Future-Oriented Learning for Inclusive Science Education

Teaching and Learning Resources for Secondary Education

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2023

Citation of the pack

This resource can be referenced as follows:

Erduran, S., & Ioannidou, O. (2023). Future-oriented learning for inclusive science education: teaching and learning resources for secondary education. Oxford: University of Oxford.

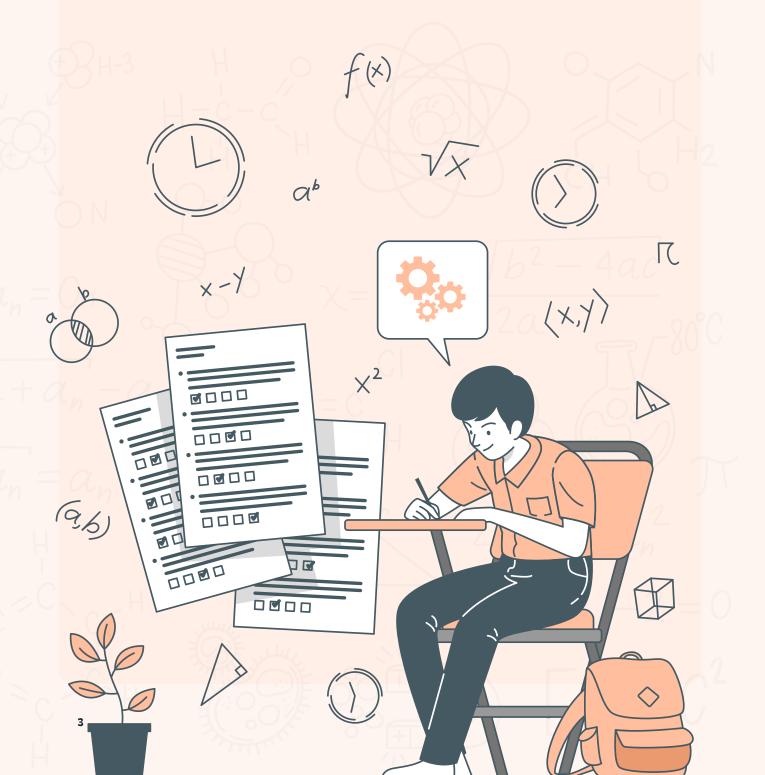
All the resources including external files are available upon request.

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Acknowledgment

The authors acknowledge ESRC IAA programme (Grant no. 2205-KICK-810; Project FutuRISE) as well as European Union Horizon 2020 Programme (Grant Agreement no. 872841; FEDORA Project) for financial support.

We would like to particularly thank to Leanne Hughes and Judith Curtis from Holme Grange School; Sam Harper from the Social Sciences Division; Claire MacLeod from University of Oxford; and Sarah Lloyds from the Museum of Natural History in Oxford for their contributions to the related projects.



