EA jnr club

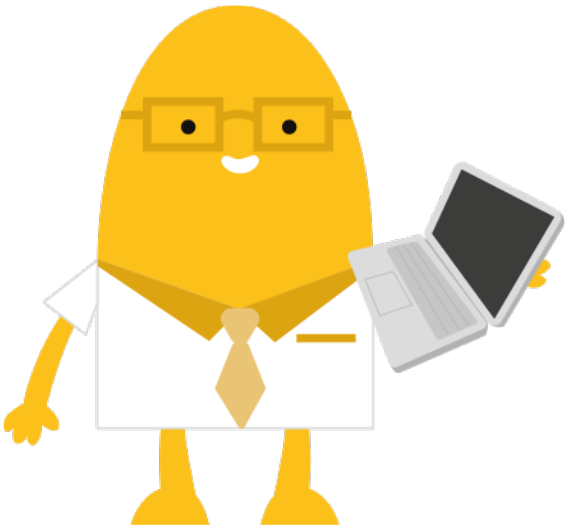
Lower Primary

TEACHER RESOURCE KIT

Publish a book

This guide includes:

- Lesson ideas
- Project instructions
- 'What is engineering?' activity sheet
- 'Look what engineering teams are doing!' activity sheet
- 'Engineering at school' activity sheet
- Know Want Learnt (KWL) Chart
- Think Want Learnt How (TWLH) Chart



ENGINEERS AUSTRALIA

Publish a book: *lesson ideas*

Science

- Show students various illustrations of the different fields of engineering. Students to complete the **'What is Engineering?'** activity sheet.

Technologies

- Students to complete the **'Look What Engineering Teams are Doing!'** activity sheet.
- Students to complete the **'Engineering at School'** activity sheet.

Mathematics

- Students to investigate which shapes are commonly found in famous structures from around the world. Which of these shapes make the structures strong and why?

English

- Explain to students what engineering teams are and do. Use pictures and key words to create a display in the classroom based on the title 'Which Engineering Teams Work in Our Community?'
- Students to complete the **'KWL Chart'** or **'TWLH Chart'** activity sheet.
- Students to brainstorm as many engineering words as possible and then create a page in their Science books on which to record them. Students will add to this as they learn new words. These words could be used to create a class word wall.
- Students to investigate books with pop-up and slide features. Discuss how these mechanisms enhance the stories or information.
- Invite a member of an engineering team to visit the classroom and give a talk about what he/she does for a living. Students to write a short recount of the talk, explaining in their own words what the speaker has said.

Humanities and Social Sciences

History

- Encourage students to bring in old books that were enjoyed by their parents or grandparents. If the books have moving parts or pop-up features, discuss how they have been constructed. Compare the books to ones that were published more recently or to students' favourite books. How are they the same and how are they different?

Geography

- Students to research the work currently being done by humanitarian engineers around the world.
- Organise an excursion to a place where engineering teams are, or have been, at work in the community. On the way there, ask students to look for things that might have been designed by engineering teams.

The Arts

- Students to create a collage using magazine pictures relating to engineering.
- Students to make their own paper.

Health and Physical Education

- When working on a project, it is very important that engineers work as part of a team. Students to practise working as part of a team by participating in team games such as basketball and football.
- Students to work in teams to build an obstacle course for the whole class to enjoy.

Languages

- Students to investigate the origin of the word 'engineer'.

Publish a book: *Project instructions*

Important safety information

Allow time to discuss the safety precautions that are essential when publishing the books. As a class, discuss how students can keep themselves and others safe. These ideas should be presented on a class poster and displayed in the classroom. All students should agree with these rules before starting and the safety precautions and guidelines should always be observed.

Getting started - research activities

- Students to participate in the 'Publish a book' lessons and complete the associated activity sheets.
- Students to investigate and research an aspect of science involving the work of engineers.

The design stage

Criteria for publishing the book may include:

- A3 size to ensure students have plenty of room to work.
- Students are to use a variety of materials (not just plain paper or cardboard). Other materials such as Paddle Pop sticks, string, wool etc. can be used to add colour, texture and interest.
- Students to include photographs, pictures and diagrams wherever relevant.
- The information provided in the book must be clear and easy to understand.
- Students are to include at least one of the paper engineering mechanisms (pop-ups, sliding parts and rotating parts) described in the 'Construction stage', on their page/s.

