Guide to using K'NEX in Secondary Schools

…including 10 K'NEX challenges

www.knexusergroup.org.uk

Contents

1. Introduction

The K'NEX construction kit has been used successfully by UK secondary schools since 1995. Initially, K'NEX was seen just as an innovative and exciting way of helping pupils to understand the Design and Technology curriculum, but increasingly K'NEX has been put to many different uses in secondary schools, including:

- Design and Technology curriculum
- Science curriculum
- Maths curriculum
- History curriculum
- ICT curriculum
- GCSE projects
- Pupils with special needs
- Gifted and talented pupils
- After-school clubs and Lunchtime clubs
- School-based family learning
- Staff team-building

The purpose of this short guide is to explain how K'NEX can be used to best effect in secondary schools, in all the above settings, from Year 7 to Year 11.

1.1 Who is this guide for?

This Guide has been written for everyone who has an interest in Secondary School education, including:

- Headteachers
- Teachers
- Technicians and non-teaching staff
- After-school Club leaders
- Parents

1.2 What is K'NEX

K'NEX is one of the most successful construction kits in the world, second in popularity only to Lego. It is based around a series of "rods", which can be joined together by "connectors" such as the one shown in our logo. Once they have mastered using these simple components, children and adults alike can use their imagination to make potentially millions of different working models.

It is ease of use and versatility that make K'NEX such a good investment for educational purposes, whether in schools, home education, children's clubs, childcare schemes, family learning or post-16 education. You will find that there is no age limit for enjoying K'NEX - it is suitable for all ages from 5 to 95. There is also a version of K'NEX with bigger components for 3 to 7 year olds, called Kid K'NEX, as shown in the photo.

Building K'NEX models helps children and adults to understand subjects such as structures, forces and simple machines, in the way that Meccano educated an earlier generation. However, Meccano was aimed and advertised exclusively at boys, whereas both girls and boys find K'NEX easy and enjoyable to use. K'NEX can also be used effectively with adults, once they have mastered the basic techniques for joining rods and connectors together, and overcome any initial nervousness.

A further strength of K'NEX is that, when used to set Challenges, it can help both children and adults to develop skills such as innovation skills, problem-solving skills and team-working skills. These are skills that are much sought after by employers. It is also worth remembering that even though educational organisations use K'NEX because of its high educational value, children and adults enjoy using K'NEX simply because it is fun. This makes K'NEX a good vehicle for engaging hard-to-reach pupils, such as disaffected pupils and pupils with behavioural and emotional difficulties.

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2. K'NEX in the KS3 and KS4 curriculum

This section describes how Secondary schools are able to use K'NEX in the National Curriculum at Key Stages 3 and 4.

2.1 Why use K'NEX at KS3 and KS4?

K'NEX is a versatile construction system, that can help Secondary schools meet the common requirements of the National Curriculum at KS3 and KS4, including:

- Communication skills
- Mathematical skills
- Problem-solving skills
- Creative skills

Not only is K'NEX "educational", but pupils also regard it as "fun and exciting", which helps to ensure that all pupils in a class often stay involved and perform to the best of their ability when a K'NEX project is being completed.

There are very few barriers to pupils using K'NEX. All they need to learn are a few basic techniques for joining rods and connectors together. Time and again, teachers find that pupils excel at K'NEX, even if they are poor in other areas, such as literacy. This can be a great advantage in developing the self-esteem of pupils.

2.2 K'NEX models from instructions

All K'NEX education sets arrive with step-by-step instructions showing how to build a number of K'NEX models, plus guidance for teachers. Building models from instructions is the best way to learn how to use K'NEX, for both teachers and pupils.

2.3 K'NEX challenges

Whilst building models from instructions is in itself educational, the real strength of K'NEX comes when pupils are set *K'NEX challenges*, in which they must build a model without instructions. Ten K'NEX challenges are included in the Appendix, and 20 more challenges may be found on the K'NEX User Group website www.knexusergroup.org.uk.

