Wild weather

Teacher's notes

Unit plan

Context

This unit for KS3 (age 11-14) pupils is about climate change and the effects it will have on people around the world. It emphasises the increasing unpredictability of the weather and explores ways people might prepare for the, apparently inevitable, 'wild weather' - floods and droughts. It also introduces the notion of food security.

Structure

The unit is divided into three pairs of lessons as given below. The first lesson of each unit is the core and tends to cover the simpler material while the second extends this into more demanding areas. The lessons can be used in isolation, in units or as a complete sequence of six. The project works particularly well as an off-timetable project or a STEM club but can also be fitted into normal curriculum time as it covers material required by the English National Curriculum.

If you are delivering all six lessons the first pair of lessons should be split so that lesson 1 is done first and lesson 2 at the end of all the other lessons.

1: Climate change	2: Floods	3: Droughts
Climate change? Exploring perceptions about climate change. What does it mean for people across the world?	**Seawater** Exploring how seawater flooding damages crops in Bangladesh even after the floods have receeded.	**Transpiration** Investigating the loss of water from a variety of plants to choose plants that can survive droughts.
Making a change Looking at ways to communicate the significance of climate change to different groups of people.	**The scientific contribution** Looking at the ways scientists and technologists can help to reduce the impact of climate change.	**Dry as a bone** Investigating the impact of drought on food security and land use.

Lessons

The tables below give an overview of the various tasks. Each unit also includes a homework suggestion.

1: Climate change

Lesson	Activities	Time / mins	Group size	Format
Climate change? Exploring perceptions about climate change. What does it mean for people across the world?	What do you think?	15	Small groups	Sorting exercise
	Sharing perceptions	5	Whole class	Discussion
	Weather and climate	5	Whole class	Video clip
	Information worth trusting	20	Individual	Internet / library research
Homework	Research task	20	Individual	Homework
Spreading the word Creating a document to increase understanding of climate change in a given audience.	Pause for thought	10	Small groups	Discussion
	Getting hot!	25	Small groups	Producing a poster
	Reviewing the plans	10	Whole class	Discussion and vote

2: Floods

Lesson	Activities	Time / mins	Group size	Format
Seawater Exploring how seawater flooding damages crops in Bangladesh even after the floods have receeded.	The wrong sort of water	15	Individual / whole class	Activity following video clip
	Salted seedlings	30	Small groups	Laboratory practical.
Homework	Flooding and floating	20	Individual	Homework
The scientific contribution Looking at the ways scientists and technologists can help to reduce the impact of climate change.	Food security	15	Small groups	Discussion.
	Bidding for research	20	Small groups	Discussion
	Spending the research dollars	10	Whole class	Discussion and vote

3: Droughts

Lesson	Activities	Time / mins	Group size	Format
Transpiration Investigating the loss of water from a variety of plants to choose plants that can survive droughts.	Transpiration investigation	30	Whole class	Laboratory practical
	Reviewing practical data (2 options)	15	Whole class	Discussion
Homework	Water and healthy plants	20	Individual	Data Response Activity
Dry as a bone Investigating the impact of drought on food security and land use.	Droughts in Kyuoso	10	Whole class	Discussion following video clip
	Irrigation	25	Pairs	Laboratory practical
	Reviewing the designs	10	Whole class	Discussion
Homework	Irrigation techniques	20	Individual	Data Response Activity

Key vocabulary

Climate; climate change; dams; drought; dykes; evaporation; food security; global warming; humus; irrigation; transpiration; water stress; weather; wilting.

National Curriculum links

The links below are typical of the content that students could cover as they work through this project. Detailed assessment of coverage will depend on individual classes and teachers.

Working scientifically

Through the content across all three disciplines, pupils should be taught to:

Scientific attitudes

- pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility
- understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas, together with the importance of publishing results and peer review
- evaluate risks.

Experimental skills and investigations

- ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience
- make predictions using scientific knowledge and understanding
- select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate
- use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety
- make and record observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements
- apply sampling techniques.

Analysis and evaluation

- apply mathematical concepts and calculate results
- present observations and data using appropriate methods, including tables and graphs
- interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions
- present reasoned explanations, including explaining data in relation to predictions and hypotheses
- evaluate data, showing awareness of potential sources of random and systematic error
- identify further questions arising from their results.

Measurement

- understand and use SI units and IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature
- use and derive simple equations and carry out appropriate calculations
- undertake basic data analysis including simple statistical techniques.

