EA jnr club

Primary

TEACHER RESOURCE KIT

Construct a model house

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ENGINEERS AUSTRALIA

Construct a model house: *lesson ideas*

Science

- Students to complete the **'What is Engineering?'** activity sheet.
- Students to brainstorm various kinds of materials used to create buildings. How many can they think of? Discuss the advantages and disadvantages of each of these materials.
- Students to test the strength and stability of various building materials. Which materials do they think are the most durable and why? If they had a choice, what materials would students use to build a house and why?

Technologies

- In groups, students to design a building after determining its main purpose. What shapes will be used to give the building strength? Which shapes should be avoided? Which shapes are used for effect only?
- Students to design a 'futuristic' house. What changes to current house designs can they make?
- Students to complete the **'How Do Simple Machines Help Us?'** activity sheet.
- Students to complete the **'Who Helped to Create Items in my House?'** activity sheet.
- Students to experiment with Lego Technic or similar to construct a house.
- Class discussion: Why do we need machines and tools?
- Students to complete the **'Machines Are All Around Us'** activity sheet.
- Place students in teams of 3-4. In the team, each student is to be given the title of a particular engineering discipline (*structural*, *civil*, *mechanical etc.*) Each team is to design an environmentally-friendly house, which is safe from natural hazards, with each member of the team identifying what their role would be in building the house. They could present their ideas to the class, then complete the **'Safe and Environmentally-friendly Homes'** activity sheet.
- Students to choose a house design that is different to their own and compare them using a Venn diagram.

Mathematics

- Students to research the heights of ten buildings or towers and create a graph illustrating the tallest to the shortest. Students could also investigate the purposes of these buildings or towers, and list interesting facts/statistics about them. Do they sway in the wind? How many people can safely visit the structure at a time? How far up can people go in the structure? What shapes make stronger structures?
- Discuss with students the concept of scale and ratio, using examples of model railways, buildings etc.
- Students to record on a graph how many machines and tools they can find in their own homes.
- Students to create a structure out of matchsticks or ice-cream sticks. Assuming that each matchstick costs $100 and each join costs $50, students can then calculate the cost of their structures.
- Students to brainstorm as many 2D and 3D shapes as possible. Ask students to identify which shapes are used in one or two famous structures around the world and explain the reasons why. Allow students free time to construct shapes using matchsticks and Plasticine (*for joins*).
- Introduce 3D shapes, cubes and rectangular prisms. Students to create structures from these blocks.
- Students to design their own structure on grid paper using a maximum of three shapes. Shapes must be drawn accurately with a ruler.

English

- Students to use pictures and key words to create a display in the classroom based on engineering, building and construction.
- Students to brainstorm as many engineering words as possible, and then create a page in their Science books on which to record these words (*with definitions*). Students will add to this as they learn new words.
- Read the 'Three Little Pigs'. Discuss the advantages and disadvantages of the materials each of the pigs used to build their house. Brainstorm other materials that the little pigs could have used to build more durable houses.
- Research to discover where the words 'construction' and 'building' originated.
- Students to complete the **'KWL Chart'** or **'TWLH Chart'** activity sheet.
- Provide students with information on a variety of famous engineering structures. Students choose one and write a short information report about it.
- Students to complete the building **'Acrostic Poem'** activity sheet.

Humanities and Social Sciences

History

- Students to investigate the history of different types of houses found in Australia. How were they built? Why were they built that way? What were they built from? How have the types of houses we build changed and why? Students present their research in an interesting way.
- The invention of tools and simple machines has had an enormous impact on the way humans lived, survived and developed. As a class, discuss how our lives would be different if we had no machines or tools. In groups, students to prepare a speech for the class in response to this discussion.

Geography

- Show students pictures of houses from around the world. Ask them to assess the suitability of these houses for the Australian climate and conditions.
- Arrange to take students on an excursion to your nearest town or city centre. Students to investigate the different types of buildings found there. What shapes are they? What are all the buildings used for? Students to present their findings and report on what types of buildings were the most common and why.

