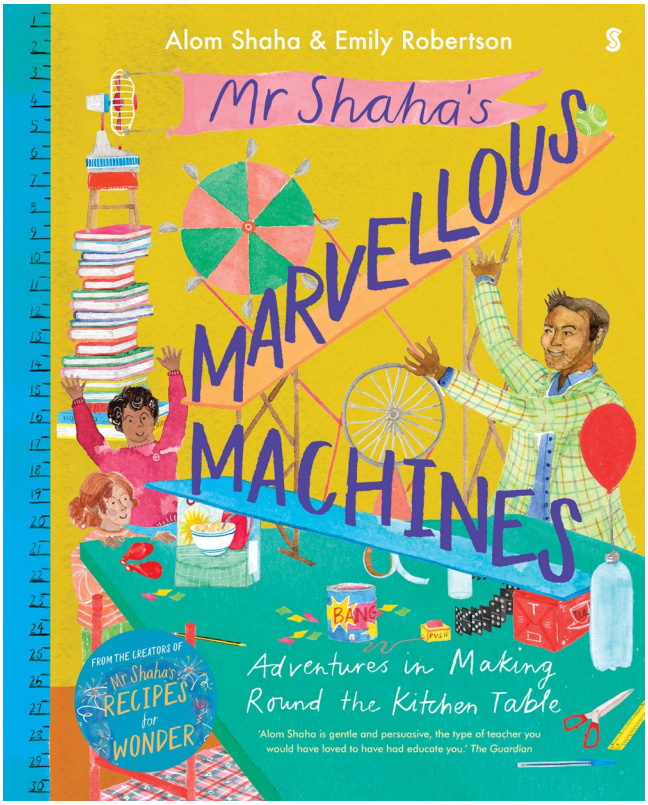


TEACHING NOTES

Mr Shaha's MARVELLOUS MACHINES

Title Mr Shaha's Marvellous Machines
Author Alom Shaha
Illustrator Emily Robertson
Publication July 2021
Category Picture book
ISBN 9781922310033

PLOT

Learn about the centre of gravity by making a balancing bird, create a toroidal vortex with a smoke-ring machine, and turn a spoon into an electromagnet. Chances are you won't need to buy the materials required for these machines because they're all in your house right now. Every child can be an engineer with the help of Mr Shaha and his marvellous machines.