Sc2: Biology

Structure and function of living organisms

Cells and organisation

- the role of diffusion in the movement of materials in and between cells

Gas exchange systems

- the role of leaf stomata in gas exchange in plants.

Material cycles and energy

Photosynthesis

- the adaptations of leaves for photosynthesis

Lesson 1: Climate change?

Learning objectives

- Explore perceptions of climate change.
- Distinguish between the terms 'weather' and 'climate'.
- Develop skills in evaluating evidence.

The content in this lesson and lesson 2 of this Unit provides a useful opportunity to explore possible cross-curricular links with geography departments.

Lesson sequence

What do you think? 15 mins

Sort the class into groups of four or five. These teams will last throughout the rest of the project. Hand out the worksheet *Climate change?* and explain to students that they will be exploring what people understand by climate change and seeing how closely this matches our current scientific understanding of the topic.

The first task is to sort the comments on the worksheet into groups. Do not specify the groups - students can have any number of groups and, provided they can justify their decisions, and put any comment into any group. This is really an opportunity to explore all the things they have heard about climate change. Encourage them to add their own comments to the mix. By the end they should have a good picture of the range of perceptions and ideas about climate change.

Sharing perceptions 5 mins

Review the groups and comments across the class. This is not an opportunity to say which classification is better or 'correct' but an opportunity to explore all the possible standpoints. Flipcharts or pinboards would be a good way to sort the comments and perhaps keep them for later reference. You can also add comments or thoughts to these displays as the project continues in subsequent lessons.

Weather and climate 5 mins

The terms 'weather' and 'climate' are often used interchangeably as are 'global warming' and 'climate change'. Show the video clip bit.ly/armstrong-and-miller-climate-change which makes this point humorously. Teachers might want to check the clip before showing it to the class as some may find some of the language and material a little too adult for some groups. Agree the correct use of the terms in preparation for the upcoming work.

Information worth trusting 20 mins

Explain that up to now the students have been looking at what people already believe. Sometimes they have evidence to back this up, sometimes they have heard it somewhere and sometimes they have made it up in their own heads or have remembered it incorrectly. These ideas may not be true in a scientific sense. This activity is to start to collect facts about climate change that have some evidence to support them - facts that we can consider to be 'true' or 'reliable'.

Agree with the class that the key features of reliable ('true') information is that it:

- comes with evidence to back it up and that this evidence can be checked by anyone
- comes from a reputable source (not always a body that campaigns on one side of an issue or which benefits from one side in an argument winning)
- makes sense - it links with our existing ideas (although surprising ideas can often be good!).

Hand out a selection of climate change articles and ask pupils to spend 5 minutes working in pairs to compare and decide which are more more reliable. Ask for feedback for brief class discussion

When these ideas have been agreed students should to start to collect climate change information.

Hand out the worksheets *Internet searches* and *Learning log*. Discuss how students can best research the topic and record information form the internet.Encourage them not to simply 'copy and paste' large tracts of material from the internet into a giant text file! The *Learning log* worksheet helps to structure notes. They do not need multiple copies of the worksheet to fill in - just use the headings when making notes in their exercise books. This is also a good time to set the homework - to find out one reliable piece of information about climate change and add it to their learning journal. Stress that this information can come from the internet, library, textbook or television or radio programme - but there must be some evidence to back it up.

Ideally, after completing this lesson, students complete the lessons on floods and drought before carrying out *Spreading the word* (the second lesson in this pair). If this is not possible they can continue directly to this lesson but the depth and quality will be compromised.

Differentiation

All students will:

- recognise that people have a range of thoughts and opinions about climate change

Most students will also:

- recognise that facts require more evidence than simple opinions
- collect information and record it in a learning journal

A few students will make more progress and:

- appreciate the characteristics of reliable information
- justify their decisions about the reliability of information

Resources

Worksheets

- Climate change?
- Internet searches
- Learning log
- Extracts from climate change articles and blogs

Equipment

Access to internet or a library for research materials.

Useful websites

bit.ly/armstrong-and-miller-climate-change
The source of the video clip discussing the difference between climate and weather in a humorous way. Teachers should view this clip prior to the lesson to ensure the material covered is suitable for their classes.

practicalaction.org/videos-climate-change
A selection of short video clips that might help to explore aspects of climate change.