Civics and Citizenship

- Engineers are valuable members of society. Students to investigate ways in which engineers have contributed to their local community.
- Students to work together, each with defined roles throughout all steps of the design, construction, testing and critiquing stages of their model house.

The Arts

- Students to make a model/diorama of their own house. These models could then be displayed in order of the year they were built.
- Students to use pictures from magazines, newspapers etc. to create a collage of as many different styles of houses as they can find.
- Students to draw and then paint (*as technically accurate as possible*) a picture of a famous structure, such as the Sydney Opera House.

- On a sheet of black paper, students to use a ruler to draw a skyline of skyscrapers, and cut along the outline. Using dark blue water-based paint, they paint a night sky for a background on a separate sheet of paper. They then glue their skyline on and decorate it using silver or gold pencils/pens.
- Using charcoal, students to produce a sketch of their own home from memory.

Health and Physical Education

- Students to discuss why we need houses/shelter. What are some other basic human needs? How different are our basic needs from those of people in other countries? Compare and discuss.

Languages

- Students to discuss famous buildings (*e.g. the Eiffel Tower*) from around the world and research why they were given their names.
- Students to investigate building styles in other countries and the names of the buildings in the local language/s. List these, and their English translations, on a wall chart.

Construct a model house: *Project instructions*

Important safety information

Allow plenty of time to discuss the safety precautions that are essential when students are constructing their houses. 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.

Reinforce to students that lighting MUST NOT be mains operated, it must be low voltage circuits, powered by batteries or solar cells.

Getting started - research activities

- Students to participate in the 'Construct a model house' lessons and complete the associated activity sheets.
- The teams can undertake some research on different building materials and their properties.
  Some factors to consider are:
  - Will the material build a strong structure?
  - Is the material readily available?
  - Can the material easily be worked or cut to the required size? Are any special tools needed to do this?
  - Is the material heavy or light? This is important when designing the roof, for example, because if heavy materials are used, the structure will need to be stronger to support these.
  - Is the material a good insulator of heat? Good insulating materials will be needed for the walls and ceiling.
  - What happens to the material when it gets wet? Porous materials such as cardboard may need to be coated (*e.g. painted)* to make them weatherproof.
  - Do the materials transmit light? Opaque materials will be required for most of the structure, with transparent materials for the windows.
  - Which materials are flammable, and which are not?
  - Are the building materials cheap or expensive? Do some materials cost too much?
- Teams will need to undertake some research about electric circuits if their house is going to include lighting. They will need to investigate aspects such as:
  - Electric circuits, switches, conductors, insulators, batteries, lamps.
  - 'Series' and 'parallel' circuits, and which one of these will be most appropriate for their project.
- Another area that students may wish to research is the energy efficiency of houses. This can include matters such as:
  - Which building materials are energy efficient?
  - Which designs are energy efficient?
  - The positioning of windows and doors.
  - The colours of the materials used.
  - The more favourable orientations for building a house (*i.e. facing in which direction?*)

The design stage

In this stage students begin to make plans for their model house. This will include planning the size and layout (*remember to match these to the 'person' for whom the house is being designed*).

The teams will need to decide on the type of design that they are going to use. For example, some designs could be based on a framework of strong materials (*perhaps wooden beams*) to which the walls are added using weaker materials (*sheets of cardboard, paper or plastic*). Other structures may need stronger sheet materials to provide the strength needed for the house. In this phase, students will need to consider the materials they will use and some ideas can be found in the 'Construction stage'.

The designs should be recorded on plans that include calculations of the size of each of the pieces of material used in the construction.

Older students can be encouraged to make their house plans 'to scale', for example, the plans could be drawn to a scale of 1:4 (*i.e. one quarter of the size of the actual model*).

Mandatory features

You may decide to ask students to include some mandatory features in their models. These could be:

- Lighting - the house should have electric lights which can be independently turned on and off using switches. (*Note: these MUST NOT be mains operated, but must be low voltage circuits, powered by batteries or solar cells*).
- Windows - the house will be fitted with windows to provide natural lighting.
- Roofing - the house needs a suitable weatherproof roofing material. The roof may need to be 'pitched' (*have a slope*) so that water will run off it.
- Rainwater - the house should be equipped with gutters and a rainwater tank so that any rain can be collected from the roof run-off.
- Insulation - the house should be energy efficient and well insulated. This will help keep the house cool in summer by limiting the amount of heat that can enter it, and warm in winter by limiting the amount of heat that can escape from it. The windows will need awnings so that the summer sun does not shine into the house.

