Image courtesy of Claire Seeley

Beat the Flood

Designing a flood-proof home, Sandlings Primary School, UK

This challenge will enable pupils aged 7–14 to discover the impact that flooding has on people's lives, and how science and technology can mitigate its effects and help find potential solutions.

By Julie Brown

Imagine living with the danger that your home could be flooded at any time. Our climate is changing and for many people living near riverbanks, the fear of flooding is constant. 'Beat the Flood'[w1] is a challenge for pupils aged 7–14 that will enable them to discover the impact that flooding has on people's lives, and how science and technology can mitigate its effects and help find potential solutions.

Working in teams, the children design and build a model of a flood-proof home for their family on the fictitious island of Watu, then test it by putting it in water and squirting it with a hose pipe. They consider how

REVIEW

- Physics
- Geography
- Maths
- Economics
- Ages 11–19

This article is a great opportunity to collaborate with other teachers of your school. It could be used as part of a physics lesson. However, pupils also need to use knowledge from different disciplines such as geography, science, and maths, and make complex decisions integrating many factors such as cost and sustainability. Therefore, it is ideal for interdisciplinary teaching and it could foster some interesting discussions on how several science or non-science subjects (e.g. geography, maths and economics) could work together.

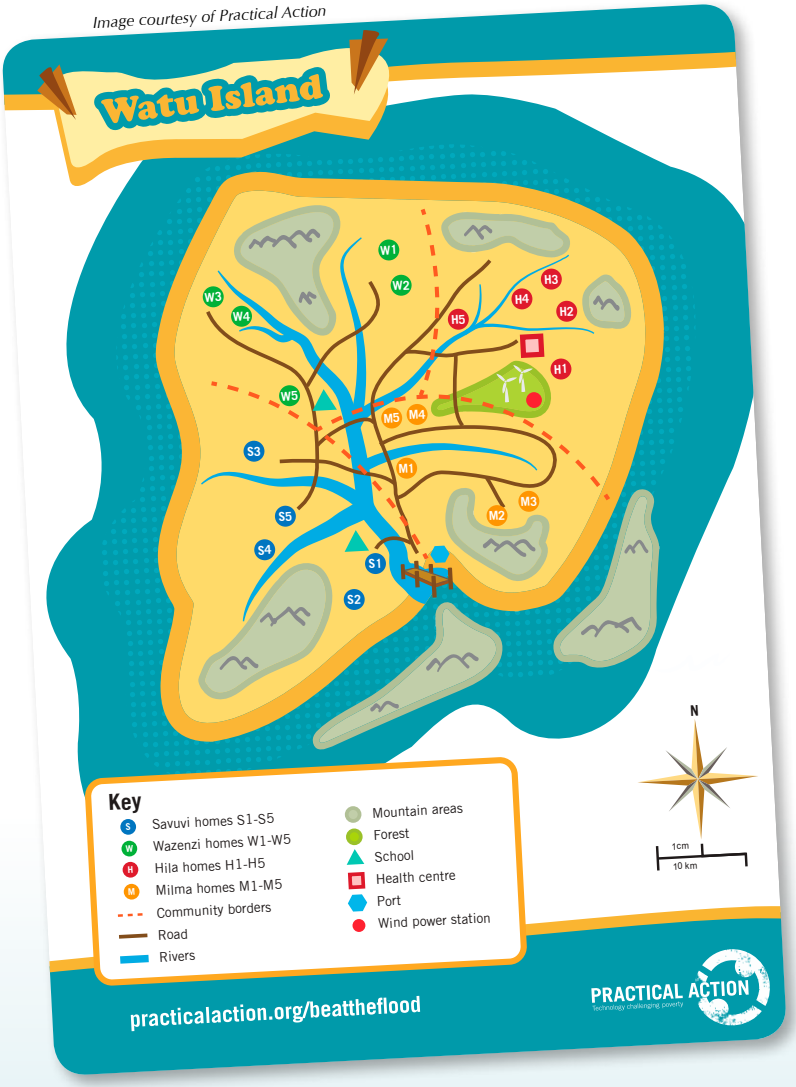
Beyond this, it presents a novel way for students to construct their own knowledge and be engaged in meaningful inquiry-based activities.

Christiana Th Nicolaou, Saint Demetrios Elementary School, Nicosia, Cyprus

flooding affects the whole community, and work out where the best place for a home would be. The challenge is suitable for a whole-day activity, or can be divided into several activities spread over many classes.