THEMES

Science
Engineering
RRR
(reduce, re-use, recycle)
Toys
Construction

BALANCING BIRD

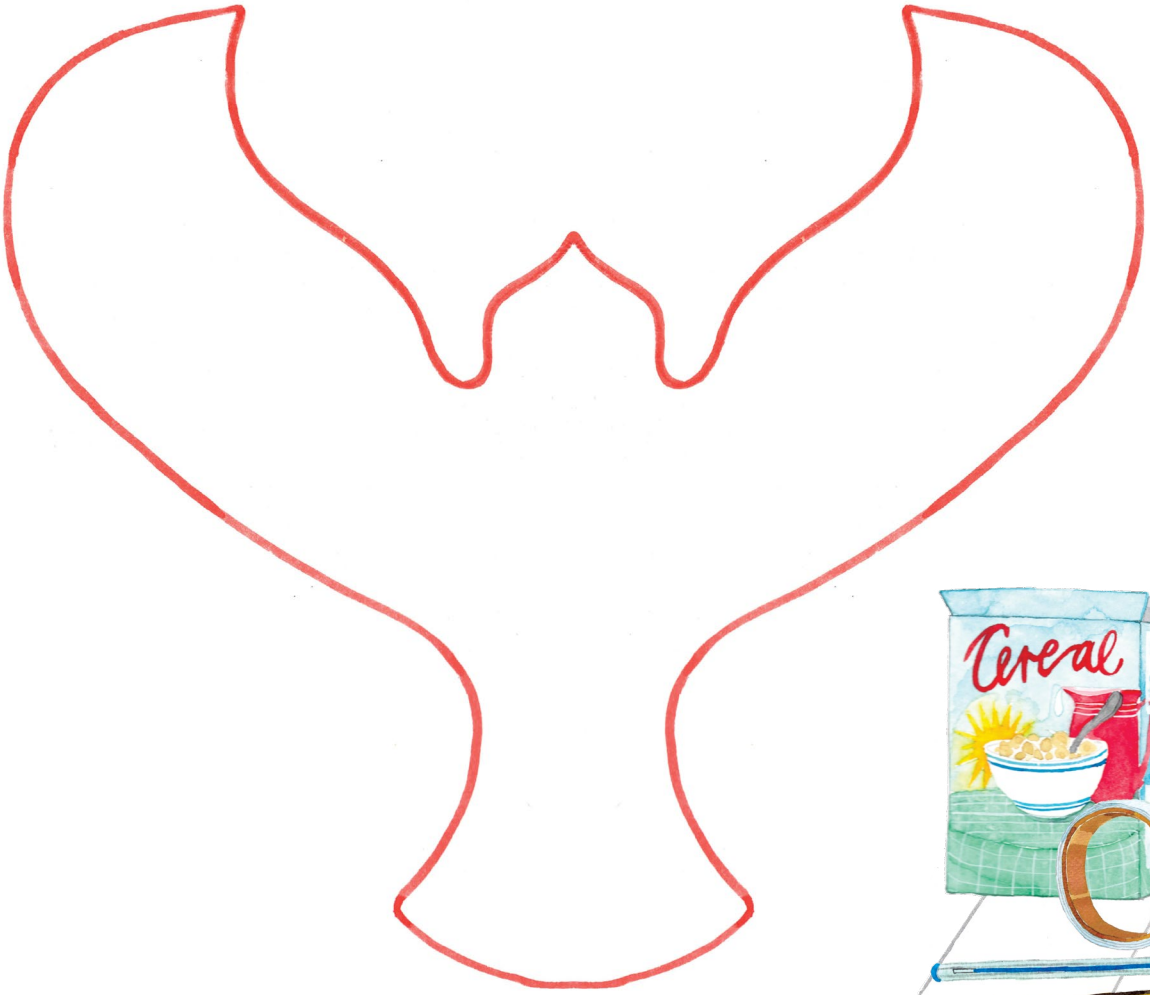
Have you seen the balancing bird in *Mr Shaha's Marvellous Machines*? Here is a printable version of this activity for you to share with your friends and classmates.

For this activity, you will need:

- Colourful pencils, crayons, or textas
- A piece of scrap card from a cereal box or similar
- 2 small coins of the same type
- Scissors
- A roll of sticky tape or masking tape
- A glue stick

Method:

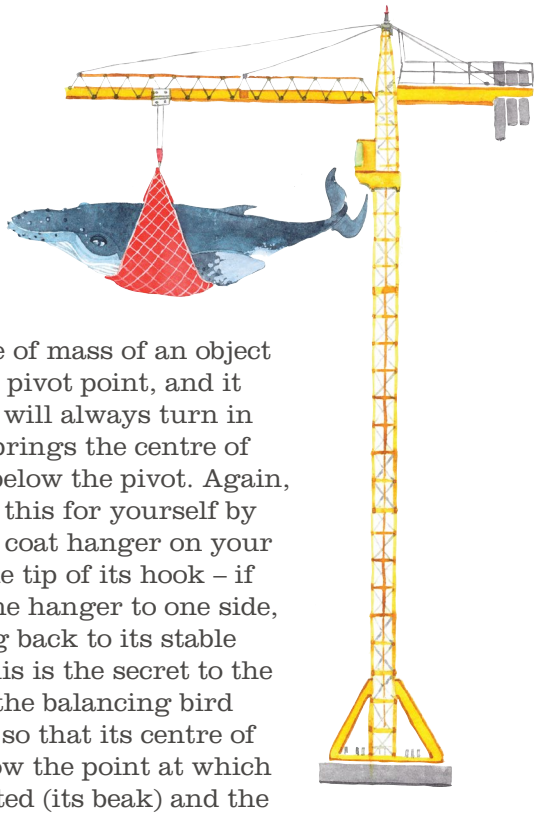
1. Decorate the bird template using the pencils, crayons, or textas.
2. Cut out the beautiful bird that you've illustrated.
3. Using the glue stick, stick it onto your piece of cardboard.
4. Cut the bird out of the cardboard.
5. Using small loops of sticky tape, stick a coin onto each wing in roughly the positions shown.
6. Bend the bird's wings downwards.
7. Bend the bird's beak downwards.
8. Balance the bird on your finger.
9. Try balancing the bird on other things.



