EA jnr club

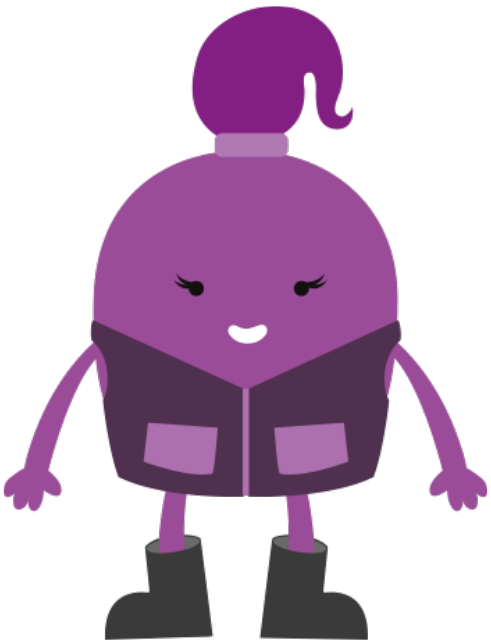
Lower Primary

TEACHER RESOURCE KIT

Construct a catchment

This guide includes:

- Background information
- Lesson ideas
- Project instructions
- 'Animals in the Cotter catchment' activity sheet
- Know Want Learnt (KWL) Chart
- Think Want Learnt How (TWLH) Chart



ENGINEERS AUSTRALIA

Construct a catchment: *background information*

Water catchments are areas of land which collect rainfall. They can stretch across thousands of square kilometres, or can be as small as a few square kilometres.

Dams/reservoirs in the catchments are used to store the water collected. Catchments can provide healthy waterways and vegetation; a supply of clean drinking water; water for farming and agriculture; and a natural habitat for recreation and wildlife.

Water catchment areas need the following things:

- a suitable location free from pollution, with plenty of water *(often situated within a national park)*
- ridges, hills or mountains to 'catch' rainfall, allowing it to flow into creeks and rivers
- a valley or gorge suitable for trapping and storing water
- a wall to hold back the water, allowing it to form into a dam/reservoir for storage
- pumping stations and pipelines to deliver the water to where it is needed for use.

Catchments are very important as they provide many animals with an ideal place to live. In dry places, a catchment can stand out like an oasis, providing a cool and colourful place for plant and animal life. Catchments will often create wetlands that are perfect for fish, birds and other animals.

Water catchment area

Construct a catchment: *lesson ideas*

Science

- Students to complete the **'Animals in the Cotter Catchment'** activity sheet.
- Class discussion: Why do we need dams and catchments? How do they enhance or affect habitats?
- Students to brainstorm all the things that might be found in a water catchment area and create a mindmap. This activity will be useful as an introductory activity for the 'Construct a catchment' project.

Technologies

- Students to research and evaluate the materials which are used to make dams and catchments (*natural and human-made*). Using this information, students select appropriate materials to make their catchment model.
- Students to build a water catchment area diorama. Materials could include twigs, dirt, sand, leaves, sponge, aluminium foil and Plasticine.

Mathematics

- Students to use various measuring containers to estimate, and then discover, what constitutes a litre (*e.g. how many cups of water make a litre?*). Students to record their results. The students can water the school garden when the activity is finished.
- Students to explore the capacity (*in formal or informal units*) of varying size containers (*e.g. small Tupperware containers or a large plastic tub*).

English

- 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 brainstorm words and terms relating to water catchment areas that can be organised into a word wall and displayed in the classroom. As new terms arise, and are understood, they can be added. Some examples are: wetlands, habitat, reservoir, dam, rainfall and evaporation.
- As a class, students to write a poem depicting the journey of water through a water catchment area. For example, one journey could begin with rain running into a creek, then into a river which flows into a dam/ reservoir and then through a pipeline until it reaches a bathroom tap.
- Students to complete the **'KWL Chart'** or **'TWLH Chart'** activity sheet.