This activity encourages pupils to work as a team and enables them to take on specific roles within a group, such as team leader, designer, researcher or architect. Pupils also need to use knowledge from different disciplines such as geography, science and maths, and make complex decisions by integrating many factors such as cost and sustainability. In addition to giving them a flavour of the different technology-related careers they could get into, this challenge will also lead pupils to realise that there is no 'perfect house' that would solve the global problem of flooding: helping people access appropriate, sustainable technology is the best way to use science and technology to combat poverty.

Image courtesy of Practical Action



Beat the flood: action!

The activity unfolds in three steps:

1. The pupils test potential modelling materials to determine how sturdy and waterproof they are.
2. The pupils test the resistance of various structures to water, movement and wind.
3. Using their previous conclusions, the pupils build a model house using the structure and materials that they think will be most resistant to flooding.

Materials

To test the strength of the materials, each group will need:

- Two sets of clamps and stands
- A set of ten 10 g weights
- Samples of the materials described in the materials cards[w2]: cling film, foil food trays, lolly sticks, straws, grass, aluminium foil, plastic bags, clay

To test the absorbency of the materials, each group will need:

- One stand with clamp
- One timer
- Six 100 ml glass beakers
- Food colouring
- Water
- Ruler
- Samples of the materials described in the materials cards[w2]: cling film, foil food trays, lolly sticks, straws, grass, aluminium foil, plastic bags, clay

To test the strength of the structures, each group will need:

- One Structures template 1 sheet[w2]
- One Structures template 2 sheet[w2]
- Drinking straws
- Modelling clay
- Digital scales
- Sticky tape
- Hairdryer
- Glue gun
- Scissors

Throughout the activity you will need:

- The teacher's guide[w3], containing a detailed description of the lesson plan and the activities
- The pupils' worksheet[w2], containing the map of Watu Island, the community cards, detailed descriptions of the materials available, and the tables to record results of testing

- The presentation[w4] to stimulate the discussion. You could view it in PowerPoint or print out copies of the slides.

Procedure

Before the class starts, you may find it useful to cut and laminate the various cards (map of Watu, community and materials cards), as well as the cube and pyramid structures from the structures template sheets, as they will be used a lot.

General discussion

Encourage your pupils to discuss flooding, how widespread it is, how it affects different communities and people, and how its effects can be mitigated. In addition to the PowerPoint presentation, you can also use a video[w5] to show a practical example of flooding in Bangladesh.

Research ideas and information

1. Divide your class into small groups and give an A3 size map of Watu Island and one card from the Watu community cards[w2] to each group.
2. Working in groups, pupils should look for information on how and where to build the most efficient flood-resistant house for their own community. You may use the *Learning from others* sheet in the pupils' worksheets[w2] and the poster[w5] to enrich their research.

   Depending on the time available you may implement a combination of the activities below, before building your own model house.