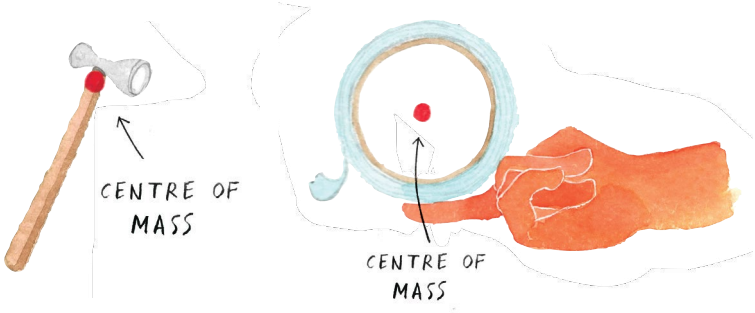
MR SHAHA says...

If you try to balance an object like a plate or a pencil, you'll find that there's only one point on the object below which you can put your finger to keep it stable. Scientists call this point the 'centre of mass' or the 'centre of gravity' of the object. You can think of it as the point around which the mass or weight of an object is evenly distributed. With something like a plate or pencil, the centre of mass is roughly in the middle of the object. For something that is heavier on one side, like a hammer, the centre of mass will be closer to the heavier end. The centre of mass doesn't have to be part of the object itself — for example, the centre of mass of a roll of sticky tape or a coat hanger is in the middle of the hole — i.e. in the air!

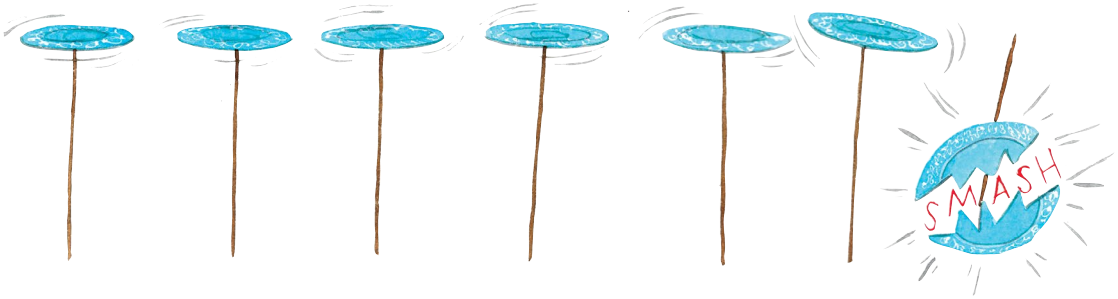
An object can only be balanced if its centre of mass stays in the same vertical line as the point at which it is pivoted, otherwise it will start to turn. If the centre of mass is above the pivot, this turning will make the object fall over. You can see this for yourself by trying to balance a roll of sticky tape on top of your finger – it's hard to do because the centre of mass doesn't stay above the pivot.



If the centre of mass of an object is below the pivot point, and it is moved, it will always turn in a way that brings the centre of mass back below the pivot. Again, you can see this for yourself by balancing a coat hanger on your finger by the tip of its hook – if you move the hanger to one side, it will swing back to its stable position. This is the secret to the stability of the balancing bird – it is made so that its centre of mass is below the point at which it is supported (its beak) and the centre of mass always falls back to a position directly below the pivot if it is moved.