Humanities and Social Sciences

History

- Students to interview an elderly person about how they used water when they were young. Was the availability of water similar to or different from today? How did they make sure they used water wisely?

Geography

- Students to brainstorm the various purposes of dams/reservoirs for human use (*such as irrigation and water supply*). Students to draw pictures to display in the classroom.
- Students to discuss the importance of water as a valuable resource. How do they use water at home? What would we do without water? Students to discuss what they can do to ensure that this precious resource is used wisely.

The Arts

- Students to build a water catchment area diorama. Materials could include twigs, dirt, sand, leaves, sponge, aluminium foil and Plasticine.

Health and Physical Education

- Students to brainstorm reasons why we need lots of fresh, clean water for our bodies.
- Students to brainstorm how catchments have helped human beings and the way we live.

Languages

- Students to learn how to say and write words such as 'water', 'environment' and 'catchment' in various languages.

Construct a catchment: *Project instructions*

Important safety information

Allow plenty of time to discuss any safety precautions that are essential when assembling and testing. These could include not using water near electrical equipment or outlets, avoiding the slip hazards of spilt water, and the safe handling of any tools that might be used in the activity. 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 must always be observed.

Getting started - research activities

- Students can investigate the dams/reservoir in their local areas, how they were constructed, and why they were built.

All steps of the design, construction, testing and critiquing stages could be recorded by students in a journal. Students may like to include: labelled diagrams, tables, graphs, photos, drawings etc.

The design stage

Students may need an introduction to models and what they can represent. It will be helpful at this stage to introduce some other examples of models and how they are used. The complexity of the models will depend on the ages and abilities of the students.

Students can work in teams to brainstorm all the things that might be found in a water catchment area. These could include land, water, native vegetation, crops, railways, water pipelines, houses, farms, roads, windmills,towns, a power station, forest plantations, national parks, wetlands, native and domestic animals and irrigation systems.

The teams then decide which of these features they are going to include in their models and plan what materials they will use to represent them.

Some examples could be:

- pieces of plants or trees (*e.g. pine tree shoots*) to represent the trees and plants in the national park
- rectangles of coloured cloth to represent crops
- blocks or cardboard structures to represent buildings, pumping stations, hydroelectric stations or power stations
- other structures could be made from matchsticks or ice-cream sticks
- straws can be used to represent water pipelines.

Each model should include at least one dam/reservoir. Students will need to plan what type/s of dam wall they will construct, and how they will do this.

They will need to decide:

- What is the main purpose of the dam/reservoir?
- What type of dam wall design will be used?

The following notes can be used as a guide for these two decisions.

The purpose of dams/reservoirs

Why are dams built? The reason can be one, or a combination of, the following:

- irrigation
- water supply
- generating hydroelectricity (*e.g. the Snowy Mountains Scheme dams/reservoirs and various dams/reservoirs in Tasmania*)
- storing and controlling waste materials (*e.g. the tailings dams/reservoirs associated with mining and mineral treatment*)
- maintaining river levels for navigation (*e.g. the locks on the Murray River*)
- creating recreational areas (*e.g. boating, water skiing and fishing*)
- mitigating (*limiting the effects of*) floods.

The types of dam walls

Dam wall designs fall into two main types:

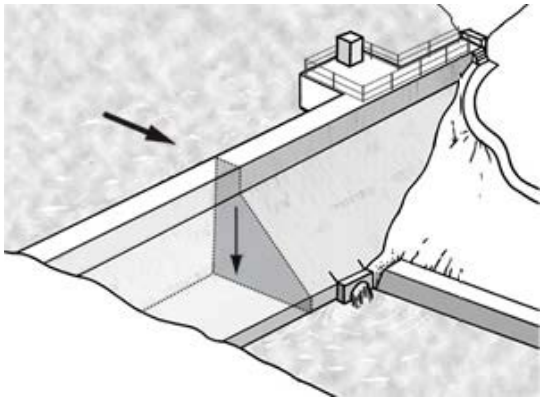
- gravity wall
- arch wall.

