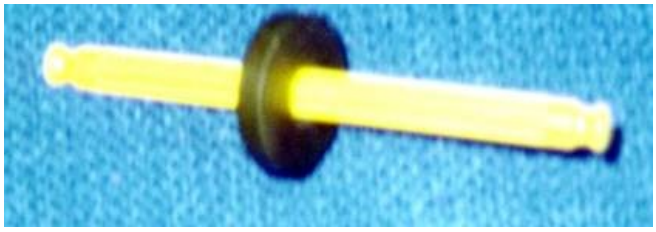
Small rubber bands

Small thin rubber bands can sometimes be useful. For instance, they can be stretched around the driving wheels of a railway engine to increase the traction.

Magnets

Magnets make a very useful low-cost add-on for K'NEX models. They can be used to provide a force of attraction (opposing poles) or repulsion (like poles).

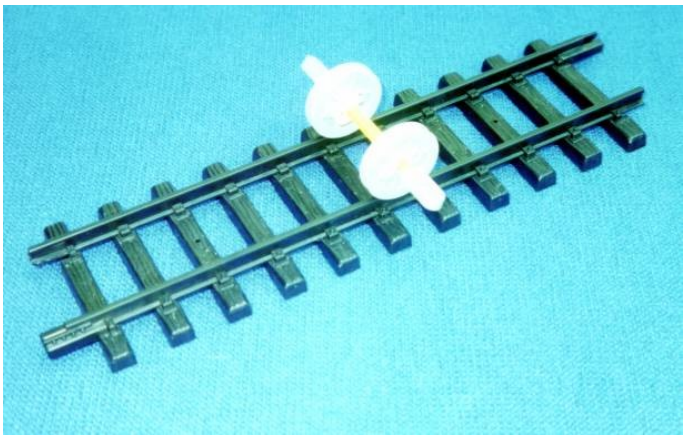
We would recommend using ring magnets, with a sufficient internal diameter to fit snugly on a K'NEX rod. The stronger the magnet the better, particularly for project such as fishing rods, where the weight of the fish that the rod can lift will depend upon the strength of the magnet.



Railway track

K'NEX is good for making working models of railway engines and trucks. The only track that K'NEX provide though comes with the Rollercoaster set. It needs special gold connectors to hold it, and it is not really designed to be used as a railway track.

We have purchased a number of straight and curved lengths of 'G' gauge plastic track ('G' is for 'Garden'). These are made of plastic, and can be slotted together to form a loop of track. 'G' gauge is ideal, because two small wheels (no tyres) either side of a battery motor on a yellow rod fit onto it nicely.



Cladding Components

Plastic sheet

Plastic sheet can be used in all sorts of ways for cladding K'NEX models. The sheet needs to be thick enough and strong enough that it won't easily tear. Coloured or transparent plastic can be used.

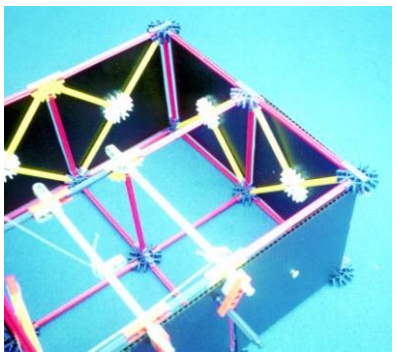
We often use plastic sheet which is donated by local companies, but if this is not available, carrier bags from local supermarkets work well. The bags may be split down the middle and cut into square sheets for most projects.

Correx/Cardboard panels

Panels can also be very useful for cladding K'NEX models. For instance, they can be used to clad the structure of a K'NEX castle with solid walls, or as the blade of a K'NEX table tennis bat.

We use a material called Correx for panels, also known as Corriflute. It comes in a variety of bright colours, in 3mm and 4mm thicknesses. We use 4mm Correx, which is light and very strong.

Corrugated cardboard can be used in a similar way, but it is less visually attractive, and will need to be replaced after it has been used a number of times. It can however be painted.



We make panels which are 14.3cm square. This is the correct size to clad a square made from four red K'NEX rods.