A typical whole-class K'NEX challenge might be delivered as follows:

1. Decide on the K'NEX challenge you are going to provide (eg the Crane challenge)
2. Provide a compartmented tray of K'NEX for every four pupils, working in pairs.
3. Give each pair of pupils a copy of the Challenge Card, or, if you prefer, explain the challenge verbally to pupils.
4. If any of the pupils haven't used K'NEX before, explain the "Handy Hints" listed in the Appendix.
5. Each pair of pupils can then work at their own pace to complete the challenge, to the 1st, 2nd or 3rd level of difficulty.
6. Wander round the classroom, answering any questions, giving the pupils any assistance they require, and encouraging each pair to work together as a team.
7. When each pair of pupils has completed the challenge to level 1, ask them to demonstrate how it works, and praise them for all their hard work.
8. If there is time, ask the pair of pupils to go on to complete level of difficulty 2, and then 3.
9. At least 10 minutes before the end of the lesson, ask the pupils to show each other the models they have built. Then ask them to dismantle their models, and put the K'NEX back tidily in the tray.

If the challenge chosen is within the capabilities of every pupil, it can be delivered by the teacher alone, but additional staff may be useful if the class includes pupils with special educational needs.

Some of the advantages of the "K'NEX challenge" approach over the "Model-building" approach are that:

- Setting challenges helps to develop the problem-solving skills and creativity skills of pupils
- Setting challenges helps pupils to apply mathematical skills (eg shape, space and measure), rather than just copying them.
- Setting challenges helps ensure that the communication skills developed by pupils extend further into the vocabulary of technology and problem-solving.

2.4 Design and Technology curriculum

K'NEX projects can be designed to meet many of the requirements of the Design and Technology curriculum, including:

- Focused practical tasks
- Designing skills
- Making skills
- Understanding structures
- Understanding simple mechanisms
- Designing and making products
- Computer control (see section 2.7)

Many K'NEX projects only require K'NEX rods, connectors and wheels, but K'NEX can also be usefully extended with other equipment and materials, for instance:

1. Simple electrical circuits, such as a K'NEX lighthouse, or K'NEX house with burglar alarms

2. Paper or card, such a K'NEX castle with walls, or a K'NEX fan with card blades.
3. Plastic carrier bags, eg to provide a sail for the Land Yacht challenge.

K'NEX can also be used successfully in GCSE projects that are related to Design & Technology. For instance, to build the prototype of a working model, or to provide the structure and moving parts for a working model that is then clad in other materials.

There are a number of K'NEX education sets that explore particular aspects of the DT curriculum, as shown in Appendix B.

2.5 Science curriculum

K'NEX can be used effectively to help pupils in KS3 and KS4 learn about physical science in a practical way. Such an approach can ensure that pupils gain a better understanding of the principles involved, and retain that knowledge longer than if they had learned it only as theory.

Aspects of the Science curriculum that K'NEX can assist with include:

- Forces and motion
- Balanced and unbalanced forces
- Wheels, axles and inclined planes
- Pulleys
- Gears
- Motors
- Science investigations

K'NEX challenges based around a science investigation can be particularly effective, for instance:

1. Building a fan with K'NEX which is driven via a gear train, and investigating how different gears can be used in combination to change speed and the direction of motion.
2. Building a catapult out of K'NEX, and adjusting variables in the model to see how far a table tennis ball can be fired (eg length of throwing arm, angle of release, starting position).
3. Building a block and tackle out of K'NEX, and investigating the effect of using pulleys in combination.

There a number of K'NEX education sets that are based on Science, as shown in Appendix B.

2.6 Maths curriculum

In building K'NEX models and completing K'NEX challenges, pupils will be applying many different mathematical principles, including:

- Counting components required
- Selecting components by shape and size
- Creating patterns
- Interpreting 2-D diagrams of 2-D or 3-D models
- Using 2-D shapes such as squares, rectangles and triangles
- Using 3-D shapes such as cubes, cuboids, pyramids and prisms
- Applying symmetry
- Using 45 degree and 90 degree angles

Furthermore, K'NEX projects can be designed specifically as a vehicle for developing maths skills in KS3 and KS4 pupils, for instance:

1. Asking pupils to build determine the algebraic formula for building a K'NEX tower of any height, where r=number of red rods, p = number of purple connectors, l = number of levels high, etc.
2. Asking pupils to make a measuring wheel out of K'NEX, and then using it help to create a map.
3. Setting pupils the challenge of building (say) a K'NEX bridge, and then asking them to cost that bridge by assigning a monetary value to each K'NEX piece (eg £10 for a grey rod, £7 for a red rod, etc).