Engineers go to great lengths to decide upon the type of dam wall that will be built in any particular location. The type of dam wall will depend upon the location and the geology of the rocks upon which it is to be built.

Gravity wall dams

In a gravity wall dam, the weight of the dam wall is sufficient to hold back the force exerted by the stored water. These dam walls are commonly built in a straight line across the valley and are very broad across the base, narrowing towards the top of the dam wall. They are large and heavy, so the force of the water in the dam/reservoir pushing on the dam wall is transmitted to the rocks underneath the dam wall.

When such dams are designed, it is important that the dam wall is situated on a strong rock base that will not let the water leak underneath the dam wall and undermine it. Most gravity wall dams are built as solid structures, though some are of hollow construction. A common method is to build the facing walls with reinforced concrete, and use rock material to fill the inside of the dam wall.

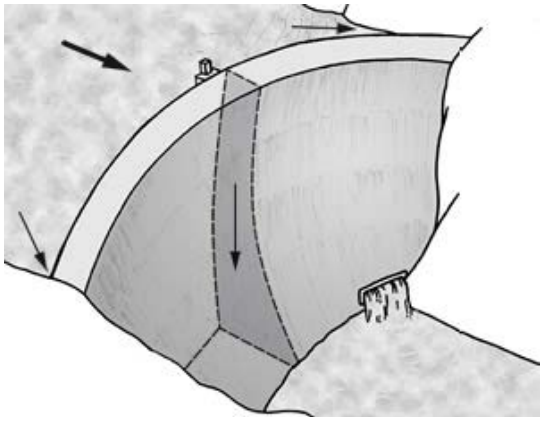


Gravity wall dam

Arch wall dam

In an arch wall dam, the wall is built in a curved shape that faces up-stream towards the dam/reservoir. This type of dam wall can only be built where there is a narrow gorge or valley with steep walls. The curved shape of the dam wall gives considerable extra strength. The force of the water, as well as being supported by the weight of the dam wall, is largely transmitted to the rocks that form the walls of the valley.

Arch wall dams are commonly constructed of reinforced concrete, but are not usually filled with rock material.



Arch wall dam

Advantages and disadvantages of gravity wall and arch wall dams

The curved shape of an arch wall dam provides considerable extra strength. This means that this type of dam wall can be built much more cheaply, and use far less building material, than a gravity wall dam. The wall of an arch wall dam is much thinner than that of a gravity wall dam of an equivalent size.

Many dam sites however are not suitable for building arch wall dams because the main force of the stored water on the dam wall is transmitted to the walls of the gorge or valley. This type of dam wall can only be built if the gorge or valley walls are steep enough and close enough together, and where the rocks are strong enough to carry the load of the water pushing on the dam wall. Gravity wall dams are thicker and larger, and use much more material to build. They are therefore more expensive to build, but can be used in many situations where arch wall dams cannot be built safely. This includes situations where the river valley is wide and has no suitable walls to support the building of an arch wall dam, or where the rocks in either, or both, of the valley walls are not strong enough to resist the load generated by the water in the dam/reservoir pushing against the dam wall.

Regardless of the type of design, it is important that the rocks underneath any dam wall are strong enough to support the load of the structure. If there are weak rocks underneath the dam wall that will allow water to leak under it, the dam wall can be undermined and be at risk of failure.

Project limitations

Students need to be made aware of the following limitations before the project begins:

- The water catchment is to be constructed from readily-available or 'found' materials, or items that can be easily and cheaply purchased in a hardware store or supermarket.
- The water catchment is to be well designed and constructed.
- There are size limits to the construction. Models mounted on a base are to measure no more than 1m square.
- As the operation of the water catchment will involve the use of water, a wet area will be required for testing.

Water conservation and efficiency

Encourage all participants to be 'water wise' and conserve water. Consideration should be given to minimising the amount of water used to demonstrate and test the catchment area models. The design could include a method of catching the water that flows from the bottom end of the catchment area model so that it can be reused.

