Moving Toys

Links to QCA schemes of work

KS1

Science: Unit 1C. Sorting and using materials
Science: Unit 1E. Pushes and pulls
Science: Unit 2D. Grouping and changing materials
Science: Unit 2E. Forces and movement
Science: Unit 2F. Using electricity
Design and technology: Unit 2A. Vehicles
Design and technology: Unit 2C. Winding up
History: Unit 1. How are our toys different from those in the past?
Art and design: Unit 9 (gen). Visiting a museum, gallery or site

KS2

Science: Unit 3C. Characteristics of materials
Science: Unit 3E. Magnets and springs
Science: Unit 4E. Friction
Science: Unit 4F. Circuits and conductors
Science: Unit 6E. Forces in action
Design and technology: Unit 3C. Moving monsters
Design and technology: Unit 5C. Moving toys
History: Unit 11: What was it like for children living in Victorian Britain?
Art and design: Unit 9 (gen). Visiting a museum, gallery or site

Background notes

Moving toys are excellent for teaching children co-ordination skills and the scientific principles of movement. The Museum of Childhood has many examples, grouped according to forces and mechanisms.

Simple push/pull toys

Wheeled toys, for children to push or pull along, have been in existence for thousands of years. There are examples from ancient civilisations made from materials including clay, wood, lead and ivory. Most are in the shape of toy animals. Some of these very early toys have holes to take a string so that they can be pulled, others are simply intended to be pushed.

Pull along horse and cart, c.1930

Horses, with or without carts or carriages, were popular pull along toys in Europe in the Middle Ages. By the end of the 16th century, some wheeled horses were large enough for a child to sit on and be pulled along, and these continue to be popular today. In the late 19th century, larger push-along toy animals, such as sheep and dogs, were designed to help very little children learn to walk.

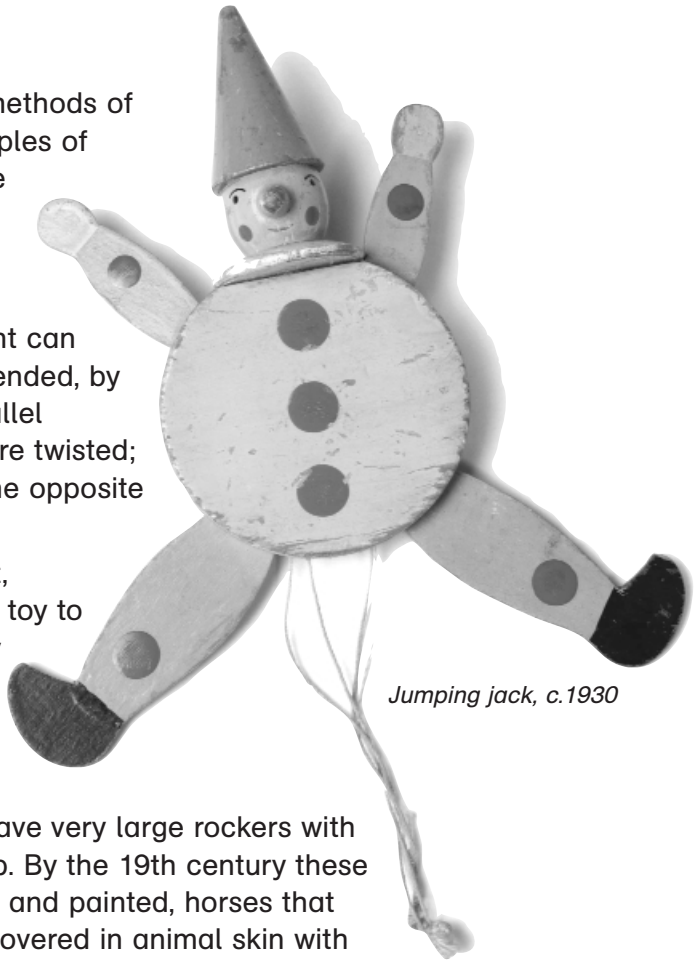
There are push or pull along toys that move in other ways too, such as hens that flap their wings. The Museum has an early example (1912) of a duck whose head bobs up and down when it is pulled. This is because its head is connected to a **cam** that converts the circular movement of the wheels into an up and down one.