Students are to decide:

- whether their book is to be portrait or landscape orientation. Which format will best suit the way in which the content is to be presented?
- how the content is to be presented in the book.
- in what format their book is going to be presented. What material is to be used for the pages? How is the book going to be bound? Perhaps suggest to students that, for durability, they make the pages of their books out of cardboard rather than paper. Alternatively, students could place their pages in plastic protector sleeves or laminate them.
- what material will be suitable for the cover? It will need to be thicker and stronger cardboard than the pages. Cardboard from a box could be covered and/or decorated with paint, fabric, pictures etc.
- what other materials are going to be needed for the task? Are the materials readily available or do they need to be purchased?
- which of the paper engineering mechanisms are going to be incorporated?

The construction stage

There are many ways of putting the book together. See the table below for different options to decide which one will be most appropriate for your class budget.

Assembly / Binding Options	Advantages
Ring Binder	• Protects contents. • Allows for large numbers of pages. • Pages lie flat when turned. • Allows pages to be added or removed.
Display folder with plastic protector sleeves	• Protects contents. • Pages lie flat when turned. • Allows pages to be added or removed. • Students can assemble it themselves.
Plastic comb or wire binding	• Allows pages to be added or removed. • Accomodates a range of different sized books with different numbers of pages. • Stiff cardboard or clear plastic covers are available. • Pages lie flat when turned. • Reasonably inexpensive if the school has a binding machine.
Accordion book	• Pages can be any size. • Pages lie flat when opened. • Inexpensive. • Different and interesting. • Students can make it themselves.
Pages and cover sewn together	• Inexpensive. • Pages can be any size. • Different and interesting. • Information about sewn binding is readily available. • Two options - The book can be sewn down the left-hand side of the pages or down the spine. • Students can do it themselves.
Stapled	• Inexpensive. • Two options - The book can be stapled down the left-hand side of the pages or down the spine. • Pages can be any size. • Students can do it themselves.

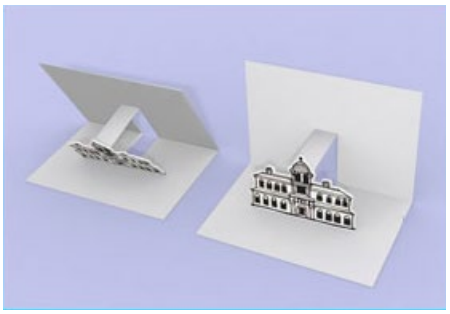
Paper engineering mechanisms – moving parts

Explain to students that by having moving parts in their books they are doing their own engineering because they are designing mechanisms to make objects move.

Students have a choice of incorporating three different types of moving parts into their book designs - pop-ups, sliding parts and rotating parts.

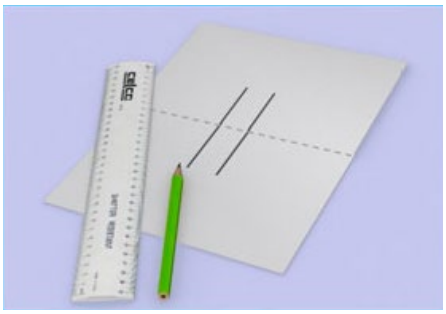
Constructing pop-ups

The mechanism commonly used in creating a pop-up book is called a 'parallelogram linkage'. If you look at a pop-up from the side you will be able to see the parallelogram linkage. Pop-ups are most commonly used in children's picture books to help bring images and scenes on the page alive and provide a more realistic and visual experience for the reader.



As the pages are closed, the linkage moves to keep the pop-up image parallel to the closing page. When the page is opened, the linkage maintains the image in a parallel position to the opening page.

Paper would be suitable for smaller pop-ups, however, cardboard, such as that from a cereal box, will probably be the most effective material for creating the pop-up mechanism.



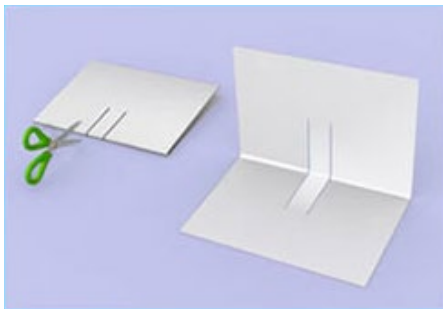
Step 1
Fold a sheet of paper or cardboard exactly in half.