The teams will also need to plan their electrical circuit if they are using one.

Note: If hook-up wire is not available, strips of folded alfoil can be used as an electrical conductor. A small block of wood with nails hammered into it can be used to make a battery holder. Switches can easily be made using paperclips held by drawing pins. Low voltage lamps are readily available, but LEDs can also be used - they draw much less current so the batteries will last longer. This process should be supervised by an adult.

The construction stage

Having completed the plans, the next stage is for the teams to construct their houses from the available materials. Some teams may need assistance with this phase.

Materials

The house is to be constructed of commonly available materials. These could include cardboard, timber, plywood, particle board, plastic, polystyrene sheeting and sheet metal. The materials can be joined using tape, adhesives, nails, screws etc.

Testing the model houses

The completed houses should now be tested:

- Is the house structurally strong?
- Does the doll/action figure fit inside the house?
- Does the house meet any mandatory requirements (*e.g. working lights, has windows, is weatherproof, is insulated and energy efficient, has rainwater collection etc.*)?

Critiquing the designs

It is likely that the teams will see a need to modify some aspects of their designs in order to make improvements (*either during the construction stage, or when the design is tested, or both*). They should be given opportunities to analyse their work, come up with suggested improvements, and test them.

Construction costs

Another project that can be introduced is to compare estimated construction material costs. This would require placing notional 'costs' on each of the materials used, then having the teams calculate the amount of each material used in their house, and thus the total cost.

Assessing the projects

While completing the construction and testing of their houses, students should be engaged in assessing the successes of their projects.

Some of the specific aspects to explore might include:

- Which particular designs were more successful? Why?
- Which shapes included in the designs appear to be stronger? (This might lead to exploring triangulation and braced structures.)
- What are the weak points in their structure? Why?
- How do their designs compare with the materials and designs of their own homes?
- What they have learned whilst doing the project?
- What else would they like to learn about housing design and construction?
- What would they do differently if they undertook the project again?

What is engineering?

Name: _____

Draw a picture or write a paragraph to describe what you think each of these fields of engineering involves.

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

How do simple machines help us?

Name: _____

Machines make it easier for us to do work. Simple machines need only one part to do the work. Investigate where we would commonly find these simple machines and how they help us.

Simple machine	Where can we find it?	What does it do?
Pulley		
Lever		
Wheel and axle		
Inclined plane		
Wedge		
Gear		
Screw		

Who helped to create items in my house?

Name: _____

List some things in your house that you think might have been created by engineering teams.

Rooms in my house	What I think engineering teams helped to create
The kitchen	
My bedroom	
The bathroom	

Machines are all around us

Name: _____

Take a walk around your school and the playground. **List all the machines you see.**

Name of machine	Who uses it?	What for?	What else could be used to do the same job?

Safe and environmentally-friendly homes

Name: _____

Structural engineering teams investigate how homes and buildings can be planned and built in the best possible way. They devise ways to make houses safer and more environmentally friendly. They also take natural hazards, such as cyclones, earthquakes and floods, into account.

Design and label a house that is both environmentally friendly and safe (*e.g. able to withstand cyclones, earthquakes and floods*).

Acrostic poem

Name: _____

B _____

U _____

I _____

L _____

D _____

I _____

N _____

G _____

Know Want Learnt (KWL) Chart

Name: _____

What I **KNOW** about design and construction of houses	What I **WANT** to know about design and construction of houses	What I have **LEARNT** about design and construction of houses

Think Want Learnt How (TWLH) Chart

Name: _____

What we **THINK** we know about design and construction of houses	What we **WANT** to know about design and construction of houses	What we have **LEARNT** about design and construction of houses	**HOW** we learnt it