String mechanism

Pulling on a string appears to be one of the oldest methods of animating a toy. The Museum has a number of examples of Jumping Jacks, which first became popular in France during the 18th century. The Jack's limbs are jointed and tied to a central string in such a way that, when the string is pulled, they jerk upwards.

A different method of using string to cause movement can be seen in acrobat **torsion** toys. The acrobat is suspended, by his hands, from two crossed strings attached to parallel wooden bars. By squeezing on the bars the strings are twisted; when the tension is released, the string unwinds in the opposite direction and the acrobat rotates.

Pendulum toys use string to different effect. A weight, attached by strings to the toy, is rotated, causing the toy to move. This effect can be seen in the pecking bird toy made in India (c.1915) and Russian bears (1990s) that appear to "play" musical instruments.



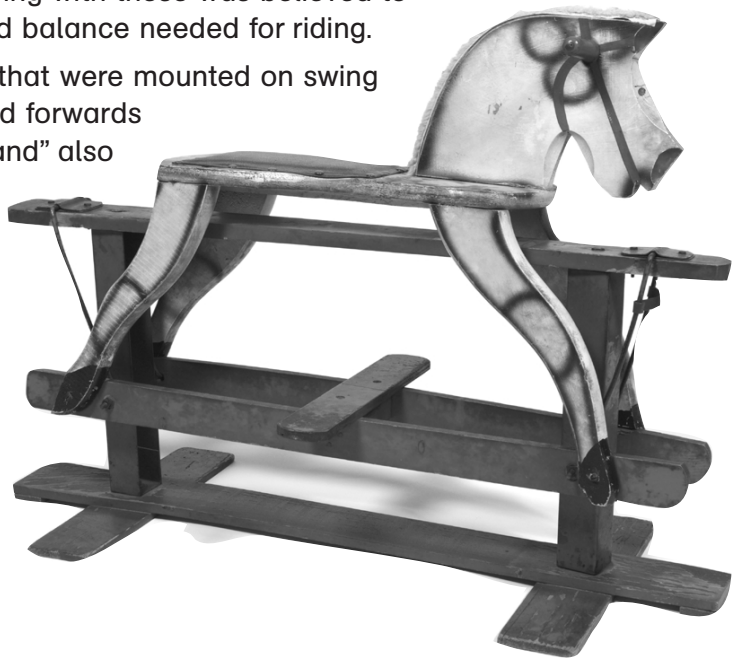
Jumping jack, c.1930

Rocking toys

Early rocking horses, dating from the 17th century, have very large rockers with a carved horse's head and a seat for the child on top. By the 19th century these had developed into more realistic, beautifully carved and painted, horses that were pegged to a rocker. The most expensive were covered in animal skin with manes and tails made of real horsehair. Playing with these was believed to teach a child the principles of movement and balance needed for riding.

In the 1880s, rocking horses were produced that were mounted on swing bars, so the child could swing backwards and forwards in complete safety. The "swing iron safety stand" also allowed a longer swing, did not move across the floor and took up less space. This became the most popular type of rocking horse in the 20th century, with a wooden or moulded metal horse.

The Museum also has examples of smaller rocking toys that teach children the precise amount of force needed to make the toy rock faster or slower, including clay figures from India (1990s).



Rocking horse, c.1944

Pedal toys

Bicycles were developed during the 1860s and refined during the next two decades. Early bicycles (such as penny-farthings) had the pedals attached directly to the **axle** of the front wheel; pushing on the pedals turned the wheel. The Museum has an example of a French tricycle horse (around 1870) that uses this mechanism, as indeed do modern children's tricycles. In modern bicycles the pedals are not attached directly to the wheel. The pedals drive a cogwheel, connected by a chain to another, that in turn drives the wheel.