The construction stage

Students should now be ready to begin the construction of their design.

Materials

Students are to create their water catchment area model out of readily-available or recycled materials, or items that can be purchased cheaply from a hardware store or supermarket. In choosing their construction materials, students will need to consider the properties of different materials and select those that are most appropriate.

Some considerations about the properties of materials should include the following:

- Strength - the structure needs to be strong enough to support its weight and to work without breaking.
- Water absorbency - some materials, such as cardboard, will absorb water and become soft and weak. If they are used they will need to be coated to make them waterproof.
- Size and shape of available materials.

To create a model topographical land surface, materials such as clay, soil, play-dough, papier mâché, polystyrene or Plasticine can be used. It is suggested that the topography can first be shaped using materials such as fly screen,

supported as needed above the base by any object that will give it the desired shape. These can be glued into place. The land surface can then be completed by moulding the clay or papier mâché over the wire frame.

As the water catchment model will need to be tested with some rainfall and runoff, it will be important to design the surface so that the water does not make it soggy. This can be done either by using materials that are non-porous to water *(e.g. plastic sheeting or Plasticine)* or by coating the surface with a lacquer or paint that will stop the water penetrating. Painting the topographic surface will also allow the use of different colours to represent different areas.

Making the model

Students should now be ready to begin construction of their design.

As a possible guide, students could construct a simple model in a tray or dish. Aluminium barbecue trays that are available cheaply from supermarkets can be used to build the model and to contain the water used to test it. Construction materials could include clay, soil, play-dough, papier mâché, polystyrene or Plasticine. Green coloured kitchen sponges which are porous could be used to help make the wetlands. If one tray is too small for the model, then two can be joined with tape (*and the separating walls flattened out*) to make a bigger tray.

Where models are constructed on a base, this should be no larger than 1m by 1m (*which is the maximum size for models allowed by various Science Teacher Association student competitions*).

The construction teams should be encouraged to label the important features of their water catchment models.

Testing and critiquing the designs

Having designed and constructed their models, the capability of the water catchment model should be tested by creating some rainfall from a sprinkler bottle or a watering can. The water must flow down the catchment area from the headwaters to the dam/reservoir, where it is trapped by the dam wall. This means the students' model will need to be constructed so the water will flow from higher levels to lower levels.

After this step, students should be given the opportunity to plan and carry out modifications and test the model again.

Following are examples of aspects for students to check:

- Are the slopes *(gradients)* correct? Does the water actually flow down the valleys as it should?
- Does the water flow across the surface without damaging the structure of the model?

Obviously there is a limit to how many of these critique and modify cycles can be built into a school program. However, it does need to be recognised that the capacity to critique a design and its performance, and consequently modify and test it again, is an important basic engineering principle.

Recording the results

Students should be encouraged to record their results in a meaningful way. Students could reflect on their catchments by drawing pictures or taking photographs or video of them and writing one or two sentences about them when they are completed.

Assessing the projects

On completing the construction and testing of their models, students should be engaged in assessing the successes of their projects. They should consider:

- Which particular designs were successful? Why?
- What have they learned whilst doing the project?
- What else would they like to learn about water conservation or catchments?
- What would they do differently if they undertook the project again?

Animals in the Cotter Catchment

Name: _____

Learn about the Cotter Reservoir, which is located in the Australian Capital Territory, near Canberra. Choose three animals that live in the surrounding national park that forms the catchment area for the Reservoir.

Use the spaces provided to illustrate the animal information.

Name of animal	Draw a picture	Draw its mainfood source	Draw where it lives

Know Want Learnt (KWL) Chart

Name: _____

What I **KNOW** about dams and catchments	What I **WANT** to know about dams and catchments	What I have **LEARNT** about dams and catchments

Think Want Learnt How (TWLH) Chart

Name: _____

What we **THINK** we know about dams and catchments	What we **WANT** to know about dams and catchments	What we have **LEARNT** about dams and catchments	**HOW** we learnt it