Appendix B gives details of the K'NEX education sets that are based on Maths, and the "UK Guide to using K'NEX for Hands-on Maths".

2.7 IT curriculum

Pupils now spend a significant amount of their time in school working on computers. K'NEX can be used to broaden the value of computer-based work, by:

1. Setting "K'NEX Computer challenges" that include both a K'NEX building element and an IT element.
2. Carrying out computer control projects in which a computer is used to program and control a K'NEX model.

An example of a K'NEX Computer challenge would be to:

a. ask pupils to building a K'NEX car that will travel down a ramp,
b. investigate how far the car will travel with the ramp set at different angles.
c. record the data collected into a spreadsheet.
d. calculate the average speed of the car.
e. produce graphs and charts from the spreadsheet.

A further example of a K'NEX challenge would be to use the Westpoint Bridge Designer to design and test a bridge on a computer, and then build and test it using K'NEX.

K'NEX ferris wheel

An example of a K'NEX computer control project would be:

a. To build a 50cm high K'NEX washing machine with a drum and opening door.

b. To program the computer to provide a wash cycle and a spin cycle.

c. To use a magnetic sensor that turns off the washing machine when the door is opened.

The Members Area of our website also includes lots of ideas for using K'NEX for computer control.

2.8 History curriculum

K'NEX challenges can be used as an enjoyable way of providing hands-on history projects to pupils, by asking them to design and build structures and mechanisms from different periods of history, including:

- Castles
- Windmills
- Waterwheels
- Bridges
- Railways
- Cranes
- Piers
- Lighthouses
- Mangonels and catapults
- Helmets and armour
- Swords and shields

The User Group website www.knexusergroup.org.uk includes challenges for a number of the above.

3. Helping pupils with special educational needs

Many schools have found that K'NEX can assist some pupils with special educational needs to develop essential skills. This is not always the case. Every pupil with special educational needs is different, but we have been told about many different K'NEX projects in which pupils with special educational needs have done well, and on occasion exceeded the expectations of their teachers.

The following notes may assist:

1. We suggest you start by assessing whether each pupil is physically able to make use of K'NEX or Kid K'NEX. For instance, some pupils with visual impairments, or cerebral palsy that affects their arms, or severe learning difficulties may find K'NEX too difficult to use.
2. If you decide you would like to try using K'NEX with a pupil, it is usually better to use K'NEX rather than Kid K'NEX, but this is not always the case, and some pupils with limited strength in their hands or poor sight may prefer to use the larger Kid K'NEX pieces instead.
3. You should then think carefully about how you introduce the K'NEX or Kid K'NEX set to the pupil. Start with easy tasks that are within the pupil's capability, and give as much assistance as is needed. Early failure may cause the pupil to reject the whole idea, even though by starting with simple tasks and then gradual development onto more difficult tasks, the pupil could have achieved excellent results.
4. If you find that the pupil does enjoy using K'NEX, you might then think about purchasing one or more of the smaller K'NEX education sets specifically for him or her. Prices start at £18 (see Appendix B), and the sets come with instruction books that are designed for educators. The "Discovery Building set" is a good general-purpose starter set.
5. Some pupils will not wish to develop beyond the stage of building the models in the instruction book you receive with the set, but if they do, you might like to start building the models using the Instruction Cards and/or the K'NEX Challenges on our website.
6. We suggest you also consider encouraging your pupil to build K'NEX models and carry out K'NEX challenges in a team of two or three pupils. Such an approach can help develop the communication skills and team-working skills of all the pupils participating.

Note that not only can K'NEX help pupils with special educational needs develop the curriculum skills shown in section 2, but achieving success with K'NEX can also help to develop self-esteem and confidence.

4. Helping gifted and talented pupils

Schools also report that K'NEX challenges are an excellent way of developing the skills and experience of gifted and talented pupils.

Some of the reasons why K'NEX challenges can work well with gifted and talented pupils are:

- Completing K'NEX challenges will help gifted and talented pupils to develop skills in Design and Technology, Maths and Science that go beyond the requirements of the National Curriculum. This broadening of the curriculum will help to keep gifted and talented pupils interested, and may help them to discover new interests and talents.