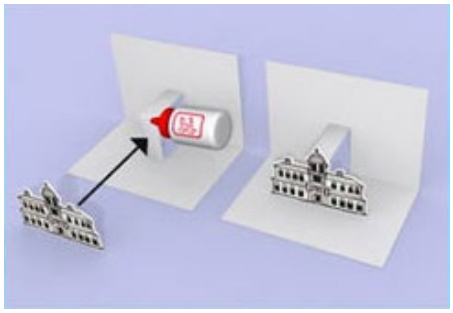
Step 2
Create the parallelogram linkage by ruling parallel lines in pencil vertically across the fold in the centre of the page. The linkages can be made as small or as large as students wish. However, the parallel lines should all be exactly the same length.

Step 3
Fold the sheet so that the pencil markings are on the outside and carefully cut along the parallel lines.

Step 4
Lift the cut section up as shown to make the linkage.

Step 5
Attach the desired image by gluing it carefully to the linkage, again as shown.



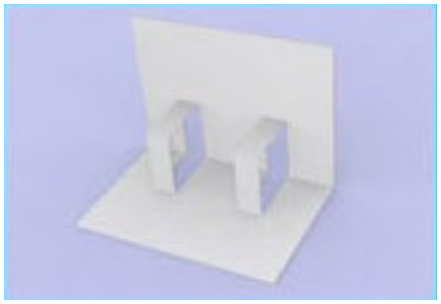
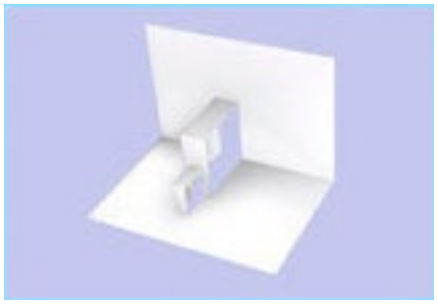
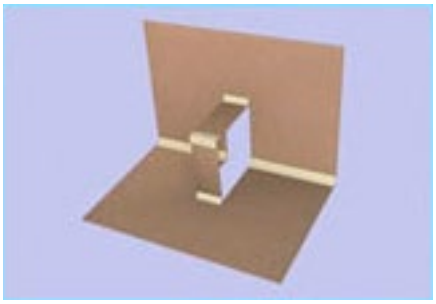


Other hints

Students do not need to be restricted to one linkage. They may wish to create two linkages on the same page so that two images pop up at the same time, as shown below.

Students can also create a smaller linkage within the main linkage to create one pop-up in front of another, as shown below.

Students might also like to create a large pop-up on one of the pages in their books. They will need to use stiff cardboard for this. The two sheets of cardboard can be joined with tape to form the hinge, and another piece of card used to create the linkage, as shown in the diagrams below.

From left to right: Two linkages the same size, a smaller linkage within the main linkage and a large pop-up.

Sliding parts

Sliding parts are a simple and effective way of creating moving objects in a book. A 'slider' moves in a straight line (*linear motion*).

Explain to students that there are many real-life examples of sliding parts. Drawers in cupboards and CD/DVD player trays slide in and out.

Another example is the pump on a soap dispenser, which moves up and down. What other examples of sliding parts can students think of? (Others include the needle in a sewing machine and the blades on an electric knife.)

Thin cardboard is the best material for making sliding parts. Cereal box cardboard works well because it is stiff and strong and will resist bending or tearing. Below is the basic concept for creating a sliding part in a book.

General hints for constructing a slider

- Students will need two pieces of cardboard to make one page. The upper surface of the top piece will be the background for the moving part. The lower surface of the bottom piece will be the next page. When using plain cardboard, the two pieces will need to be painted and decorated before moving on to the next step.
- The top piece of cardboard is where the slit is cut and the bottom piece is to hide the sliding mechanism.
- When the sliding mechanism is complete, the top and bottom sections of the page can be glued or taped around the edges, still allowing plenty of room for the slider to work freely.

Note: Remind students about the danger involved in cutting the slits as they will likely use a craft knife or a sharp pair of scissors to do this.