Homework suggestions

Students should find out something about climate change (such as how climate change has an impact on food or how it affects people in poverty) that they feel is relevant, useful and reliable and record it in their learning log. Stress that it needs to be supported by evidence, that they should know where this evidence can be found and be confident that this is a reliable source.

Lesson 2: Spreading the word

Learning objectives

- Identify key messages about climate change for a range of audiences.
- Understandhowtoconveykeymessagesaboutclimatechangeappropriatelyandeffectively.
- Identify personally significant responses to the issues of climate change.

Lesson sequence

Pause for thought **10 mins**

Give students two minutes to think about what they have learnt so far form the project on climate change and how people around the world will have to change. They can note these things down on a scrap of paper - it's not a test, it's a chance to reflect and think before the next activity begins.

Now have a class brainstorm about the things the students have learned. These questions may help to get contributions started:

- What has been the most surprising thing you have leant?
- Has your attitude to climate change changed as a result of the work?
- What do you know now that you did not know at the start?
- Where in the world do you feel people are most affected by climate change?
- Who do you think is most affected by climate change?

It would be useful to ensure that students have a sense that it is often the world's richest countries that are contributing most to climate change, but the world's most economically poorest people who are hardest hit by devastating droughts, floods and other extreme weather events.

The idea of this activity is to draw out a wide range of insights from the whole class and make them visible rather than a chance to assess if students have learnt a particular aspect of the topic. It will be useful to note the contributions down on a flipchart or noticeboard.

Getting hot! 25 mins

Hand out the *Getting hot!* and *Spreading the word* worksheets. Ask students to identify different groups of people who could slow down climate change e.g parents, government, car manufacturers, then ask them to choose one group that they think they might be able to influence by putting together a campaign.

In their teams they should fill in the diagram on the *Getting hot!* worksheet to draft their campaign then produce a more detailed plan to share with the rest of the class.

- Which groups of people can make a real difference in reducing climate change?
- Who will your campaign focus on?
- How will you reach them? Poster, newsletter article? TV ad? Badge? cartoon?
- What will you tell them to make them want to take action?
- What action do you want them to take

They should then begin to draft out campaign materials

Hand out the worksheet *Spreading the word* to give them some ideas.

Reviewing the plans 10 mins

Each group should have 45 seconds to present their plan to the class (time them!). Work round the class so that each team has a chance to report back but keep this section very rapid-fire, don't let people overstay their timing.

Once all the groups have reported throw it open to the class to identify ideas or approaches they liked in any of the plans. This is not an opportunity to choose the 'best' because they will al be designed to do different things with different audiences but do take the chance to draw out any particularly worthwhile approaches.

Finish the lesson by asking the students to decide for themselves one thing they will do individually now that they know more about the threat of climate change. It can be a small or a big thing, and they do not need to share it with anyone else if they do not want to, but it should be an honest response to the work they have completed.

Differentiation

All students will:

- identify insights they have gained as a result of this project

Most students will also:

- contribute to a plan for an informative document
- identify the particular needs of their chosen audience

A few students will make more progress and:

- identify the key issues that need to be addressed in their document and give them suitable prominence in the plan

Resources

Worksheets

- Getting hot!
- Spreading the word

Lesson 1: Seawater

Learning objectives

- Carry out an investigation into flood damage in plants.
- Analyse data from the investigation.
- Relate results from the investigation to the issue raised.
- Understand how climate change impacts people in the developing world.

Bangladesh is an example of a country that is regularly facing the threat of changing weather patterns. During the monsoon season, the increased rainfall year on year is causing widespread flooding affecting over 1 million people. Many families lose their crops and the vegetables they were growing to feed their families

Lesson sequence

The wrong sort of water — 15mins

This lesson will look at the effect of climate change on a particular farmer in Bangladesh.

Show the video clip bit.ly/seawater-flooding-Bangladesh . Encourage the Students to take notes or anything that will help them to remember information from the clip as they will be having a short test afterwards.

Hand out the worksheet *Flood alert* and give the students two minutes to complete the questions in silence. After 2 minutes say they can have 30 seconds (time it!) to ask each other questions in their groups to help with the answers they do not know. Finally another 30 seconds in silence to complete the test. Review the questions and answers. This is a good opportunity to ask questions about how useful the 30-second conference was and how to make it more useful. Emphasise how sharing (and that often means listening!) can be very productive.

One of the problems for farmers is that they might have plenty of food at one point (perhaps during the growing season) and none at other times (perhaps following their crops being wiped out by flooding or drought). The term **food security** means that an individual or country can count on a constant supply of sufficient food for a healthy life at all times - even during the bad times.