- Setting K'NEX challenges to gifted and talented pupils will help stretch them to the limits of their ability. For instance, the third level of difficulty of some of our challenges are difficult even for adults.
- Completing K'NEX challenges helps gifted and talented pupils to develop "life skills" such as problem-solving skills, creativity skills and team-working skills. These will be essential in the pupil's later life, whatever career they eventually follow.

Note that it is not necessary to segregate gifted and talented pupils before setting them K'NEX challenges. The main reason that all the K'NEX challenges in this Guide and on our website have three levels of difficulty is so that they can be used in classes or groups of mixed ability. For instance, in allowing a KS3 class an hour to complete the Crane challenge:

1. Pupils with special needs might only complete level of difficulty 1.
2. The majority of pupils in the class might complete level of difficulty 2.
3. Gifted and talented pupils might complete level of difficulty 3.

5. Using K'NEX in after-school clubs and family learning sessions

A school's "investment" in K'NEX can usually be justified solely by the benefits that the school will gain in delivering the National Curriculum during the school day. However, many schools then increase the return on their investment by using K'NEX in non-curricular activities at the school, that might include:

- After-school clubs
- Lunchtime clubs
- Wet weather break times
- Summer schools
- Family learning sessions

K'NEX can be used successfully in clubs, at break time and in summer schools as a "free play" resource, that pupils can use as and when they like. Increased educational value, and enjoyment for the pupils, can be gained if staff on occasion set them K'NEX challenges, such as the ones in Appendix A, and on our website www.knexusergroup.org.uk.

The User Group has also written a £5 20-page "Guide to using K'NEX in Children's clubs and Childcare schemes", which provides lots of extra resources, including a further 10 challenges – see Appendix B.

K'NEX challenges can also be used very effectively to attract parents into secondary schools, for instance by setting a "Bridge that Gap" challenge after school for parents. It is the User Group's experience that your pupils will be very keen to bring parents, grandparents and other family members into school to help them complete the challenge, and you may attract parents who have not been into school before. Furthermore, K'NEX challenges develop the skills of adults as well as pupils, and because of this you may find that local community education organisations are very keen to assist you if are considering any family learning sessions in your school.

The User Group has written a £5 20-page "Guide to using K'NEX for Family Learning", which will assist you if you considering running a K'NEX Family Learning event – see Appendix B.

Appendix A – Photocopiable resources

Handy Hints

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

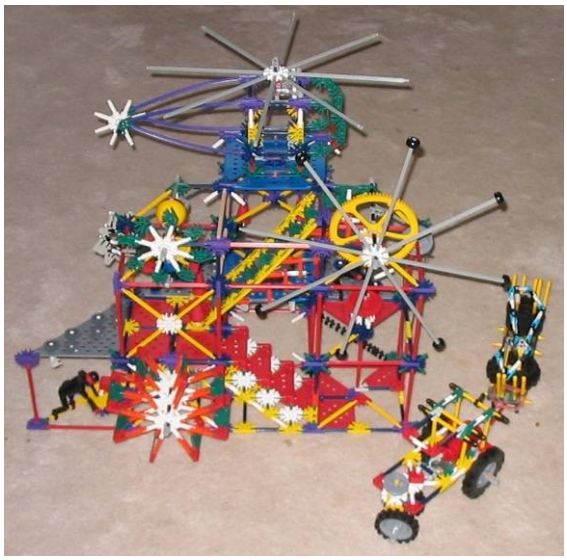
Challenge cards

Block and Tackle	**Bridge that Gap**
Crane	**Earthquake**
Fork lift truck	**Golf**
Land yacht	**Mars rover**
Spotlight	**Wheelchair**

Appendix B – K'NEX Catalogue and Order Form

- Catalogue of K'NEX Education sets, guides and accessories
- K'NEX Order Form

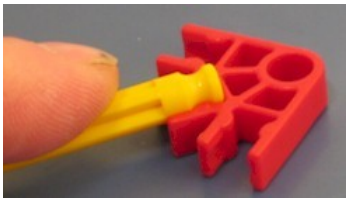
Note that more full-colour Handy Hints, instruction cards and K'NEX challenges are available on www.knexusergroup.org.uk.



