Flooding – Teacher Resource

Intended Use of Resources

This project has been designed so that teachers from different STEM areas can pick and choose sections relevant to their subject area to work on. All activities in this package do not need to be completed to get value from the package – each activity can be completed as a stand-alone or can be approached, as a team, as a larger project. The package has potential to be extended into a much longer project to include curriculum points from different STEM subjects.

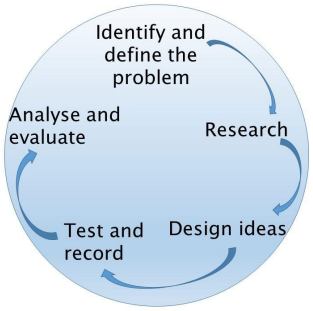
There are three **student workbooks - Open, Guided and Scaffolded,** that go along side this resource; all have the same suggestions for activities, however they have been written and edited to provide differentiated learning options to support good teaching practice**.** Teachers may pick and choose which versions they give which students, and may wish to edit them further to address their learning needs. Due to the differentiation of the workbooks, the **Open** activities will enable more syllabus links to be addressed, which is why each activity has its own syllabus links key. However, if you wish to give a truly open ended investigation then you could just give the students the challenge and background information section of the Student Workbook.

The Woodside Australia STEM Project aims to be accessible and supportive for teachers and students, please contact us if you have questions, require assistance or would like to arrange an incursion or a professional development workshop - www.wasp.edu.au

The Student Challenge

Floods can be damaging to property. For people looking to build in areas surrounding waterways it is vital that they understand which areas are most likely to be flooded so to assist them in making decisions about where and how to build.

Your job is to investigate factors that lead to flooding and design defences against flooding for an area surrounding a river. The end result 'hazard map' should show areas where flooding is most likely to happen and give some suggested solutions to reduce the impact of these floods.



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Background Information

Flooding occurs when increased water in a river channel can no longer be contained within that channel. This can happen when there has been long periods of rain or a sudden, large, downpour.

It has been predicted that as global climate changes storms and cyclones will become more frequent. This could lead to more flash floods, as rivers struggle to cope with sudden increases in volume of water.

Floodplains are often built on as they are flat areas of land which may be easier to work on. They are often very picturesque, which also makes them desirable. However, they are areas most at risk of flooding.

A simple way of reducing the damage caused by flooding is to restrict building near high-risk areas. There are also natural and engineered methods of preventing flooding where buildings do exist. These include building levees and deepening channels. Both can be expensive and can cause flooding downstream.

Flooding can lead to the destruction of houses, crops and farmland. Areas next to a river can become boggy and plants can be flattened. Local governments may try to minimise these impacts by developing hazard maps to identify areas prone to flooding then engaging engineers to come up with solutions for problem areas.

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Activities

This booklet contains extra information on each activity, including syllabus links the overall activity objective, suggestions for recommended equipment or alternative ways to run investigations as well as useful resources and website links. Please note that any reference websites provided in the entirety of our resource documents were current at the time of publication. Please advise if links are no longer accessible.

The syllabus links have been colour coded – please see the colour key below:

Covered in Scaffolded, guided and Open student workbook
Covered in Guided and Open Student workbook
Covered in Open student workbook

List of Activities

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Background Research

Objective

In this activity students will gain a greater understanding of what causes flooding. They will research the dangers of flooding. They will find out how to keep safe during a flood and what they can do to prepare for flooding. This includes what to pack in an emergency kit, what to do with animals and how to prepare your house. They will also research how to clean up after a flood and discover the importance of avoiding contaminated water.

	Australian Syllabus Links
Science	ACSSU096 Sudden geological changes and extreme weather events can affect Earth's surface. ACSHE100 Scientific knowledge is used to solve problems and inform personal and community decisions

Testing Soils

Objective

In this activity, students test the water retention of different soils. They find out if soils hold water, allow it to pass through quickly or do not allow it to pass through at all. They then relate this to the potential for flooding.

If you do not have funnels and beakers for this investigation you could use bottles cut in half and upturned. You could also use ordinary kitchen paper instead of filter paper, provided it is of high enough quality to prevent the soil breaking through.

Students should wash their hands after this investigation to avoid any contamination from touching the soil.

Students should find that soils rich in clay retain the most water and sandy soils retain the least. This is strongly related to the particle size and shape. Sandy soils are made of coarser particles than clay. The large particles also mean there are larger pore spaces between the particles and thus can transmit more water through them. Areas with soils that allow water to pass through them quickly will be less likely to flood, as less water will be trapped on the surface and unable to infiltrate.