Ask the class why climate change is reducing food security for the farmers of the Bangladesh river delta.

Salted seedlings — 30 mins

Sea water flooding creates a number of problems. One mentioned in the video clip is that the seedlings are washed away by the currents and that even when the seeds are replanted the yield is lower. Why might this be? Ask students to suggest possible reasons for the fall in yield. They are likely to suggest minerals being washed away, less time for growth, damage of soil by salt in the water etc. Explain that they will now be investigating seed germination in salty conditions and that they will have to design an investigation into the effect of salt water on growth of rice seedlings.

Students will not be able to guess the conditions to grow rice seedlings so be prepared to offer help with some of the technical aspects. These are indicated in the speeches on the worksheet *Salted seedlings* and some teams may want to look online for clues. They should produce their plan showing how they will collect reliable, relevant and rigorous evidence. The key learning issue here is the control of the key variables and thinking about how to measure successful germination so try to avoid giving clues in these areas. There is no single correct method for assessing the damage done by salt water so expect a range of techniques. The simplest is to create a set of saltwater samples using known amounts of sodium chloride in a given volume of deionised water and then use this to wet seeds in petri dishes or jars. The concentration of these samples is up to the students to choose but the speech bubble on the worksheet Salted seedlings quotes seawater at about 3.5% salt so figures should revolve around this value. Paper towel is a useful base to grow the seeds on - avoid cotton wool as this often gets tangled up with growing roots making them difficult to see.

After they have created their plans and had them checked they should set up their investigations. The investigation will take a few days to produce results so students should organise a safe place to keep their investigation and a rota to come in to check on the seedlings. This is quite a demanding task for some teams and they may need some help.

Differentiation

All students will:

- collect data from a practical activity

Most students will also:

- handle equipment safely and carefully to produce accurate data
- analyse raw data and relate this to their original ideas

A few students will make more progress and:

- use insights from the investigation to explain why saltwater flooding can be more damaging than freshwater floods

Resources

Worksheets

- Flood alert
- Salted seedlings
- Floating and flooding

Equipment

Will vary according to the investigations students are engaged with but will probably include:

- Petri dishes or jars to grow the seedlings with markers or labels to identify them.
- Paper towels.
- Scissors to cut the paper towels to suitable shapes for the containers.
- A supply of salt. Cheaper cooking salt from the supermarket is suitable rather than the purer, more expensive sodium chloride available from laboratory suppliers.
- Electric balance.
- Measuring cylinders.
- Suitable seeds: cress is very fast growing but rice grains give a more authentic feel to the task. If you choose to use rice you will need brown rice and will need to check it is viable before the investigation - some rice grains are dead when bought from the supermarket.

Useful websites!

bit.ly/seawater-flooding-Bangladesh
The source of the video clip about seawater flooding in Bangladesh.

Homework suggestions

Hand out the worksheet *Flooding and floating* to complete for homework.

Lesson 2: The scientific contribution

Learning objectives

- Explore the notion of food security.
- Suggest options for scientists and technologists working in this field.
- Identify the best options and justify their choices.

In the previous lesson students had a chance to learn about the impact of flooding for communities in Bangladesh. It's worth recapping that severe flooding can lead to disaster for people. It destroys homes, cultivated land and livestock, increasing the risk of food shortages and the ability of people to re-build their lives.

Lesson sequence

Food security **15mins**

Option A: Brainstorm

Ask students to list all the people who might have been involved in making sure they have enough to eat to provide them with 'food security'. The presentation *Food security* might be helpful if students cannot come up with any suggestions.

Option B: Food dominoes

Download the Food dominoes resources from practicalaction.org/europafrica-foodconnections and connect the dominoes according to the rules given on the sheets.

When you have a list of people who might be involved in a food chain delivering food to our tables move on to consider any threats to this chains. Ask students, in their teams, to pick one or two of the people in their lists and brainstorm what they need in order to do their job. So, a supermarket manager might need to have money in the bank to order the food from the wholesaler, a fleet of lorries to transport it to the shop, safe roads to travel on and so on. A farmer growing the food may need good ground, enough money to buy seeds and fertiliser etc. for the crop, money to pay workers until the crop is sold and access to buyers who will give a fair price for the crop etc.

Give the teams 10 minutes to list the things that each worker needs and then share them in a quick class discussion.