Pedal cars were developed in the early 1900s. Early examples were moved by pushing pedals that were connected to the **crankshaft** by a chain. After 1918, pedals connected to levers replaced the crankshaft. These continued to be popular toys throughout the 20th century.

Spinning toys

There are several different kinds of spinning tops. In East Asia the conventional way of spinning the top is by using a string. By the late 16th century, tops like these were being used by adults in Britain. The Museum has a varied collection of spinning tops, humming tops and gyroscopes.

A number of optical toys, developed in the early 19th century, use spinning to create moving pictures. One of these is the zoetrope invented in 1834. It consists of a metal drum pierced by a series of thin vertical slots. Paper strips, depicting a moving figure or object, are placed inside. When the child spins the drum and looks through the slots, the pictures appear to move. This is due to the principle of "persistence of vision"; the brain remembers what the eye has seen for a fraction of a second and so "pieces together" the separate pictures.

Spring mechanisms

The Jack-in-the-box is probably the best known old toy that uses a spring to make it move. When the lid is pushed closed the spring is compressed; when it is opened the spring is released and the toy jumps up as far as the spring allows. The longer the coil of the spring, the greater the force of energy released.

The toy seems to have originated in the 16th century when it was known as a Punch-box, which suggests that it may have been based on the puppet character that we know as Punch. Early examples either have carved wooden or papier mache heads and spring out of wooden boxes; the Museum also has 20th century versions made from various materials including tin and plastic.

Jack-in-the-box, c.1820-50

Wind-up toys

The simplest examples of wind-up toys are ones that use turning handles. The Museum has an example of a racing toy where the jockeys and riders are attached by strings to a drum inside a box; by turning the handle children coil the string around the drum and can "race" the horses to the post (1905-1910).

Clockwork toys work on a similar principle to that of a spring. A steel coil is wound up with a key and then released. A balance wheel is used to control the speed of release and ensure that the rate of relaxation is uniform. This results in a consistent release of energy. **Cogwheels** are used to convert the energy into movement.

From the late 17th century, French craftsmen made expensive clockwork toys for wealthy adults out of materials such as silver. In the 19th and early 20th century, there were expensive clockwork toys, such as walking dolls, but there were also mass produced tin toys.

Clockwork musical boxes are believed to have been developed by clockmakers in Switzerland in the early 18th century. They were not produced as children's toys until the 19th century but continue to be popular today, particularly as jewellery boxes with revolving ballerinas.

Clockwork Cinderella and Prince Charming, c.1955-60

Some wind up toys use **friction** to make them move. A central wheel (the friction wheel) is wound up by pushing the rear wheels of the toy backwards or forwards against a flat surface. When the toy is placed on the ground the friction wheel provides momentum to the other wheels to move the toy. The Museum has various examples, dating from the 1920s to the 1970s, including tin cars, trains and animals.

Battery-powered toys

Battery toys were first developed in the early 20th century. A battery contains special metals and acids that produce **electricity**. The electricity starts flowing when the ends, or terminals, of the battery are connected to form a loop or circuit. The electricity in a circuit from a battery will always flow in the same direction.

Most battery-powered toys will have an electric motor. An electric motor consists of magnets and coils of wire; when electricity (from the battery) flows in the coiled wire it makes the motor turn. The Museum has a number of examples of battery-powered toys including trains, cars, dolls and robots.

There are also a number of examples of electrical toys in the Museum such as trains and racing track games. The electricity from the mains changes direction very rapidly, therefore the design of the electrical motor needs to be slightly different.

Gravity toys

A number of toys use **gravity** to make them move. Early examples include pairs of tumblers from China that are weighted so that they will flip each other over as they "tumble" down a series of steps. In the 19th century, British makers produced cheap versions of this toy, including figures that tumble down ladders.