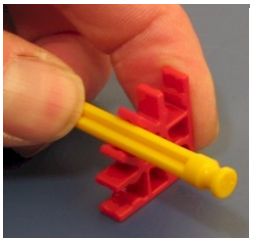
Handy Hints

Hint 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 main 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.

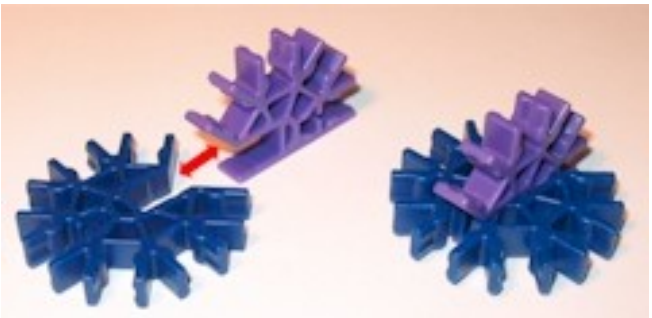


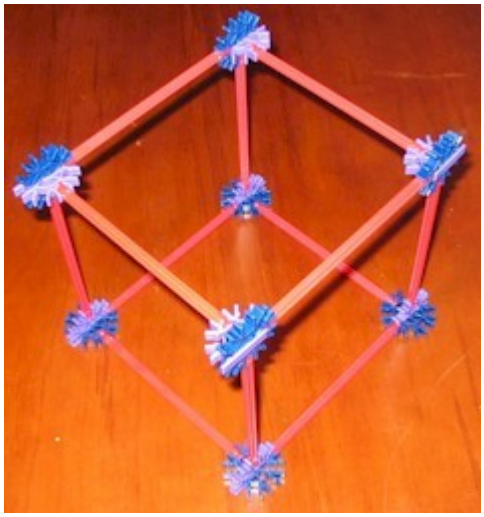
To make a Side-on connection, hold the connector in one hand, the rod in the other, and push the edge of the rod into one of the slots. You will need to push quite hard - young children may find this type of connection difficult. Note that you can only make this type of connection where there are ridges 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.

Hint 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.



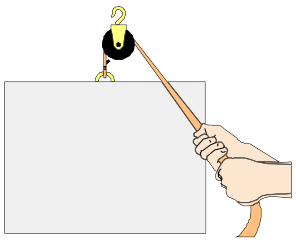


Using blue and purple connectors together like this is very useful if you are making a 3-D K'NEX model which needs corners, which can be a good starting point for some K'NEX challenges.

Younger children may find connecting blue and purple connectors together quite difficult. You may prefer to join them together yourself for them, before they start their K'NEX challenge.

Note that in K'NEX sets that have mainly grey components, rather than components in secondary colours, the corresponding connectors are mid grey and dark blue.

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?

Levels of difficulty	
Level 1	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 set** 1 metre length of string

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.

☺ Handy hints

L1 3 ways to connect rods and connectors

L3 Making corners with blue and purple connectors

L5 Wheels and tyres

L7 Pulleys

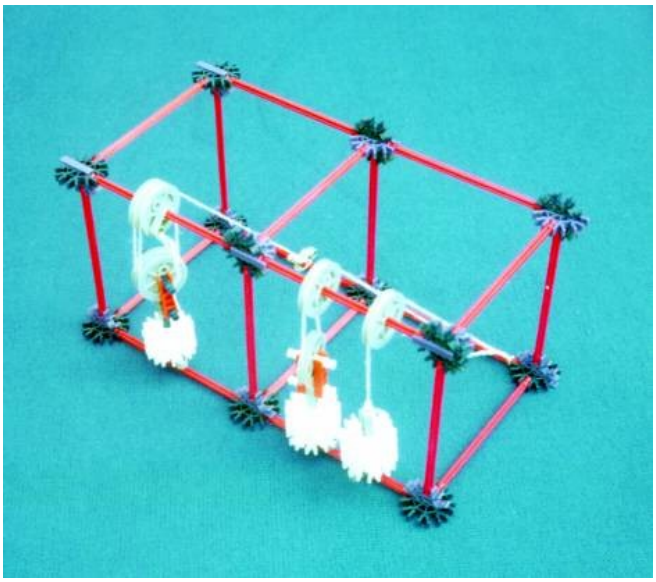
N1 String

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

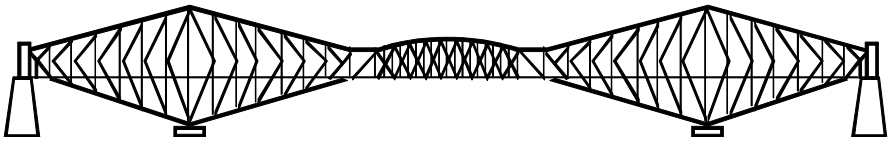
→ Conclusion

→ 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 travelled) is always the same regardless of the number of pulleys used