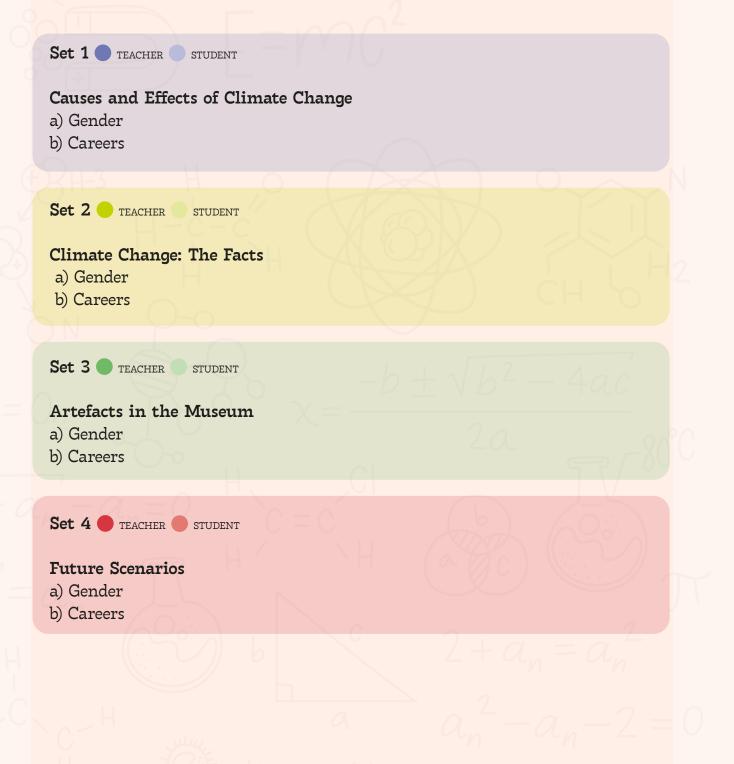
Introduction

The resource pack contains materials for science teachers and secondary pupils, and aims to support lessons about timely and pressing issues related to science and society. There is an increasing need for future citizens to acquire skills that are needed to grapple with societal challenges such as climate change. Project FutuRISE (Future-Oriented Learning for Inclusive Science Education) based at the Department of Education at University of Oxford focused on future-scaffolding skills needed to construct visions of the future that empower action in the present in a responsible and sustainable way. Future-scaffolding skills include scenario thinking, systems thinking, thinking beyond the realm of possibilities, action competence, risk as well as uncertainty and management of complexity.

Apart from future-scaffolding skills, Project FutuRISE aimed to foster pupils' engagement in activism, taking pupils' identities such as gender as well as their career aspirations into consideration when teaching science, particularly in transition from secondary education to tertiary education or employment. To this effect, the lesson resources have been designed to capitalise on such features in enriching the teaching and learning of climate change.



There are four sets of materials on the topic of climate change that cover the causes and effects of climate change, facts about climate change, engagement in an informal learning environment such as a museum and discussion of future scenarios. Each set is designed to engage and empower the pupils. Extension activities are highlighted about gender and career options. The following is an outline of the overall structure of the pack:



Activity Frameworks

The activities included in this booklet aim to (a) empower secondary pupils through active participation in learning by using pedagogical strategies such as group discussions and role play, and (b) promote pupils' sense of agency in socially significant problems such as the climate change emergency. A particular emphasis is placed on how a topic such as climate change can be coupled with promoting awareness about gender and careers as a strategy to enthuse pupils' active citizenship.

Empowerment

Secondary pupils' perceptions of STEM need to be challenged for them to understand that STEM is for them, that they can be successful in STEM subjects. Through education, pupils can be empowered to see the value and transferability of STEM skills, and they can be encouraged to play an active role in STEM-related issues for social justice. The activities include active learning strategies such as group discussions and role play in order to enthuse pupils about learning.

Gender

Historically the majority of the world's poor — over 1 billion people — are women and children. Women make up a large proportion of human resources and can contribute to the talent pool of scientists and innovators.^[1] Yet women continue to be underrepresented in STEM subjects^[2]. Education can enhance girls' empowerment and participation in STEM through inclusive teaching practices in lessons. Inclusive teaching practices can be extended to capture pupils from all gender identities including LGBTQ+ pupils.

Careers

Pupils close to transition from secondary to tertiary education or employment need to be supported in recognising the importance of STEM in their lives and the lives of others. Education needs to develop their skills for employment in STEM and STEM-related professions. The activities explicitly highlight different types of jobs and engage pupils in considering different roles. Exposure to different role profiles is like to raise pupils' awareness about their options.

References

UNESCO Science, Technology and Gender: An International Report and Executive Summary (2007)
 UNESCO Institute for Statistics Women in Science: UIS fact sheet number 6 (2010)

Causes and Effects of Climate Change

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SET 1 - TEACHER GUIDELINE Causes and Effects of Climate Change

Introduction

The lesson will introduce climate change and cover the causes and effects of climate change. Pupils will watch videos that will encourage them to think about scientific evidence and claims about climate change, and how they may contribute to problem-solving about climate change. By engaging in realistic discussions about how pupils can input into problem-solving, the activity will empower them to be active agents in solutions in society.

Learning goals

Through this activity pupils will be able to -

- a) understand the causes and effects of climate change;
- b) evaluate scientific claims and evidence about climate change;
- d) differentiate true claims from false ones based on scientific knowledge;
- e) engage in active learning strategies through group and pair discussions.

Activity framework

The activity will cover causes and effects of climate change as well as some facts about climate change. During this activity, pupils will be engaged in active discussions to empower their engagement and participation in issues that are of concern to them and their futures.