To ensure food security each person in the 'food chain' discussed must be able to carry out their role. What things threaten food security? Suggestions might include bad weather and poor harvests, new pests for crop plants or diseases for livestock but try to encourage students to consider other issues like poor roads meaning transport of food from areas of harvest to areas of need is too slow or poor storage facilities means food rots before it can be used or shortage of money means no food can be imported by a country etc.

Encourage a very broad brainstorming of possible problems - and encourage students to see that the transport of food around the world is actually surprisingly successful enterprise. It's amazing how much of it goes on given how many potential problems can occur. List on the board the possible threats to food security for people around the world.

Bidding for research … 20mins

What can scientists and technologists do to improve food security for everyone on the planet - particularly in the light of climate change?

Hand out the worksheet *Bidding for research*. This describes possible responses to climate change that might be appropriate for the scientific and technological community. In their teams students should select one research area that they think will be most beneficial (appropriate) to people living in the developing world. They should then suggest:

- The research they think needs to be done (*what* do they want to find out?)
- How they will do this research (*how* will they find out?)
- How long they think it will take to get results (when do they get answers?)
- What they plan to use the results for?(*why* bother to find out?)
- How the potential solution is appropriate to the people who will use it (is it affordable, sustainable etc.)

They should produce a poster making the case for their research plans so that their ideas can be reviewed alongside ideas form other teams in the class.

Spending the research dollars 10mins

Review the posters and suggestions for suitable scientific and technology initiatives. Ask each group to justify their decisions. The easiest way to do this is for each group to speak to their poster while the rest of the class takes any useful notes. Allow the class two questions for each team's suggestions - but emphasise these should be about the *purpose* of the research suggested not just the technical details (this is not just an exercise in reviewing plans for investigations). The slide *Assessing innovation* in the presentation *Food security* provides a useful set of questions for students to consider as they assess the merits of the various plans.

At the end have a vote. The class can agree two approaches that they will fund. Which two are the ones most likely to increase food security for their chosen client group?

Differentiation

All students will:

- suggest some ways that scientists and technologists could improve global food security

Most students will also:

- appreciate the complexities of any scientific or technological change that impacts directly on people
- identify the most productive research projects based around food security

A few students will make more progress and:

- justify their ideas in relation to the needs of the chosen clients

Resources

Worksheets

- Bidding for research

Presentation

Food security

Equipment

- Suitable materials for creating posters (e.g. large sheets of paper, marker pens) and a place to display these posters.

Useful websites!

practicalaction.org/europafrica-foodconnections
The source of the food connections dominoes for Option B in the starter.

Lesson 1: Transpiration

Learning objectives

- Carry out an investigation into water loss from plants.
- Analyse data from the investigation.
- Relate results from the investigation to the issue raised.

Lesson sequence

Transpiration investigation — 30 mins

How much water does a plant really need? Almost all of the water entering the roots is transpired by the leaves so a measure of water loss can give a good measure of water requirement - certainly it is accurate enough to allow comparison between different leaves and plants and different environmental conditions.

Introduce the potometer as a way to measure water loss from a plant. It is a deceptively simple piece of kit but quite fiddly to get right. It allows students to explore the effect of a variety of conditions on water loss from plants directly. When you are sure they know how to use the potometer they can start to plan their investigations.

Students should now carry out their investigations in their teams. Offer support as required. The worksheet *The potometer* describes a technique that can be used to measure water loss from a twig but allow students to develop their own investigation based on the key problems they have identified. So, they will need to identify their own variables, the range of data they will need to collect and the way they will analyse their findings.

This investigation can be tackled in two ways - if a variety of plants and leaves are available Option A or B below is possible. If a single species of plant is available students will have to carry out an assessment of environmental factors (temperature. light levels, wind speed etc.) and will only be able to do Option B.

OPTION A: Plants for dry areas — 15 mins

Review the data from the transpiration experiments. Which plants tended to show the lowest rate of water loss? Is it something about the size or number of leaves? Or the shape? Or whether the leaves are waxy? How can this help in choosing plants suitable for dry areas?

OPTION B: Environmental conditions — 15 mins

Review the data from the transpiration experiments linking it to the problems identified earlier. Knowing that increased temperature or wind speed increases the rate of water loss is interesting - but stress that this information is of little value until applied to solve a real problem. How can growers help to protect their plants from excessive water loss in the field? Take suggestions from the class but point out that ‘watering the plants more often’ is not an answer - increasing water input does not solve the problem of too great an output and in areas where water is in short supply this strategy is not always possible.