There are three different types of sliding parts for books:

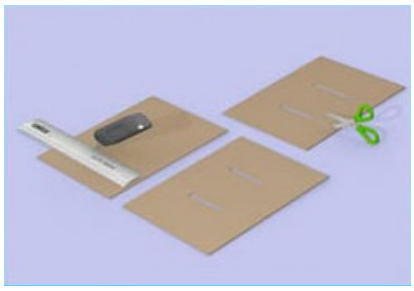
Constructing a slider

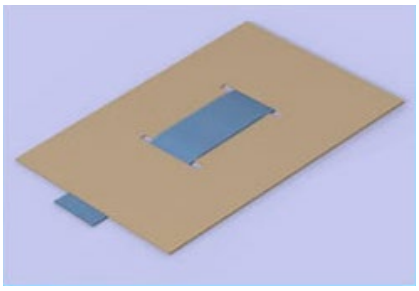
Step 1

Cut a strip of cardboard which will form the sliding part (the slider).

Step 2

Cut two slits in the page to guide the slider. The length of the slits need to be slightly greater (about 4-5cm) than the width of the slider. The slider can be threaded through the slits on the page, which guide its movement.



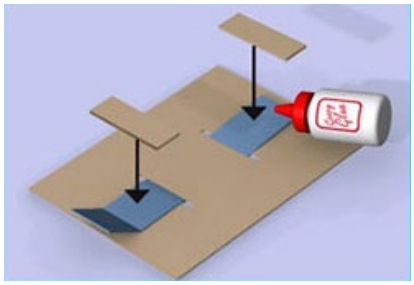


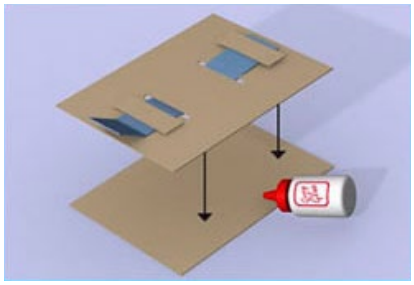
Step 3

The end of the slider can be folded slightly upwards. This makes it easier to grip the slider when moving it. To prevent the slider coming out of the slits, small pieces of cardboard can be glued to it.

Step 2

Students can now glue this top page to the bottom page using craft glue or tape around the edges.

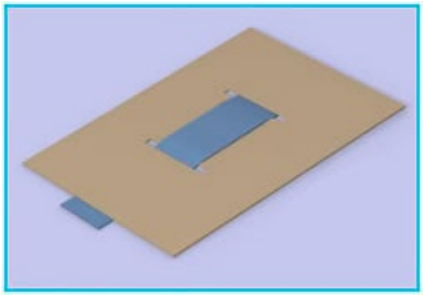


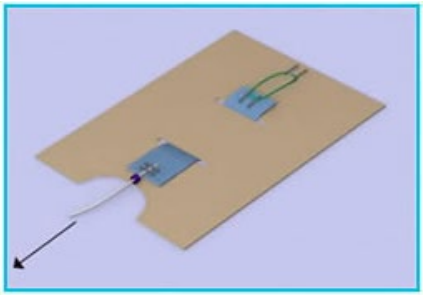


Other options

A second simple sliding mechanism, which is similar to the one described above, is arranged so that the slider is threaded through the slots from underneath instead of the top. A cut-out section at the bottom allows the user to grip the end of the slider more easily. A fairly stiff piece of cardboard is needed for this slider.

For extra complexity, students could create a spring-loaded sliding mechanism. This time, a piece of string or thin cord attached to the end of the slider controls its movement.





However, instead of just pushing and pulling the slider back and forth, a rubber band can be used to return the slider to its original position. One end of the band is stapled to the end of the slider, and the other to the page.

Students may also like to investigate other more complex sliding mechanisms which they could incorporate into their books.

