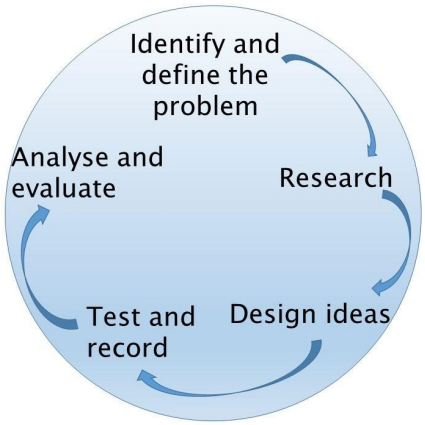
Flooding – Student Workbook

The 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.



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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Background Research

Visit the Department of Fire and Emergency Services' (DFES) website and use the information found here, particularly in the video, 'Dangers of Floodwaters', to answer the following questions:
(https://www.dfes.wa.gov.au/safetyinformation/flood/Pages/default.aspx)

1. What is the most common type of flooding in Australia known as?
2. How many deaths have been related to floods in a ten-year period?
3. What three simple steps can you take to keep safe around floodwaters?
4. List some of the dangers of floodwaters.
5. DFES recommends that people use a range of sources of information in an emergency. List three.
6. List three ways you can prepare for a flood.
7. List five items that you need in your emergency kit.
8. What should you do with pets during a flood?
9. List some household tips that can help you prepare for a flood and protect your property.
10. Jot down three tips for returning home after a flood.
11. What should you do with food that has been exposed to floodwater?
12. What should you do with mattresses that have been soaked with floodwater?
13. How do you access the DFES public information line?

Testing Soils

Background

The type of soil in an area can be a major factor in determining whether it is prone to flooding or not. Some soils do not allow water to soak into them readily, causing it to wash away (or flood). Others allow water to soak in quickly, causing it to move downwards into underground water stores (so are less likely to flood). Others soak up water readily and hold it, these soils are said to have a high water-holding capacity (these soils can become very waterlogged after a lot of rain).

Objective

Design and conduct an investigation which will examine a range of soils to see how they respond to the addition of water.

Equipment

- 3 beakers
- 1 funnel
- Graduated cylinder (or other equipment that can measure mL of water collected)
- 6 sheets of filter paper
- 3 soil samples
- Retort stand with boss head and clamp (or similar)
- A cup/scoop
- Stopwatch

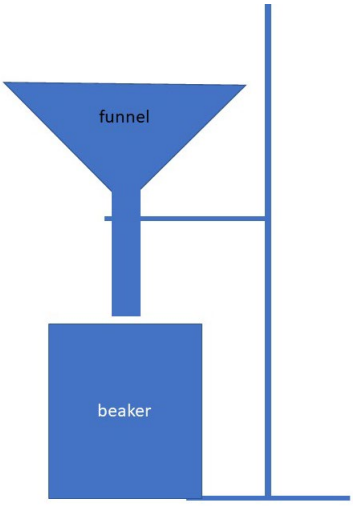

Figure 1. Equipment set-up

Hypothesis

Write your prediction for what will happen when water is added to each of the three soil types provided.

Method

Using the equipment above and any other equipment you feel necessary, write out a method which will allow you to examine and compare the properties of different soils in a dry and saturated state. Ensure you have your teacher's approval before conducting the investigation.

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Results and Analysis

1. Create a table to record your results in.
2. Present your results in a bar chart or pie graph or another suitable means.
3. Which soil had the highest water-holding capacity?
4. Was there a difference in how the soils behaved when water was added to them when dry, and when already wet?
5. Which soil is most likely to become waterlogged? Explain your answer.
6. Which soil is most likely to allow water to pass through into underground water stores? Explain your answer.
7. Did any of the soils you were working with take a long time to soak up the water added (you would have seen water sitting above the soil in the funnel)?
8. Which soil type is most likely to contribute to flooding? Explain your answer.

Discussion

1. What kind of soil do you have in your area and what does this mean in terms of the likelihood of flooding occurring?
2. Which type of soil do you think that gardeners prefer? Explain your answer.

Evaluation

1. Was this experiment a fair test?
2. How could you change the experiment to make it better?

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The Effect of Vegetation on Flooding

Objective

Design an investigation to determine what impact vegetation has on the likelihood and consequences of flooding.

Method

Design an investigation which will enable you to compare the effects of flooding in a vegetated and non-vegetated area. Show your method to your teacher and gain permission before conducting your investigation.

Hypothesis

Write a hypothesis for your investigation – what do you predict will happen?

Results and Analysis

1. Draw and label diagrams to explain what happened in the experiment trials.
2. Explain what you think caused any differences in the trials.
3. Is a vegetated area or a non-vegetated area more likely to flood?

