urban science

iChange - Carbon and Me

These activities provide an introduction to climate change which underpins Urban Science. They add to the Stage 1 and possibly Stage 2 part of the Urban Science cycle and can be used to replace/add to sections of other Urban Science modules. It will increase student knowledge and understanding of further topics and help to show the interrelatedness of them all.

A curriculum linked learning module for students aged 13-16 to develop competences in working scientifically.

Learning challenge: iChange - Carbon and Me

We read a lot about climate change in the news and in the media; it is a hot topic. In our daily lives we can experience the effects of changes in temperature, especially warmer winters and less water in the summer months. But what does it all mean for me and what is my understanding of climate change?

The activities in this learning module provide an introduction to climate change and how it affects and is influenced by urban areas. The activities address Stage 1 and possibly Stage 2 of the Urban Science cycle. They can be delivered on their own as an introduction to the topic or used to replace/add to activities in other Urban Science modules.

The learning module can be used flexibility within the curriculum to support key knowledge about chemistry and develop working scientifically competences. The learning links with the Sustainable Development Goals and provides a broader context for student learning.

www.urbanscience.eu

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To deliver this module we recommend:

- Using it to check and confirm key knowledge of students.
- Use at the start of your Urban Science journey to stimulate engagement with climate change issues.
- Use all the activities provided.

Subject

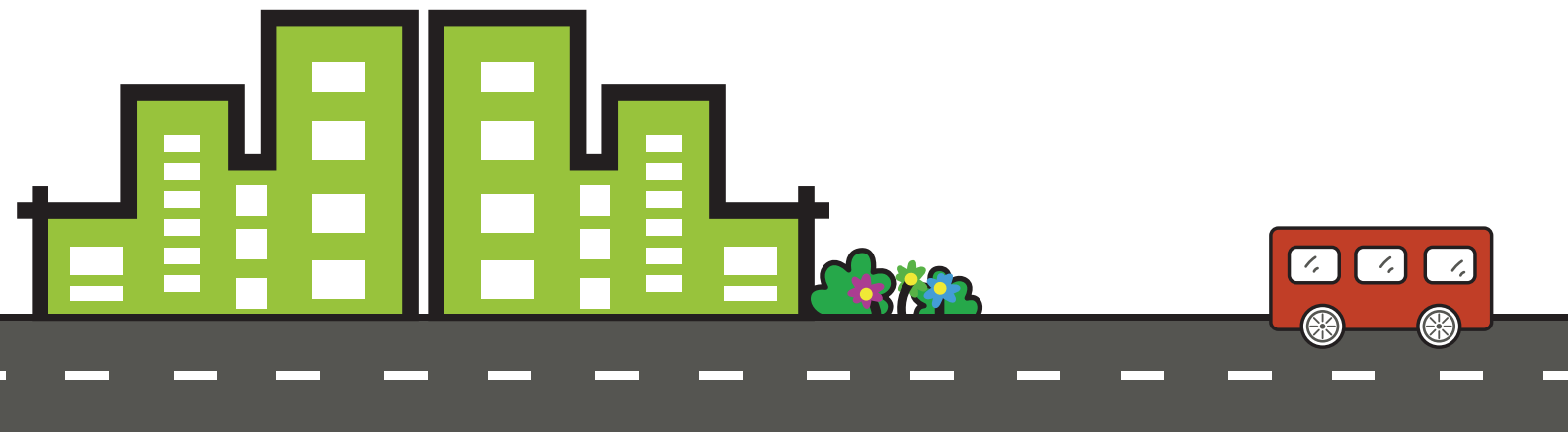
Biology	Chemistry	Physics	Raising Attainment
	✓		✓

Programme of Study reference

• GCSE Chemistry	**Climate Change** • evidence, and uncertainties in evidence, for additional anthropogenic causes of climate change. • potential effects of, and mitigation of, increased levels of carbon dioxide and methane on the Earth's climate.	• Working scientifically	Students successfully completing this module will have had the opportunity to access these statements: 1b, 1c,1d, 2a,3iv,3v,3vi,4a See Annex 1 for full statements.

Health and Safety: please refer to the guidance provided on the Urban Science website before commencing the module.

www.urbanscience.eu/uk/learning-modules/health-and-safety/



Sustainable Development Goals

All Urban science modules try to 'ensure inclusive and equitable quality education and promote lifelong learning opportunities for all' and in addition focus on education for sustainable development and global education - SDG 4.7. Support and resources here:

http://www.teachsdgs.org/

iChange particularly support SDG 13 Climate Action 'Take urgent action to combat climate change and its impacts'. By completing this module with your students, you will have contributed towards their understanding of this goal. Other resources can be found here:

http://worldslargestlesson.globalgoals.org/global-goals/protect-the-planet

Inquiry based learning stage

Stage 1 - Initiating and eliciting	✓	**Stage 2 - Defining and responding**	
Stage 3 - Doing and making		**Stage 4 - Communicating, presenting and evaluating**	

Learning objectives

1. Students investigate the meaning of 'sustainability', climate change and the greenhouse effect.
2. Students investigate key questions.