Constructing turning and rotating parts

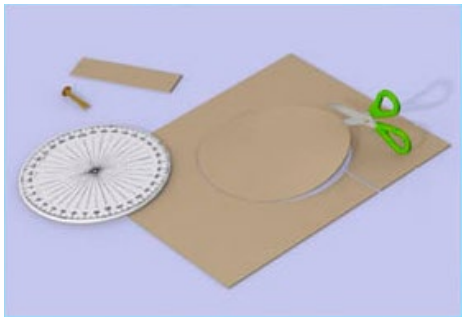
One of the most common types of movement in machines is what is called 'rotary motion'. We usually use words such as turning, spinning, rotating or revolving to describe this motion. Many things we see and use every day include examples of rotary motion. Examples include a Ferris wheel, the wheels on a train and the wheels on a large mining truck. Examples of smaller wheels include the wheels on a car, a bicycle, and on a wheelchair.

Brainstorm other examples of large and small wheels with students.

To construct a turning or rotating part, students will need cardboard, scissors, a split pin for each wheel mechanism and some glue. The legs of the split pin should be as short as possible.

Step 1

Using a protractor (*or an item to trace around*), draw the desired wheel or disk size onto a piece of cardboard, then cut it out.

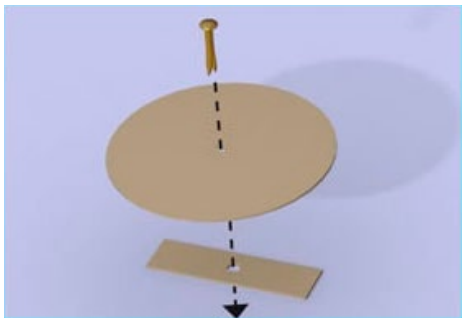


Step 2

Cut a thin strip off a stiff piece of cardboard. The strip must be shorter and narrower than the diameter of the disk, so that it will be hidden on the finished product. Put a hole in the centre with a hole punch (*it doesn't matter if the hole punch makes a second hole in the cardboard as it will be hidden by the disk*).

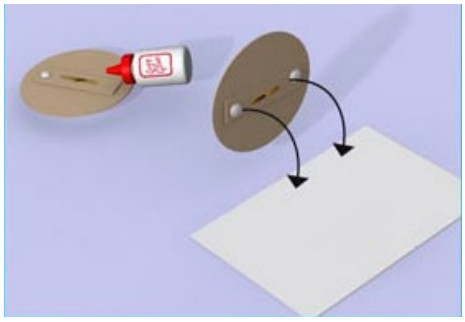
Step3

Make a small slit in the centre of the disk for the split pin. Then place the pin though the holes in the disk and the stiff piece of cardboard. Bend the legs of the pin to secure it.



Step 4

Apply glue to each end of the strip (*making sure that it stays away from the pin*) and attach the strip to the page, hiding the pin. Make sure that the disk is able to spin freely and apply pressure until the glue dries.



Constructing a small rotating part (wheel or disk)

Students may wish to have small wheels, such as those on a car, in their books. The process is basically the same as the method described earlier.

Step 1
Cut out the disk and make a small slit in the centre for the split pin.

Step 2
Cut out the shape of the image to which you are planning to attach the disk and punch two holes where the centre of the wheel is to be attached.

Step 3
Assemble the image, the wheels and the pin. Then apply glue around the edges of the image, making sure you keep it clear of the bent-over legs of the split pin.

Critiquing the designs

Students are to critique their books once they are completed:

- How durable is the book? Discuss how it might look once 100 people have read it.
- How well do the moving parts work? How durable are they?
- Does the content accurately reflect the information gathered about the topic? How easy is the information to read and understand?

What is engineering?

Name: _____

Draw a picture to illustrate what these fields of engineering involve.

Civil engineering	Chemical engineering
Electrical engineering	Mechanical engineering
Transport engineering	Hydraulic engineering

Look what engineering teams are doing!

Name: _____

Draw one item from each room of your house which could have been designed by an engineering team.

Kitchen	Living Room	Laundry
Bathroom	Study	Bedroom

Engineering at school

Name: _____

Brainstorm how each engineering field has helped, or is helping, your school and community.

Field of engineering	How engineering teams help or have helped our school
Civil	
Chemical	
Electrical	
Mechanical	

Know Want Learnt (KWL) Chart

Name: _____

What I **KNOW** about engineering	What I **WANT** to know about engineering	What I have **LEARNT** about engineering

Think Want Learnt How (TWLH) Chart

Name: _____

What we **THINK** we know about engineering	What we **WANT** to know about engineering	What we have **LEARNT** about engineering	**HOW** we learnt it