Whilst panels can be stuck to K'NEX models with double-sided tape, we prefer an approach which doesn't make the K'NEX sticky. This is to put a *butterfly clip* through a hole in the centre of each panel, with the ends pushed through a white connector, and turned out flat to attach the panel to the connector.

The panels can then be attached to any red square, by attaching yellow rods from each corner, meeting at the middle of the square in a white connector. The butterfly clip can then be attached through the hole in the centre of the white connector.

Electrical Components

Battery pack

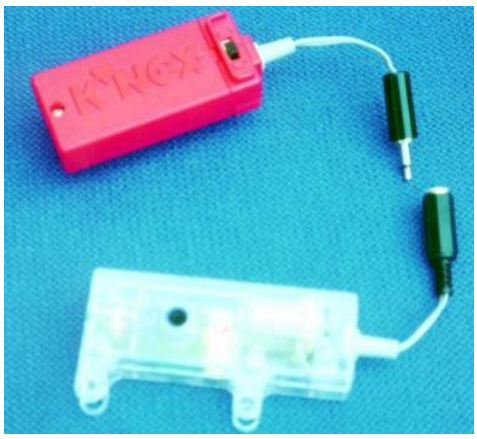
The easiest way to provide a battery pack for electrical projects with K'NEX is to adapt the 3v battery pack that comes with the battery motor. This can be done by:

a) cutting the wire in the middle that joins the battery pack to the motor

b) fitting a male jack plug to the battery end of the cut wire, and a female jack plug to the motor end of the cut wire, so that the battery pack can still be connected to the motor as required.

c) wiring up a second female jack plug to two different coloured wires about 50cm long with crocodile clips on the other end.

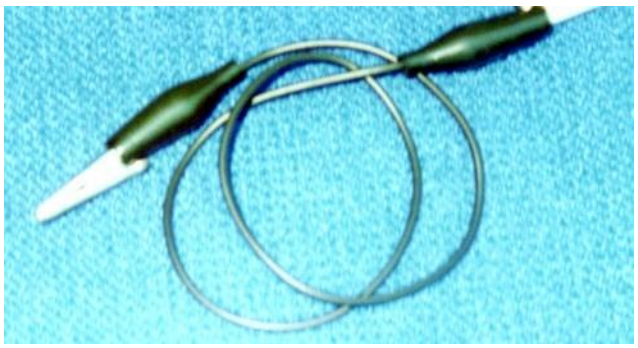
The crocodile clips can then be attached to light bulbs, coloured LEDs, buzzers and switches to create electrical circuits.



The switch built into the battery pack can be used to turn the power on and off, and to reverse the polarity of the wires.

Lengths of wire

The length of wire with a jack plug on one end and crocodile clips on the other end can be used to make a simple circuit with (say) a light bulb. To make circuits with additional components, we provide 50cm lengths of wire with a crocodile clip on both ends.



The crocodile clips have plastic sleeves over them, so as to prevent accidental short circuits. We find it best to slide the plastic sleeves off for

younger children, though, so they can see the actual crocodile clip when they are trying to open it.

Terminals

A number of the electrical components described later in this section are attached to a white K'NEX connector, which has two brass bolts sticking out

for use as electrical terminals.

The brass bolts we use are Pan-headed M5 x 25mm long. They may be screwed directly into a white connector as shown in the photo below.

If the white connectors are fairly warm when this is done, it will reduce the possibility of the white connector breaking under the strain.

Components may then be attached to the connector, and wired to the terminals. Usually the wires are connected to the bolts by tightening a nut. They may also be soldered for added strength.

Light bulb

Light bulbs feature in a number of Challenges. We usually use a 2.5v bulb screwed into a small bulb holder.

We then attach the bulb holder into the centre of a white K'NEX connector. This can be done by carefully cutting away three segments out of the centre of the connector with a very sharp craft knife, and simply pushing the bulb holder in. The

connectors will cut more easily if they are fairly warm.

The two terminals on the bulb holder may then be pushed round so they touch two brass bolts screwed into the connector, and secured with two nuts. The connections may also be soldered for added strength.