Remind students of the micro-irrigation or drip irrigation technique they saw in the film clip earlier (see 1: 27 section). Is this a good way to get precious water directly to the plants that need it?

Differentiation

All students will:

- collect data from a practical activity

Most students will also:

- handle equipment safely and carefully to produce accurate data
- analyse raw data and relate this to their original ideas

A few students will make more progress and:

- use insights from the investigation to develop a strategy for coping with droughts

Resources

Worksheets

- The potometer
- Water and healthy plants

Equipment

Will vary according to the investigations students are engaged with but will probably include:

- Fans or fan heaters.
- Capillary tubing and a supply of soft rubber tubing suitable for making simple potometers.
- Suitable leafy twigs - aim for a selection of different types of plants. Holly is an excellent low-transpiration species whereas Impatiens (Busy Lizzie) provides a good high transpiration example.
- Vaseline to seal any leaks between the twig and the soft rubber tubing.
- Timers or stopclocks (many students will have mobile phones with stopwatch apps on them).

Homework suggestions

Hand out the worksheet *Water and healthy plants* to complete for homework.

Lesson 2: Dry as a bone

Learning objectives

- Carry out an investigation into water flow in pipes.
- Identify key features of a successful micro-irrigation system.
- Design a micro-irrigation system for a dry area.
- Understand that climate change causes both drought and flooding which has a big impact on lives of people who grow crops.

The work here about cross-sectional areas, volumes and rates of flow provides a useful cross-curricular link to mathematics.

Lesson sequence

Droughts in Kyuoso — 10 mins

The work in the previous lesson about transpiration shows how important a constant supply of water is to plants. As our climate becomes more unpredictable droughts can become more common. Explain that in this lesson the students will be looking at the effect of droughts on people, their lives and crop production.

Ask how droughts would affect food security and then show the video about climate change in Kyuso. bit.ly/climate-change-kyuso

Irrigation — 25 mins

Show the video clip about the effects of climate change in California at bit.ly/climate-change-california This is particularly useful as it reinforces that climate change is a development which affects all of the globe and not just poor farmers in Africa or Bangladesh. Draw attention to the irrigation system at about 1:27 onwards. The vines are being given the minimum amount of water to keep them healthy and productive.

But how do micro-irrigation systems work? Students should plan a simple investigation into the rate of water flow along pipes from a central store. Which factor is most important - the height of the water store above the ground or the diameter of the tubes? How can they predict the length of time the water store will last if they add more pipes? Does a pipe with a single output at the end deliver as much water as one that is the same diameter but perforated to allow water to pass out along its length?

The Practical Action Technical Brief on micro-irrigation systems bit.ly/technical-brief-micro-irrigation provides useful background information here.

The final output should be a labelled poster or document giving the essential design features of a micro-irrigation system suitable for a small-scale farmer in Africa.

Reviewing the designs — 10 mins

Review some of the class designs drawing out the key scientific principles and developing the idea that a micro-irrigation system must meet certain technical issues (length of pipe, rate of flow, size of water store etc.) and a range of 'human context' issues (cost, ease of maintenance, security of device etc).

The class can vote for the best design - but draw out good features from all to show that learning from others is a valuable skill - none of us get it completely right!

Differentiation

All students will:

- collect data from a practical activity

Most students will also:

- handle equipment safely and carefully to produce accurate data
- analyse raw data and relate this to their original ideas

A few students will make more progress and:

- use insights from the investigation to develop a micro-irrigation system

Resources

Worksheets

- Micro-irrigation technical brief
- Irrigation techniques

Equipment

Will vary according to the investigations students are engaged with but will probably include:

- Pipes or rubber tubing of various diameters.
- A suitable 'water store' - an upside down fizzy drinks bottle with the base cut ogg is a suitable model for this.
- Measuring cylinders of various sizes to measure volumes of liquid.
- Metre stick or tape measure to measure height of water store above ground.
- Timers or stopclocks (many students will have mobile phones with stopwatch apps on them).

Useful websites!

bit.ly/climate-change-kyuso

The source for the video clip about the effects of droughts in Kyuoso, Kenya.

bit.ly/climate-change-california

A video clip about the effect of drought in the vine-growing region of California.

bit.ly/technical-brief-micro-irrigation

A Technical Brief from Practical Action giving information about the technicalities of making and managing a micro-irrigation system.

Homework suggestions

Hand out the worksheet *Irrigation techniques* to complete for homework.