Sand toys, developed in France around 1800 and popular until the 1880s, also use gravity. Cardboard figures, often of acrobats or trapeze artists, are enclosed in wooden boxes with a glass front. The mechanism works on a similar principle to an hourglass; when the box is turned so that the sand is at the top, it trickles through a hole and turns a wheel. This sets in motion the figures that are connected to the wheel by wire or string.

Sand toy, c.1850-70

The Museum has a modern King Kong model (1978) that uses gravity to spectacular effect. It consists of King Kong, suspended by string between two buildings, each with aeroplanes on rods above. On top of one building is a **pulley** mechanism, with a single hook. When a weight is placed on the hook, gravity pulls it down. This makes King Kong "climb" the tower and the aeroplanes rotate. When the weight reaches the bottom, it automatically falls off the hook and King Kong slowly drops back down.

Useful websites

- www.museumofchildhood.org.uk
  Includes our Moving Toys and Build-a-toy interactive enabling children to find out how toys move and view x-ray photographs of their mechanisms.
- www.bbc.co.uk/schools/4_11/science.shtml
  Includes interactive games, puzzles and activities related to the QCA schemes of work for Science.
- www.teachingpets.co.uk/Science)/Contents.htm
  Ideas for teaching science including lessons exploring the ways in which objects move, magnets and electricity.
- www.toypost.co.uk
  Mail order company that sells a variety of traditional wooden toys including spinning tops and gravity toys.
- www.tinplatetoys.co.uk
  Mail order company that sells a variety of traditional tin toys including clockwork toys.

Word List

axle	A pin or rod in the centre of a wheel on which the wheel turns.
cam	A mechanism designed to change rotary motion into linear motion.
cogwheel	A toothed wheel.
crankshaft	A shaft attached to the axle of a wheel, for transferring linear motion into rotary motion.
electricity	A form of energy. **Current electricity** is electricity that flows; the path along which the current flows is called a circuit. For the current to flow there must not be any gaps in the circuit. When we turn on a light switch, for example, we are completing the circuit.
force	A force is often described as a push or a pull. It takes a force to change the motion of an object. For example, to stop or start moving, to speed up or slow down, to change direction. The heavier the object, the greater the force needed.
friction	Friction is produced when two surfaces rub together resisting motion. When you try to push a heavy object across the floor, it is friction that resists the motion.
gravity	Gravity is often described as the force that pulls everything downward towards the centre of the earth. In fact, all objects pull on all other objects with gravity. Gravity is a weak force and is only noticeable when one of the objects is very big like the earth.
lever	A bar placed on a support or fulcrum. If one end of the lever is further from the fulcrum than the other, a small force pushing on the long side of the lever produces a much bigger force at the other. It can therefore be used to lift heavy objects.
pulley	A pulley usually consists of two wheels and a rope. One wheel is attached to a fixed point and the other to a heavy object. The rope is fed from the fixed point, around the wheel attached to the heavy object, then back round the wheel attached to the fixed point. Pulling on the other end of the rope can then raise the heavy object. As with the lever, a small force is translated into much greater one.
torsion	The force with which a string or wire tends to return when twisted.

Pre-visit activities

- Make a collection of as many moving toys as you can (e.g. cars, clockwork toys, spinning tops). Ask children to investigate how to make the toys start and stop, to go faster and slower, and to change direction. Older children could record their findings on charts or spreadsheets.
- Try to collect as many mechanisms as you can (e.g. wheels, springs, string, clockwork). Encourage children to experiment with these and explain how they could use them to create movement. Can they match them to the toys above?
- Make a booklet out of plain paper for children to use during their museum visit. Ask them to decorate the cover and write their name and the title: Moving Toys. During their visit, they should draw a different moving toy on each page. Older children can be asked to label their drawings to show materials, mechanisms and/or arrows to show the direction of the forces.