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 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

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

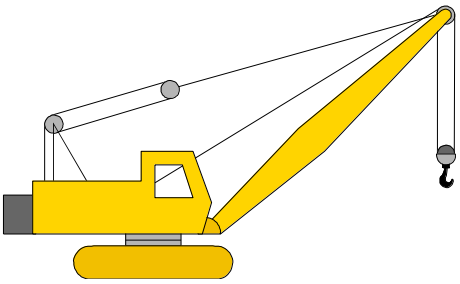
→ Conclusion

- → 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 has been used
- ⇒ Project on the history and structure of a local bridge

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?

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?

Levels of difficulty

Level 1	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

☺ 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

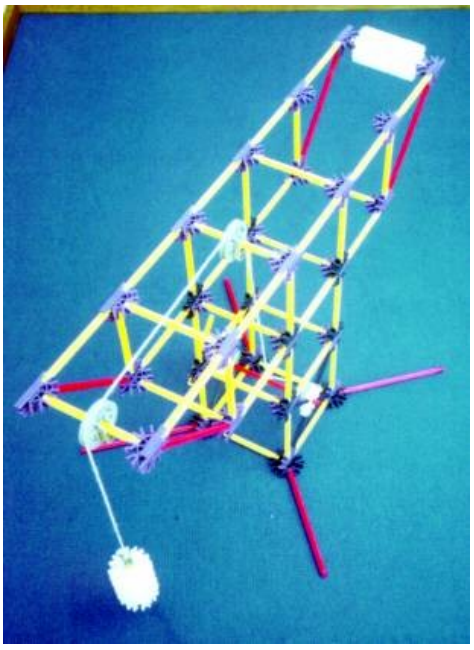
Equipment needed: **K'NEX set**
1m length of string

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

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?

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

Levels of difficulty	
Level 1	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

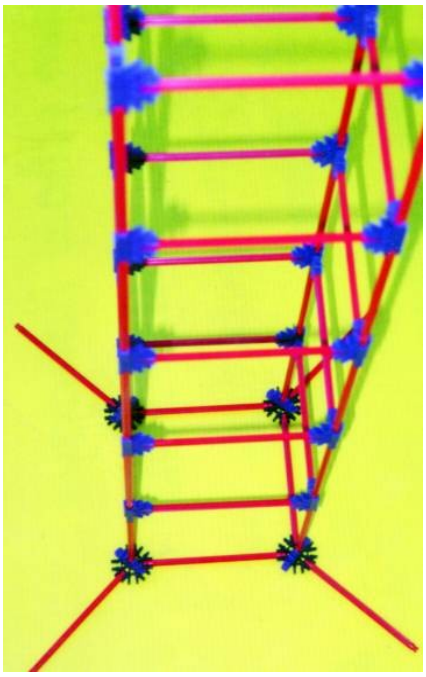
Equipment needed:	**K'NEX set**
Test area:	*Sheet of board or stiff cardboard 50cm square, on 4 blocks each 5cm high*

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

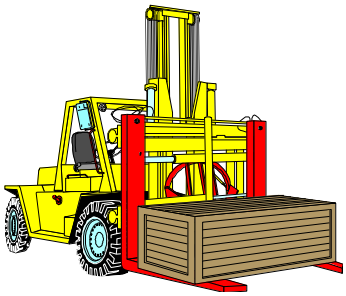
→ Conclusion

→ 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.