Image courtesy of Practical Action

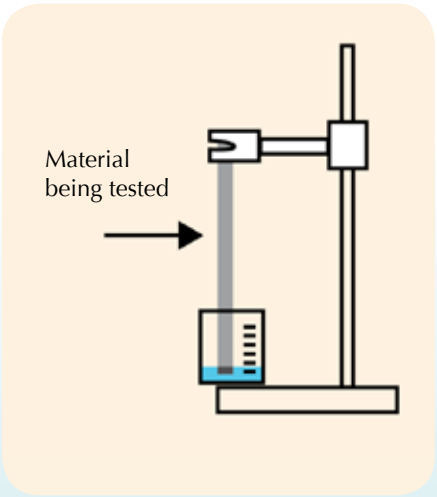


Image courtesy of Practical Action

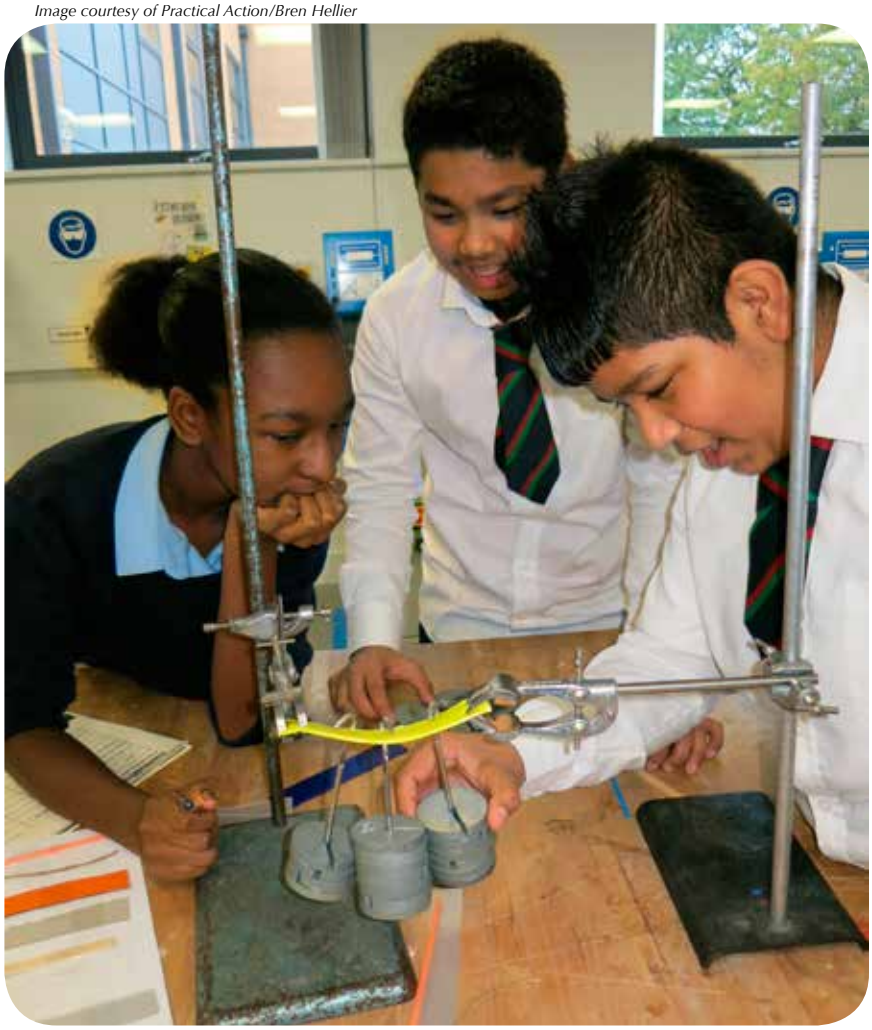
Experiment to test the absorbency of materials.

Test the absorbency of materials

The aim of this activity is for pupils to determine which modelling materials are the most water-resistant and would therefore be good for a flood-proof house. It takes approximately 30 minutes.

1. Set up clamp stands so they are about 15 cm high.
2. Measure and cut a standard sample of 15 cm x 2 cm for each material available to ensure a fair test.

Image courtesy of Practical Action/Bren Hellier



Testing tensile strength of materials at Judgemeadow Community College, UK

3. Attach the sample to the stand and clamp so it is held in a vertical position over a beaker containing coloured water, 25 cm deep.
4. Start the timer once the material is lowered into the water.
5. Leave it in for 3 minutes then remove from the water.
6. Record how high up the material the water was absorbed, using the table provided in the pupils' worksheets.
7. Repeat the tests twice more with fresh pieces of the same material, and take an average result.

Test the strength of materials

The aim of this activity is for pupils to determine which modelling materials are the strongest and would therefore be most resistant to wind and rain and make a good flood-proof house. It takes approximately 30 minutes.

1. Set up the clamps on the stands about 15 cm apart, with clamps facing each other.
2. Measure and cut a standard sample of 15 cm x 2 cm for each material available to ensure a fair test.
3. Clamp one sample of material between the two stands.
4. Add 10 g weights to the midpoint of the material until the material bends or breaks.
5. Record the weight necessary to break or bend the material in the table given in the pupils' worksheets.
6. Repeat the test two more times with fresh pieces of the same material and take an average result.

Test the strength of different structures

The aim of this activity is to determine what kinds of structure resist

Images courtesy of Practical Action

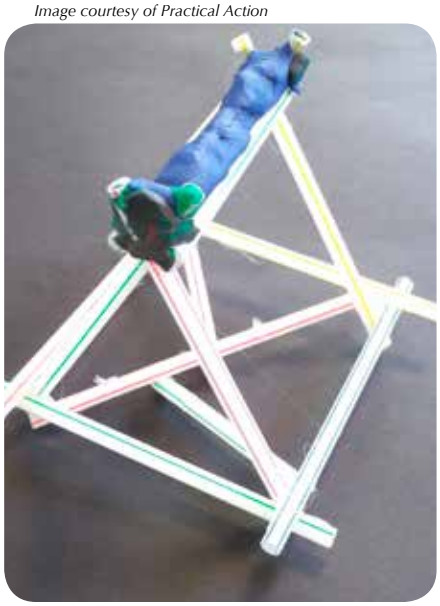
Image courtesy of Practical Action

Pupil at Northlands Primary School, UK, building a model house

Image courtesy of Practical Action

How strong is the structure with the clay inside the frame?