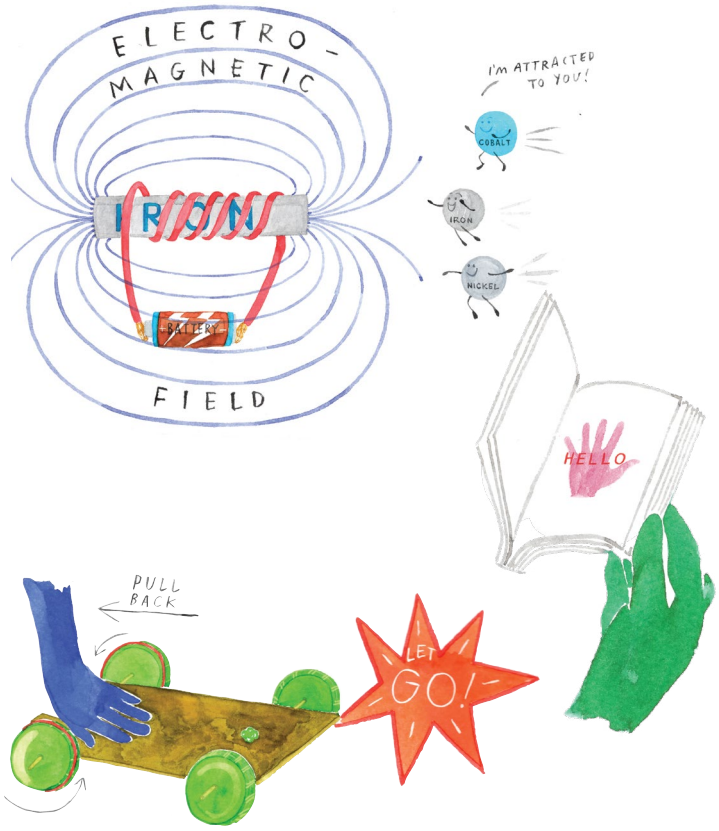


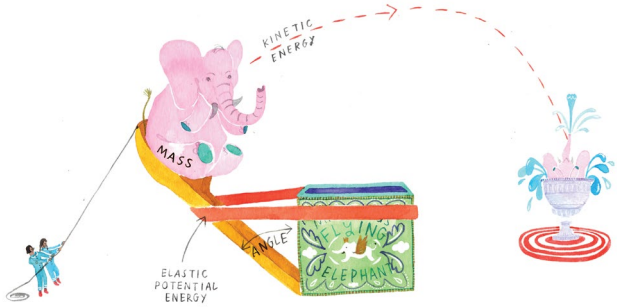
You can change the centre of mass of the bird by changing the position of the coins or by adjusting the angle at which you bend the wings. If you want the bird to balance, most of its weight needs to be below the pivot point.



MR SHAHA'S MARVELLOUS QUIZ

1. What is Newton's third law? Extra points if you can name some toys from the book that use this law!
2. What is the law of conservation of angular momentum? Name some toys from the book that use this law (one point per toy!)
3. When you pull back a mangonel or slingshot, what kind of energy are you storing up in it?
4. What is 'persistence of vision'? What toy in the book relies on this to work?
5. What is a magnetic field?
6. What is the 'centre of mass' or the 'centre of gravity' of an object?





Answers

1. The law says that forces always occur in pairs of equal size but acting in opposite directions. So, if you push something, it will always push back on you with the same amount of force in the opposite direction. Toys that use this law include: the rubber-band racer, the powered paddleboat, …
2. The law states that spinning objects tend to stay spinning unless an external force is applied. Some toys that demonstrate this law are the vortex cannon, the smoke-ring machine, and the water whirler.
3. Elastic potential energy.
4. Persistence of vision is the physical phenomenon of a person's eyes and brain keeping hold of an image for a fraction of a second, even after it's no longer in view. The mini movie machine takes advantage of this, turning a series of images into a 'moving' image — it only works if we flip through at least ten pages per second. Cinemas and TV shows do something similar — cinemas show us 24 images per second, and TVs show us 25 images per second.
5. A magnetic field is the space around a magnet, in which another magnet can be pushed or pulled.
6. This is the point around which the mass or weight of an object is evenly distributed.