	Australian Syllabus Links
Science	ACSIS103 Identify, plans and apply the elements of scientific investigations to answer questions and solve problems using equipment and materials safely and identifying risks. ACSIS104 Decide variables to be changed and measured in fair tests, and observe measure and record data with accuracy using digital technologies as appropriate. ACSIS107 Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships in data using digital technologies as appropriate. ACSIS108 Reflect on and suggest improvements to scientific investigations WATPPS36 Select, and apply, safe procedures when using a variety of components and equipment to make solutions. WATPPS38

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	Work independently, or collaboratively when required, considering resources and safety, to plan, develop and communicate ideas and information for solutions.
Technologies	ACTDEK023 Characteristics, properties and safe practice of a range of materials, systems, tools and equipment: and evaluate the suitability of their use.
Mathematics	ACMMG138 Connect volume and capacity and their units of measurement.

Useful website:

- Short video showing how to set up an investigation testing soils: https://www.youtube.com/watch?v=Ond_-SsiWE8

The Effect of Vegetation on Flooding

Objective

This investigation asks student to examine the impact of vegetation during heavy rainfall. Students slowly pour water over soil at the top of a slope, and then repeat the investigation with soil with a plant growing in it (ensure it is quite well established, with roots holding the soil together).

Students should see that when there is a plant much less soil is washed away, as it is held together by the roots of the plant. They should also observe less water passing through and down the slope as the plant takes in some water and the roots create pore spaces next to them for water to fill. The soil with the plant growing in it acts more like a sponge and should hold more water.

This is one reason why afforestation (planting trees), is a popular method of flood management. Plants are often placed on slopes to slow percolation and prevent excess run off during high rain periods. Plants next to rivers also stabilise the banks and make it less likely for the bank to be washed away.

	Australian Syllabus Links
Science	ACSSU096 Sudden geological changes and extreme weather events can affect Earth's surface. ACSHE100 Scientific knowledge is used to solve problems and inform personal and community decisions ACSIS103 Identify, plans and apply the elements of scientific investigations to answer questions and solve problems using equipment and materials safely and identifying risks. ACSIS104 Decide variables to be changed and measured in fair tests and observe, measure and record data with accuracy using digital technologies. ACSIS221 Compare data with predictions and use as evidence in developing explanations.

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Useful websites:

- ABC news article explaining how the removal of vegetation has caused flooding in the UK and Australia: http://education.abc.net.au/newsandarticles/blog/-/b/635262/lessons-from-the-summer
- Short video explaining how the introduction of mangroves can protect river banks and prevent them being washed away, therefore preventing flooding: https://www.youtube.com/watch?v=9lq8SeiDUEA
- Short article explaining how trees help prevent flooding, comparing vegetated to non-vegetated areas: http://www.greening.in/2013/05/how-trees-help-in-preventing-floods.html

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Permeable Pavement

Objective

The aim of this experiment is for students to work out their own permeable concrete mix.

It is important that students wear safety glasses for this investigation as it can be dangerous to get concrete dust in one's eyes. Teachers should be vigilant that safety precautions are being observed.

This investigation allows students to understand more about the properties of materials. They can discuss why a permeable pavement would be beneficial. Permeable pavements have high porosity and a rough texture. They are, however, not suitable for use on roads as they are not strong enough and would wear down tyres more quickly.

Each group will make their own permeable pavement which will produce differing results for the infiltration rate. Encourage students to use the plastic spoon to add the ingredients to their mix, so that they are only adding a little of each ingredient at a time. This avoids excess quantities being made and a reduction of mess created.

	Australian Syllabus Links
Science	ACSIS103 Identify, plans and apply the elements of scientific investigations to answer questions and solve problems using equipment and materials safely and identifying risks. ACSHE100 Scientific knowledge is used to solve problems and inform personal and community decisions. ACSIS108 Reflect on and suggest improvements to scientific investigations
Technologies	ACTDEK023 Characteristics, properties and safe practice of a range of materials, systems, tools and equipment: and evaluate the suitability of their use. WATPPS33 Define a problem, and a set of sequenced steps, with users making solutions for a given task WATPPS36 Select, and apply, safe procedures when using a variety of components and equipment to make solutions WATPPS38 Work independently, or collaboratively when required, considering resources and safety, to plan, develop and communicate ideas and information for solutions

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Mathematics	ACMNA126 Solve problems involving addition and subtraction of fractions with the same or related denominators.

Useful websites

- Video showing how to conduct investigation to create and test pervious pavement: https://www.youtube.com/watch?v=mTgifdu1r3s
- Video on creating pervious pavement with helpful tips on consistency measures throughout the process: https://www.youtube.com/watch?v=tDblkXphYlw

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Modelling Rivers

Objective

This investigation helps student to model the behaviour of rivers and determine reasons why a river may flood. Models are often used to make predictions and test designs by engineers.