What to see and do in the museum

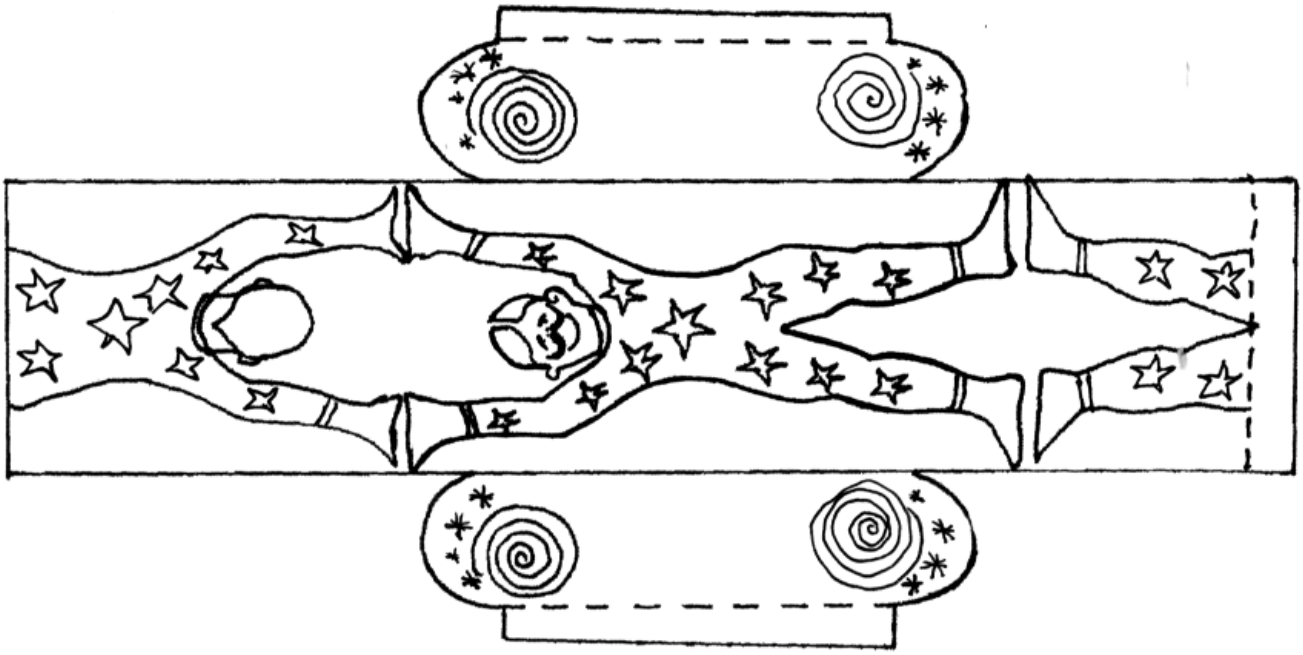
- Look at all the moving toys in the cases in the Lower Gallery
- Use the computer interactives to discover how the toys move (also available on our website)
- Play with the push and pull-along toys
- Ride the rocking swing-frame horse
- Play with the gravity toys and the electric train set

Post-visit activities

- Children can make a class museum of moving toys, using the ones collected before the visit. They should decide how to group and display the toys (e.g. according to force, to mechanism, to materials, to chronological age). KS2 children can write the wall panel information for each group of toys and make object labels.
- Using the museum's Moving Toys interactive (see **Useful websites** above), KS2 children can draw "x-ray photographs" of a toy in the class museum to show its internal mechanism.
- Help children make their own Tumbling Acrobat toy using the instructions and template provided.

Make your own Tumbling Acrobat

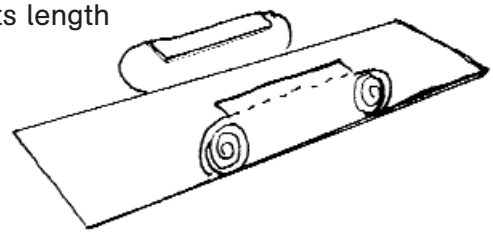
Template



Instructions

1. Enlarge and photocopy the template onto card. Colour it in and cut around it.

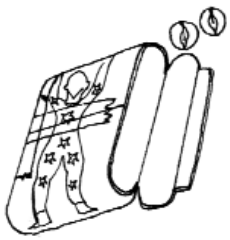
2. Place the pattern upside down on a table top and rub along its length several times with the side of a pencil, until it is very flexible.