Learning outcomes

1. Students discuss and check each other's understanding.
2. Student identify key questions they have.
3. Students research and find out relevant information.

Overview of lesson

Our aim in these first short activities is to clarify students key 'basic' knowledge and terminology. For example, what does the term 'sustainability' mean? What is the greenhouse effect? These ideas are explored in more depth by analysing a graphical presentation by Bloomberg. We will end with learning more about each other through sharing our personal experiences, knowledge and feelings concerning climate change through a 'Climate Change People Search'. A homework research task could be undertaken using 'Thinking Hats'. Any unanswered questions students have can be put them on a 'wonder wall'.

Lesson structure

Introduction: Climate Change and Sustainability - Clarification and misconceptions

5 mins Use the presentation, including teachers notes, to introduce and clarify key terms with students.

You can download the presentation from:

https://urbanscience.eu/uk/learning-modules/introduction-climate-change/

10 mins **Data Race**

In this 'very active' activity students race to be the first ones to get the answers to a series of questions on climate change (see Student Sheet 1).

The teacher sets students off on a 'race' to find out key bits of information on the topic of climate change. It is important to set a suitable time limit. We suggest these two websites to help students find answers:

PEEP https://www.peep.ac.uk/content/1833.0.html

NASA https://climate.nasa.gov/causes/

Both these are good websites for students to find their answers. In this way the activity is kept very focused on the key ideas and facts so that they can move on to delve deeper into the topic. Details on how to run the activity are to be found in the accompanying presentation.

The activity is a quick way of gathering and sharing information about the topic. It can lead to discussions about the nature of information and data sources, and the teacher can raise questions about the accuracy and sources of the information, and suggest other ways of approaching the topic. This can be a useful mechanism for ascertaining the level of knowledge on a particular topic. It is also a good and efficient mechanism for getting students to find knowledge in a short period of time.

Main 1: Checking the Evidence

10 mins Climate change skeptics offer various reasons why the Earth is warming.

Bloomberg has created a set of graphs comparing a range of factors with global temperature rises, using data sources from NASA and the Global Research Project. Use the presentation and at each stage ask students to predict the results. It is important to describe the validity of the work and why the link is so strong.

https://www.bloomberg.com/graphics/2015-whats-warming-the-world/

To check students understanding use a Listening Triad:

Students work in groups of three. Each student takes on the role of talker, questioner or recorder. The talker explains something, or comments on an issue, or expresses opinions. The questioner prompts and seeks clarification. The recorder makes notes and gives a report at the end of the conversation.

Lesson structure *(continued)*

Main 2: Climate Change People Search

20 mins Give every student a copy of Student Sheet 2.

Invite students to move around the classroom and join up with someone who can respond in a positive way to one of the items in the handout.

Ask them to write the name of the person into the space on the sheet and ask questions of their partner so as to encourage sharing of detail of their experiences and/or feelings.

Let the group know that they can only have one positive response from any one person. They must move on to other people to fill in other lines on the handout.

Encourage them to complete as much of the handout as possible in the time available but without rushing so they benefit from listening to each other's stories.

Plenary: Describe homework task if appropriate:

10 mins Climate Change - what does this mean for our city?

Create a poster around this issue using the De Bono Thinking Hats methodology to provide a range of perspectives.

Thinking Hats (Edward De Bono)

Here students take a different stance towards a question or problem. They can be encouraged to put on actual different hats to examine a question from a variety of perspectives. For example:

- White Hat. Discuss the facts and other objective information about the problem.
- Red Hat. Share feelings and emotions about the issue.
- Black Hat. Present negative aspects, or worst-case scenarios, regarding the situation.
- Yellow Hat. Consider positives, or advantages, of the situation.
- Green Hat. Consider creative ideas that come from looking at the problem in a new way.
- Blue Hat. Sum up all that is learned.

Students complete a Plenary Pyramid

List 3 things you learnt today, 2 things you are unsure about and 1 question you would like to ask.