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

☺ 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

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

For teachers

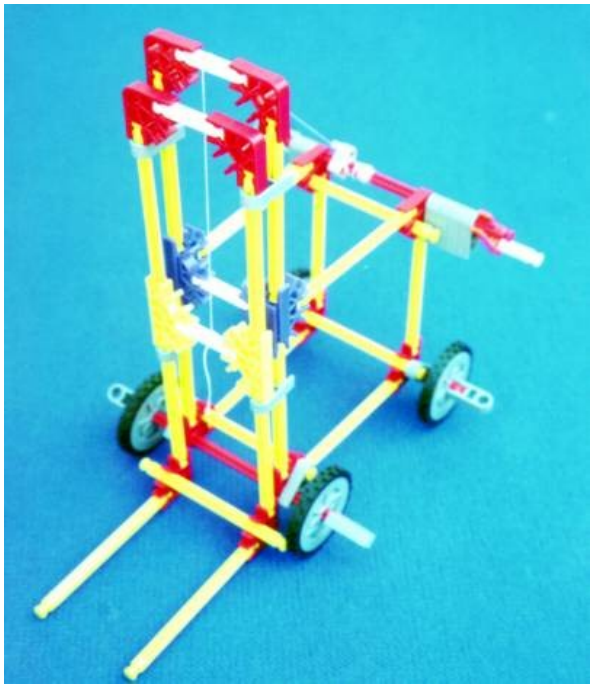
Key topics: **Forces** **Designing skills** **Mechanisms** **Making skills**

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.

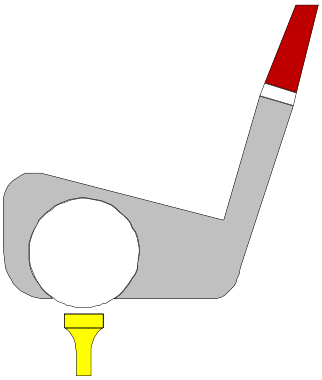
→ Finally, ask them to try and determine the relationship between the weight of the counterbalance and its distance from the front wheels, using a graph

⇒ Possible follow-on activities

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

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

Equipment needed:	**K'NEX 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

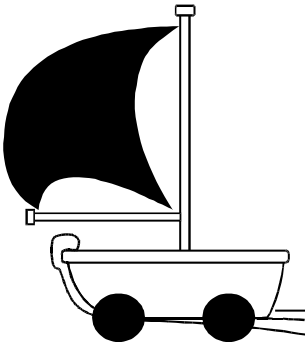
→ Hold competitions to see who can hit the ball furthest, and who can complete the golf hole in fewest shots

→ 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)

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 your 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	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

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

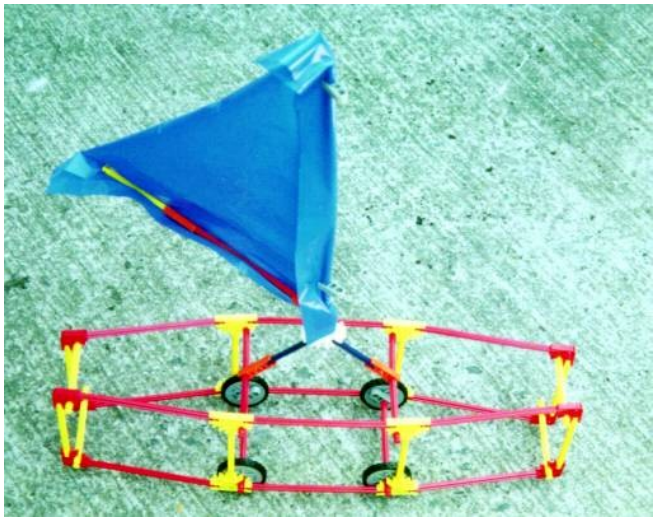
Equipment needed:	**K'NEX set**
For level 2:	Plastic sheet
Test area (level 3):	*A flat smooth area. If there is no wind, consider using a powerful electric fan*

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

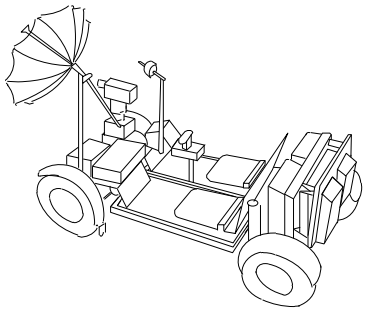
→ Get the children to explain what causes the yacht to move long

→ 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

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?"

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?