You could try using homemade playdough instead of clay. This will be cheaper although please note that it may be more porous so results may vary. You could also colour the water with food colouring to make it easier for the students to see where the water is running. It is important that you fill the trays right to the top with the clay/ dough and then cut and fold the tray edges back so that the water doesn't run over the lip of the tray. Using a larger tray (creating a larger river) will lead to more easily observable results.

Students should observe that where there is less space for the water to flow (the narrow and shallow points) is where flooding occurs. This can lead to discussion about dredging and making the river deeper to hold more water.

Students will also find that water wants to take the path of least resistance, so will try to go straight at the meander and cut the meander off (this is how oxbow lakes form). River straightening is another engineered solution to flooding (although it can lead to flooding happening further downstream).

Students need to pour the water at a gentle pace – fast enough so that they will observe flooding, but slow enough so that it doesn't just flood everywhere. It may take them a few attempts to get the speed right and to observe the effects of river shape on flooding.

	Australian Syllabus Links
Science	ACSSU096 Sudden geological changes and extreme weather events can affect Earth's surface ACSIS221 Compare data with predictions and use as evidence in developing explanations
Technologies	Select, and apply, safe procedures when using a variety of components and equipment to make solutions.

Useful websites

- Short video explaining meander and oxbow lake formation: https://www.youtube.com/watch?v=4qKS_Nk7UmY

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Levees Experiment

Objective

In this activity students use materials to design a model levee. There is suggested material that the students could use however to provide a challenge you could limit certain materials such as duct tape. For more advanced students, you could cost each material which adds an economic factor for the students. You could ask the students to make the most economical levee by charging more for materials such as duct tape.

Students should find that their final design using the manufactured materials is the most effective at preventing water to pass through. However, there are many places in the world where they cannot afford to install concrete, impermeable levees. In these places mud and silt levees are built instead. These are easily eroded and washed away during periods of high rain when the river flows faster. The best way to prevent this from happening is to plant vegetation on river banks so the roots will hold the soil in place. Man-made levees also make it difficult for the water to retreat if it does burst over the banks – meaning the flooding lasts longer.

	Australian syllabus links
Science	ACSSU096 Sudden geological changes and extreme weather events can affect Earth's surface ACSIS103 Identify, plan and apply the elements of scientific investigations to answer questions and solve problems using equipment and material safely and identify potential risks.
Technologies	ACTDEK023 Characteristics, properties and safe practice of a range of materials, systems, tools and equipment: and evaluate the suitability of their use. WATPPS36 Select, and apply, safe procedures when using a variety of components and equipment to make solutions

Useful websites

- Building levees experiment video: https://www.youtube.com/watch?v=e4DxUTyestU&feature=youtu.be
- National Geographic education page explaining what levees are and how they work https://www.nationalgeographic.org/encyclopedia/levee/

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Designing Defences

Objective

This exercise asks students to draw on their findings from the Modelling Rivers activity. If they have not done this then they will need to do some further research about where flooding commonly occurs in a river and the possible causes of flooding.

Having made predictions about where flooding is most likely to occur, students research different techniques used to prevent flooding, and add details from investigations they have carried out (such as dredging to allow more water to flow through).

Students should consider the infrastructure when making suggestions for improvements. For example, straightening a river where there is a large meander may not be a viable option. This may be due to changing the ecology of the area, the logistics of earthworks and the prohibitive cost of relocating existing infrastructure.

If there is a lot of vegetation around the river a good suggestion would be to plant trees to secure the banks. In more built up areas, levees may be a better recommendation. For the guided and open students, considering the river bathymetry (depth) and suggesting dredging at places where the river is narrow and shallow to create more space for the water to flow may be an option.

	Australian Syllabus Links
Science	ACSSU096 Sudden geological changes and extreme weather events can affect Earth's surface ACSHE100 Scientific knowledge is used to solve problems and inform personal and community decisions Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts.
Technologies	ACTDEK023 Characteristics, properties and safe practice of a range of materials, systems, tools and equipment: and evaluate the suitability of their use. ACTDEK019 How people address competing considerations, including sustainability when designing products, services and environments and future use.

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Useful websites:

- BBC Bitesize page explains how different river management strategies work and their advantages and disadvantages: https://www.bbc.com/bitesize/guides/zppdg82/revision/5
- Bathymetry (depth) data of the Swan River: https://www.transport.wa.gov.au/imarine/Gregory-to-Perth.asp#36360

Bibliography

(Figure numbers from scaffolded booklet)

Figure 5: Rang-ayan Bridges Dikes River Paniqui, accessed at https://commons.wikimedia.org/wiki/File:0474jfAbogado_Rangayan_Bridges_Dikes_River_Paniqui_Tarlacfvf_35.JPG on 23/5/19

Figure 6. Map of Perth metro and the Swan River, accessed at https://goo.gl/maps/f4hYmZMTAVhNcWhi6 on 23/05/19