Image courtesy of Practical Action



How strong is the structure with the clay on the frame?

movement and therefore potential damage from water and wind. Use it to emphasise the importance of understanding the local conditions when designing houses. It takes approximately 30 minutes.

1. Use the laminated structures from structures templates 1 and 2 in the pupils' worksheet[w2] to create pyramids and cubes. For each type of structure, create one with 10 g of modelling clay inside and one without.
2. Develop a range of frame structures using the straws, some without weight and some with 10g of modelling clay added.
3. Develop a structure that combines a frame with straws and laminated shapes.
4. Test the resistance of the structures to water: put them in a tray of shallow water and simulate waves by shaking them.
5. Test the resistance of the structures to wind: put them on a dry surface and blow a hairdryer on them.

Consider cost and sustainability

By considering cost and sustainability, pupils will touch on some of the real-life compromises that engineers face. You could give the pupils a fixed budget or just ensure that they appreciate how important cost and sustainability are in their design.

Hand out the material cards and summary of costs sheets (in the pupils' worksheets[w2]). These will help the pupils to make the link between modelling materials and the real-life materials they represent. This activity should take approximately 20 minutes.

Design, build, test and evaluate the models

1. Using the results of their experiments and information from the materials cards, pupils should work in small groups to design their house using the materials and the structure that they feel are most appropriate. Allow one hour for the pupils to complete the design specification, design ideas and final design worksheets (in the pupils' worksheets[w2]).
2. Allow one hour for the pupils to build their model based on the design created in step one.
3. Pupils should test their models by standing them in a tray half full with water and squirting them with a hosepipe.
4. After testing, pupils may redesign their models if necessary.
5. In groups, pupils should evaluate their work then feed back to the rest of their class. They can use the *How well did they do?* worksheet in the pupils' worksheets[w2] to rate other groups' work, so that an overall winning design can be chosen by the class.

Web references

w1 – The web page of the 'Beat the Flood' challenge includes all the necessary teaching materials, as well as examples of pupils' work and links to case studies of the challenge being run in schools. See: www.practicalaction.org/beattheflood

w2 – The pupils' worksheet contains all the information that the pupils will need at each step of the activity, including the various tables to fill in. You can download it from the *Science in School* website: www.scienceinschool.org/2015/issue32/PA#w2, or from here: http://practicalaction.org/beatthefloodpupils

Image courtesy of Practical Action/Bren Hellier

Pupils at Sandlings Primary School, England, testing their flood-proof house

w3 – To read the detailed descriptions of the lesson plan and the activities, download the teacher's guide from the *Science in School* website: www.scienceinschool.org/2015/issue32/PA#w3It is also available here: http://practicalaction.org/beatthefloodteachers

w4 – The PowerPoint presentation offers a structure for a classroom discussion on flooding. You can download it from the *Science in School* website: www.scienceinschool.org/2015/issue32/PA#w4or from here: http://practicalaction.org/beatthefloodteachers

w5 – Watch a video showing how Practical Action designed houses for a region exposed to flooding in Bangladesh: www.practicalaction.org/video-beat-the-flood

Resources

Watch a video by children's TV celebrity Ortis Deley explaining how using the right materials is a vital part of helping a community become flood-proof: www.practicalaction.org/video-beat-the-flood

Flooding is also an issue in Europe and solutions are starting to emerge. The BACA architecture studio in London, UK, is building the first amphibious house on the Thames: www.baca.uk.com/index.php/living-on-water/amphibious-house

Beat the Flood is one of several science, technology, engineering and mathematics challenges offered by Practical Action. Each is set in a different scenario and involves pupils working together to find a solution to a problem faced in the developing world. For more information, visit: www.practicalaction.org/stem

A range of other resources that help teachers embed global learning into their science teaching can be found at: www.practicalaction.org/schools

Image courtesy of Practical Action

Designing a flood-proof house based on previous observations

Julie Brown is Practical Action's education manager. She has more than 20 years, experience working in the education sector at both primary and secondary levels. Currently leading an EU-funded project involving six partners and four countries, Julie is passionate about encouraging teachers in Europe to integrate global issues into science and design and technology teaching. She believes that when young people make the link between science and poverty reduction through engaging practical activities, they are more likely to develop a positive attitude towards global poverty reduction, and a desire to make a difference themselves.