3. Fold up the flaps on the pattern along the dotted lines.

4. Fold the pattern around so that it makes a loop. Overlap the ends and tape them together.

5. Fold in one of the flaps and tape it to the loop. Put two marbles inside and tape the other flap closed.



6. Your Tumbling Acrobat is now complete! Test him out on an inclined surface such as a tilted book. If he slides instead of tumbling, the surface is probably too smooth; try covering it with fabric such as felt.

KS1 Guide sheet

Moving Toys

Most moving toys use forces to make them move, change the way they move or stop them from moving. A force is often described as a push or a pull.

Go to the Moving Toys Gallery on the lower floor

Find the toys that you push or pull along

- Which toys do you have to pull to make them move?
- Which toys do you have to push?
- What would happen if you pushed or pulled very gently? Or very hard? *(They would move slowly, or more quickly.)*

Find the toys that have pedals

- What do you have to do to make these toys move?
- How can you make the bicycle slow down or stop? *(Use the brakes.)*

Find the toys that you have to wind up

- How do you wind up the toys? *(e.g. with a handle, with a key)*
- What happens when you wind them up? *(e.g. they move forwards or rotate)*
- What do you call a toy that you wind up with a key? *(clockwork)*

Find the toys that use springs to make them move

- How would you make the Jack's head jump out of the box?
- How would you play with the other toys that use springs?

Find the battery-powered toys

- What must you put inside these toys to make them work?
- How would you start the toys? *(e.g. press a button or switch)*
- What would happen to each toy when you did this? *(e.g. the legs would move, lights would flash)*

Other things to see or do in the gallery

- Look at toys that use natural forces to make them move.
- Use the computer interactives to discover more about how the toys move.
- Play with the push and pull-along toys.
- Ride the rocking swing-frame horse.
- Play with the gravity toys and the electric train set.

KS2 Guide sheet

Moving Toys

Most moving toys use forces to make them move, change the way they move or stop them from moving. A force is often described as a push or a pull.

Go to the Moving Toys Gallery on the lower floor

Find the toys that you push or pull along

- Can you find any toys with parts (other than the wheels) that would move as you pulled them along? How would the other parts move?
  (e.g. the duck whose head bobs up and down)
- (Year 5 and 6 only) What mechanism does this toy use? *(a cam)*

Find the spinning toys

- How do you make the tops spin? *(e.g. by pulling on the string)*
- Can you find the zoetrope? What would you see if you could spin the drum and look through the slots? *(Moving pictures, like a cartoon film.)*

Find the toys that you have to wind up

- Can you explain how clockwork toys work? *(The key winds up a steel coil, or spring. As it unwinds, it turns cogwheels that, in turn, move the toy.)*
- What is friction? How would you make the friction toys work?
  (Friction is the force produced when two surfaces rub together. You wind the toys up by rubbing the friction wheel, on the base, on a flat surface.)

Find the battery-powered toys

- What must these toys have inside them, as well as batteries?
  (They must have wires, to make an electrical circuit, and a motor, to power the toy.)

Find the gravity toys

- What is gravity? *(The force that pulls objects down towards the earth.)*
- Look at the sand toys. Can you explain how the mechanism at the back would move the figures? *(Gravity pulls the sand down to fill up the wheel; the weight pushes the wheel round, which moves the figure.)*
- Find other toys that use natural forces. Which forces do they use?

Other things to see or do in the gallery

- Look at toys that use other mechanisms to make them move.
- Use the computer interactives to discover more about how the toys move.
- Ride the rocking swing-frame horse.
- Experiment with the gravity toys and the electric train set.