Evaluation

1. Was this experiment a fair test?
2. How could you change the experiment to make it better?

Extension

Green Infrastructure (GI) relies on designs which use natural systems to manage stormwater runoff. One method of GI is green roofs which are rooftops that are planted with native vegetation over a waterproof layer. Discuss how green roofs could help prevent flooding.

From the experiment discuss any other hazards that are caused by lack of vegetation.

Permeable Pavement

Background

When there is heavy rain in built up areas flash flooding can occur, as the water runs off concrete surface. One method of reducing the amount of storm water run-off is by creating a permeable pavement. This allows the rain water to pass through it into the soil below. A normal pavement is made of sand, cement, aggregate and water. To make it permeable the mixture for the pavement must be changed, by removing one of the usual ingredients. A **permeable** pavement needs to be **porous** enough to allow water to pass through it but also strong enough to allow people to walk over it. The perfect mix should not be too wet or it won't drain well, or too chunky as then it will break easily.

What do the following terms mean?

a) Porous
b) Permeable

Objective

To investigate the best mix of materials to create a permeable pavement.

Hypothesis

Which mixture of materials do you predict will make the best permeable pavement?

Equipment

- Plastic table cover
- 1 container of coarse aggregate e.g. limestone, pebble or granite
- 1 container of sand
- 1 container of Portland cement
- Water
- Measuring scoop (the one from washing powder is a good size)
- 3 plastic cups
- 3 stirring sticks
- 2 x measuring beakers
- Filter, retort stand, boss head and clamp
- 3 x filter paper
- Stopwatch
- Gloves
- Safety glasses

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Method

Design an investigation which will enable you to test mixes with different proportions of aggregate, sand and cement for suitability as a permeable pavement.Results and Analysis

Result and Analysis

1. Create a table to record your results in.
2. Present your results in a bar chart or pie graph or another suitable means.
3. Which mixture had the highest infiltration rate (allowed the water to pass through the fastest)?
4. Which mix was the least permeable (allowed the least water to pass through)?
5. Which mix would be best to use in pavements to prevent flash flooding? Explain your answer.

Evaluation

1. Was this experiment a fair test?
2. How could you change the experiment to make it better?

Extension

The most permeable mix was also likely very porous and had a rough surface. Discuss why although it is suitable for a pavement but it may not be suitable for use on a road.

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Modelling Rivers

Background

Rivers contain many features and are not just straight; they have meanders (bends). Rivers also pass through different rock types, this might mean they will erode the sides and bottom at different rates, this can lead to parts of the river being narrower or shallower than other parts.

Objective

Design an investigation to model river features and determine where flooding is likely to happen.

Method

Write up a step-by-step method of how you will model the river and test to see where flooding occurs. Show this to your teacher and gain their approval before you conduct the investigation.

Results

Draw diagrams to show where flooding occurred in each scenario you set up.

Discussion

1. Why do you think that flooding happens in particular areas?
2. What could be done to the river to try and prevent flooding from happening?

Evaluation

1. How true to life do you think your investigation was?
2. How could you improve the investigation?

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Levees Investigation

Objective

Design, test and evaluate model levees and compare their effectiveness.

Research

1. What is a levee?
2. What is the purpose of a levee?
3. How does a natural levee form?

Equipment

- Sandwich bag
- Popsicle sticks
- Gravel
- Sand
- Cardboard
- Duct tape
- Plastic container
- Cup/beaker
- Sand

Method

Using the equipment above and any other equipment you feel necessary, write out a method which will allow you to examine how effective levees made from a variety of materials are. Ensure you have your teacher's approval before conducting the investigation.

Results and Discussion

1. How effective were your levees at keeping the water contained?

Extension

In some places in the world they can't afford to pay for man made levees, what might be the problem with only using sand and gravel as a levee?

Levees can be quite controversial, people argue that man made levees can make flooding worse. Use the results of your investigation to discuss how this could be possible.

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Designing Defences

Objective

To research different flood management techniques and design flood defences for a local river.

1. Download the Bathymetry maps of Swan and Canning river from the Department of Transport website (https://www.transport.wa.gov.au/imarine/Gregory-to-Perth.asp#36360). These show you the depth of the rivers as well as the course that they take. Highlight areas you think flooding is most likely to occur and **explain why**.
2. Research different types of flood prevention and record your findings.
3. Mark on your map where you think different flood prevention techniques should be used.
4. For each location explain why you have chosen a particular river management technique and how you think it would prevent flooding.

Discussion

What other information would you like to find out about the area, and why would that help you decide which flood prevention techniques to put in place?