Student Sheet 1

Q1. What is climate change?	The term 'climate change' refers to long-term trends in the average climate, such as changes in average temperature.
Q2. What is the greenhouse effect?	The greenhouse effect is the natural process by which the atmosphere traps some of the Sun's energy, warming the Earth enough to support life. Scientists believe a human-driven increases in "greenhouse gases" is increasing the effect artificially.
Q3. What are the main greenhouse gases?	Greenhouse gases are largely CO_2 and other oxides produced by burning fossil fuels or CFCs, but also include methane produced by farming, landfill waste and released from melting permafrost. It is people who have released all these gases through manufacturing, farming and energy use.
Q4. What are the main effects of climate change?	Regional rainfall patterns are likely to be drastically altered, which will change the patterns of world food production. Parts of the world will see an increase in the number of heatwaves, others will see an increased intensity of tropical storms. Sea levels will rise due to melting of ice (glaciers and polar ice) and thermal expansion of water. Sea levels are likely to rise by 28-43cm. This rise will cause flooding; salinisation of soils (increased saltiness) and coastal erosion.
Q5. What does the term 'carbon footprint' mean?	Each of us is responsible (directly or indirectly) for carbon emissions and this is known as our carbon footprint. It is the total amount of carbon dioxide emitted through the combustion of fossil fuels as the person / business/school engages in everyday activities.

Student Sheet 2

Find someone who:		Name	Notes from your discussion
1	Has joined in climate change community action.		
2	Is worried about what the future might bring.		
3	Has heard that a warming climate will bring new diseases.		
4	Is not sure what the difference is between climate and weather.		
5	Feels the normal rhythm of the seasons is changing.		
6	Knows of people who have had to move because of the effects of climate change.		
7	Can think of changes being made to stop climate change getting worse.		
8	Blames wealthy nations for climate change.		
9	Can share a recent climate change story.		
10	Is trying to be 'green' by cutting down on energy use.		
11	Thinks cities contribute more greenhouse gases than rural areas.		
12	Knows of a farmer who is worried about climate change.		
13	Feels that their lifestyle and culture are under threat from climate change.		
14	Thinks that girls and women will suffer most as the climate heats up.		
15	Has seen the effects of climate change where they live.		
16	Can think of changes being made to adapt to climate change.		
17	Feels very emotional about climate change.		
18	Has heard or read of awful climate change predictions.		
19	Has learned of species going extinct because of climate change.		
20	Thinks that their children will not be able to live as we have.		

Annex 1 - Key Stage 4 Working Scientifically Statements

Through the content across all three disciplines, students should be taught so that they develop understanding and first-hand experience of:

1. **The development of scientific thinking**
    a. the ways in which scientific methods and theories develop over time.
    b. using a variety of concepts and models to develop scientific explanations and understanding.
    c. appreciating the power and limitations of science and considering ethical issues which may arise.
    d. explaining everyday and technological applications of science; evaluating associated personal, social, economic and environmental implications; and making decisions based on the evaluation of evidence and arguments.
    e. evaluating risks both in practical science and the wider societal context, including perception of risk.
    f. recognising the importance of peer review of results and of communication of results to a range of audiences.

2. **Experimental skills and strategies**
    a. using scientific theories and explanations to develop hypotheses.
    b. planning experiments to make observations, test hypotheses or explore phenomena.
    c. applying a knowledge of a range of techniques, apparatus, and materials to select those appropriate both for fieldwork and for experiments.
    d. carrying out experiments appropriately, having due regard to the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations.
    e. recognising when to apply a knowledge of sampling techniques to ensure any samples collected are representative.
    f. making and recording observations and measurements using a range of apparatus and methods.
    g. evaluating methods and suggesting possible improvements and further investigations.

3. **Analysis and evaluation**
    a. applying the cycle of collecting, presenting and analysing data, including:
        i. presenting observations and other data using appropriate methods.
        ii. translating data from one form to another.
        iii. carrying out and representing mathematical and statistical analysis.
        iv. representing distributions of results and making estimations of uncertainty.
        v. interpreting observations and other data, including identifying patterns and trends, making inferences and drawing conclusions.
        vi. presenting reasoned explanations, including relating data to hypotheses.
        vii. being objective, evaluating data in terms of accuracy, precision, repeatability and reproducibility and identifying potential sources of random and systematic error.
    b. communicating the scientific rationale for investigations, including the methods used, the findings and reasoned conclusions, using paper-based and electronic reports and presentations.

4. **Vocabulary, units, symbols and nomenclature**
    a. developing their use of scientific vocabulary and nomenclature.
    b. recognising the importance of scientific quantities and understanding how they are determined.
    c. using SI units and IUPAC chemical nomenclature unless inappropriate.
    d. using prefixes and powers of ten for orders of magnitude (e.g. tera, giga, mega, kilo, centi, milli, micro and nano).
    e. interconverting units.
    f. using an appropriate number of significant figures in calculations.