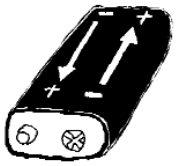
KS1 Activity sheet

Moving Toys

Tick the boxes when you find toys that use:

☐ a spring 

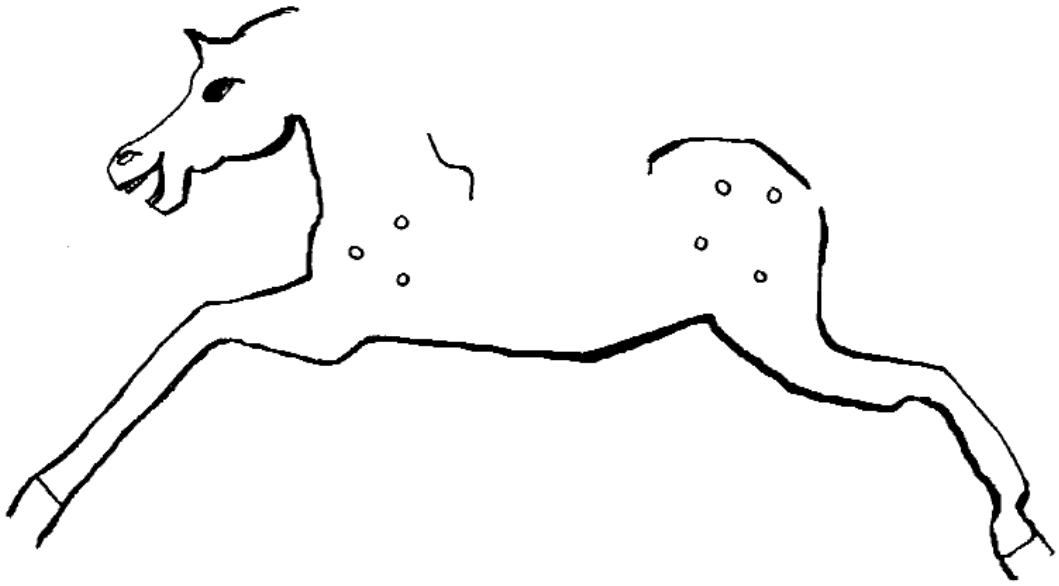
☐ a key 

☐ a battery 

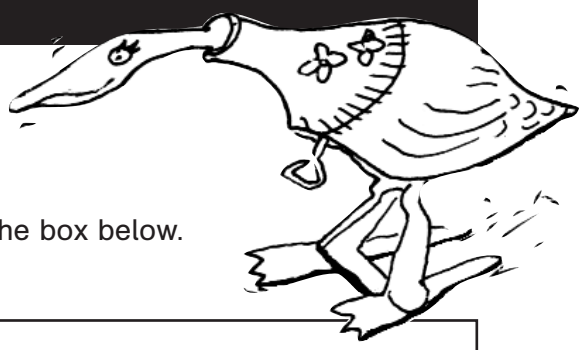
Draw your favourite moving toy in the box below and complete the sentence underneath.

My favourite toy uses ..... to make it move.

Now complete the drawing of the rocking horse. Don't forget his rockers, his saddle, his mane and his tail!



KS2 Activity sheet



Moving Toys

Look at the toys in the Moving Toys Gallery.

Choose one toy and make a careful drawing of it in the box below. Label the moving parts. (e.g. wheels, joints)

Now answer the following questions about your chosen toy.

1. What type of force does it use to make it move?

.....

2. Can you make it move faster, slower or stop? If so, how?

.....

3. Tick the boxes if it uses any of the mechanisms below:

☐ clockwork ☐ cam ☐ pulley ☐ lever ☐ spring

4. What material (or materials) is it made out of?

.....

5. Circle the reasons why you think this material (or materials) was chosen.

light heavy hard soft

durable waterproof rigid flexible