Coloured LEDs

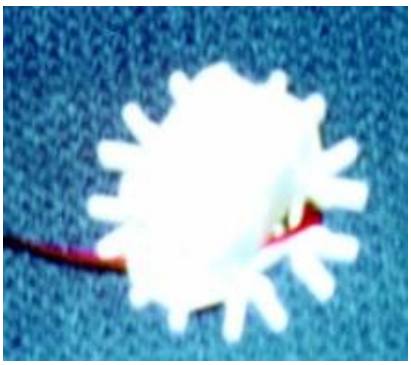
We use green, red and yellow 8mm LEDs, so as to have the correct three colours for projects such as Traffic Lights.

Each LED is attached to the centre of a white connector by pushing its wires through two of the central segments, and then securing them to two brass bolts.

Buzzer

We use small 3v buzzers. These can be loosely attached to the surface of a white connector by pushing the wires from the buzzer through two of the central segments of the connector, and securing them to two brass bolts.

Buzzers should not be attached too tightly to connectors (eg by glue), because they will not make a loud noise unless they are free to vibrate.



Switch

In addition to asking the children to make their own switches, we also use push-button switches. These are attached by drilling out the centre of a white connector slightly, and then screwing the switches in. Crocodile clips can then be connected directly to the terminals on the back of the switch.

Sound components

Chime bar

The only add-on components we use to extend K'NEX into the Key topic of sound is a chime bar. This is usually attached onto a K'NEX frame with a short length of string, so that it vibrated freely when struck.

Note that if the chime bars are attached too tightly, they will not be free to vibrate.

Optical components

Mirror panels

Mirror panels are very useful in optical projects using K'NEX. Plastic double-sided panels are available, which give a high standard of reflection. They do need to be looked after carefully, to avoid scratching with repeated use. We would not recommend glass mirrors, for safety reasons.

Boxes for components

The main K'NEX general-purpose sets such as the Discovery set comes with a carrying case. These are very strong, but suffer from the disadvantage that the K'NEX is all mixed up inside.

Many Education sets come complete with a compartmented box, which has compartments of variable size for each different type of K'NEX component. This makes it much easier for children using K'NEX to find the exact rod or connector that they need.

An alternative form of compartmented box may be found in DIY shops. Such boxes can have lots of compartments, for putting nails, screws, etc in. The box that we use is called a *Stanley 14-compartment organiser*, and it can usually be found in B&Q.

K’NEX Set reviews

The K’NEX User Group sells a full range of K’NEX sets, guides and parts in its online shop at **www.knexusergroup.org.uk.** Two of the most popular K’NEX education sets are described below, together with an Order Form overleaf.

K’NEX Discovery Building set

A general purpose K'NEX set that is equally effective in the home, schools, clubs, childcare schemes and family learning.

20 different models can be built from instructions, and the set is also a good base for setting simpler K'NEX challenges.

Suggested age range: **5 to 95**

Number that one set can support:

2-4 children, working in pairs

K'NEX Primary Education set

Large general-purpose K'NEX set, with a good mix of classic K'NEX parts. Ideal for use in the home, schools, clubs, childcare schemes and family learning, and excellent value for money.

All the models shown in the photo could be built **at the same time** with this set.

32-page Teacher's guide based on UK Primary curriculum, plus 12 double-sided activity cards, covering the topics: Flat shapes, Patterns, Symmetry, Cubes and cuboids, Designing and building, Working with pulleys and Balancing.

Suggested age range: **5 to 95**

Number that one set can support:

12 children, working in pairs

K'NEX Order Form

To use this order form, please print it out, and fill in every field marked with an asterisk. Then fax to **(0208) 196 2248**, or mail to *K'NEX User Group, 87A Newton Road, Mumbles, Swansea SA3 4BN.* If you have any queries on completing this form, please email us via info@knexusergroup.org.uk

***Date ordered**		***Your purch. order ref.**		
***Organisation**				
***Address**				
		***Postcode**		
***Telephone**		***Email**		
***Name**		***Position**		
***Signature**		**(Order not valid unless signed)**		

Part no.	Description	Price	*Quantity	*Value
78650	K'NEX Discovery set			
79520	K'NEX Primary Education set			
			*** Nett value of goods =**	**£**

All orders are subject to our Terms and conditions, which may be found at:

http://www.knexusergroup.org.uk/acatalog/tandc.html