Levels of difficulty

Level 1	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

☺ 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

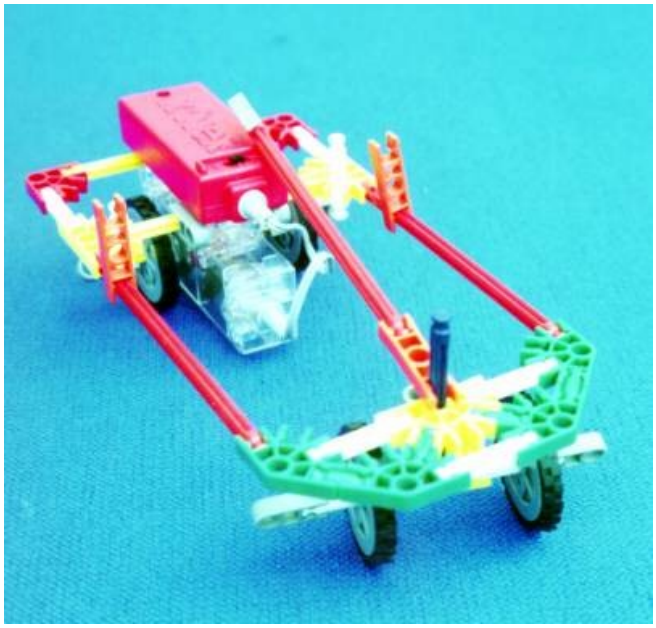
Equipment needed:	**K'NEX set**
For level 2:	Battery motor
Test area (for level 2):	*A rough piece of ground, or a floor area with small objects on it, to test the vehicle's ability to climb over obstacles*

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 motor



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

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	Make a K'NEX holder for a torch
Level 2	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

Equipment needed:	**K'NEX 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

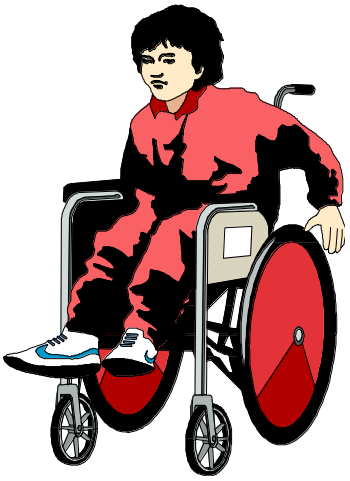
√ Look at an example of a spotlight used to illuminate a stage

→ 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

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	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

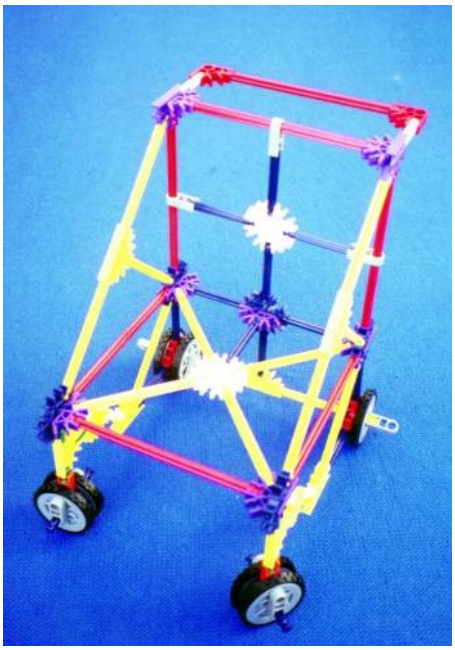
L5 Wheels and tyres

Equipment needed: **K'NEX 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 7 Yellow 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)

K’NEX Set reviews

The K’NEX User Group sells a full range of K’NEX education sets, guides and parts in its online shop at **www.knexusergroup.org.uk.** Two of the most popular K’NEX 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 Simple machines deluxe set

An enormous K'NEX set that is ideal as a general-purpose K'NEX resource for schools, clubs, childcare schemes and family learning. The set includes:

- 3,400 pieces of K’NEX.
- a mains-powered 12v motor
- 5 teacher’s guides (Levers, Pulleys, Gears, Wheel & Axles, Inclined Planes)
- 57 lesson plans for key stages 1 & 2
- instructions to build a science fair model, the 4’ tall Big Ball Factory

Suggested age range: **5 to 95**

Number that one set can support:

Supports 20-30 students working in teams of 2-3.

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 Simple machines deluxe 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