Example teaching sequence

- 1. Show the video "Causes and Effects of Climate Change" by National Geographic (https://www.youtube.com/watch?v=G4H1N_yXBiA).
- 2. After watching the video, ask the pupils to complete the table (Part 1) in the worksheet. The intention here is to consolidate some information from the video and to get the pupils to use reasons to justify their points of view.
- 3. Next put the pupils into groups of 3 and ask them to answer the following questions. Assign one question to each pupil and get them to ask it to the rest of the group. Here, role play can be used as a strategy to engage and empower pupils. The rest of the group will take turns in asking and answering the questions:
 - What causes climate change?
 - What are some consequences of climate change?
 - What can be done to avoid the negative effects of climate change?

- 4. Now show the pupils another video: "Climate Change The Facts with Sir David Attenborough" (<u>https://www.youtube.com/watch?v=EOctIuyVfnA</u>). Like the previous video activity, after watching the video, get the pupils into groups of 3 and ask them to answer the following questions. Assign one question to each pupil and get them to ask it to the rest of the group. The rest of the group will take turns in asking and answering the questions:
 - How many degrees is the temperature expected to rise in the next decades?
 - Which communities are going to suffer the most?
 - What can be done to avoid this?
- 5. Following on from the group discussions about the videos, get the pupils to write down their ideas about how they might contribute to solving the climate crisis. Ask the pupils to write down what they might propose to do themselves to contribute to problem-solving about climate change. Get them to discuss their ideas with another person in a pair discussion. Following the pair discussion, get the pupils to write down one new idea that they learned from the discussion with their peers.

Gender

The activity can be followed up or complemented with a further activity to stress gender issues in relation to climate change.

- 1. After watching the Attenborough video, put the pupils into groups of 3 and ask them to complete the work-sheet on gender.
- 2. After the pupils complete the worksheet individually, conduct a plenary discussion around the main questions to compare and contrast their opinions.
- 3. Following on from the group discussions about the videos, get the pupils to write down their ideas about how gender and science may be related.



The activity can be followed up or complemented with a further activity to raise pupils' awareness about career options and employment in relation to climate change. Use the worksheet on careers and employment to get the pupils to work individually and in groups. Assign a role to them as a teacher, climate scientist or a museum educator. After writing down their responses about their own roles, encourage them to discuss with the rest of the group and write down what they learned from the others. You might get the groups to report on some ideas about each profession and how they might help problem-solving about climate change emergency.

SET 1 - STUDENT RESOURCE Causes and Effects of Climate Change

Part 1: Videos

After watching the video, decide if the claims below are 'true', 'false' or you 'don't know'. You can tick in one box only for each statement. Explain your reasons.

Ideas about climate change	True	False	I don't know	Reasons	
1. The earth's climate has fluctuated in the past.					
2. Overpopulation is not contributing to climate change.					
3. Greenhouse effect has nothing to do with heat, but rather it involves photosynthesis.					
4. Smog contains ozone particles which increase at higher temperatures.					
5. Carbon dioxide levels in the atmosphere has been decreasing in the last hundred years.					
6. Storms and droughts are a direct result of climate change.					
7. Climate change may change the weather but it does not cause any health problems.					

Part 2: What is climate change anyway?

In your groups, you will discuss the following questions. Be prepared to ask your question and take turns to answer them.

- What causes climate change? (Pupil 1)
- What are some consequences of climate change? (Pupil 2)
- What can be done to avoid the negative effects of climate change? (Pupil 3)
- How many degrees is the temperature expected to rise in the next decades? (Pupil 1)
- Which communities are going to suffer the most? (Pupil 2)
- What can be done to avoid this? (Pupil 3)

Part 3: What can I do about climate change?

List 3 things you can do to help solve the climate problem.

Now discuss your ideas with the person next to you. After your discussion, write down one new idea that you got from your discussion.



• What did you observe about the images in the videos?

• Do you think that girls and women were included? Why? Why not?

How do you think women can help with solving the climate change emergency?

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SET 1 - STUDENT RESOURCE - Careers Causes and Effects of Climate Change

There are many ways to help with the climate change crisis. Your teacher will give you a role to play! You will either play the role of a teacher, a climate scientist or a museum educator.

Write down what you think you could do in your job to help the climate and how you could contribute to society.

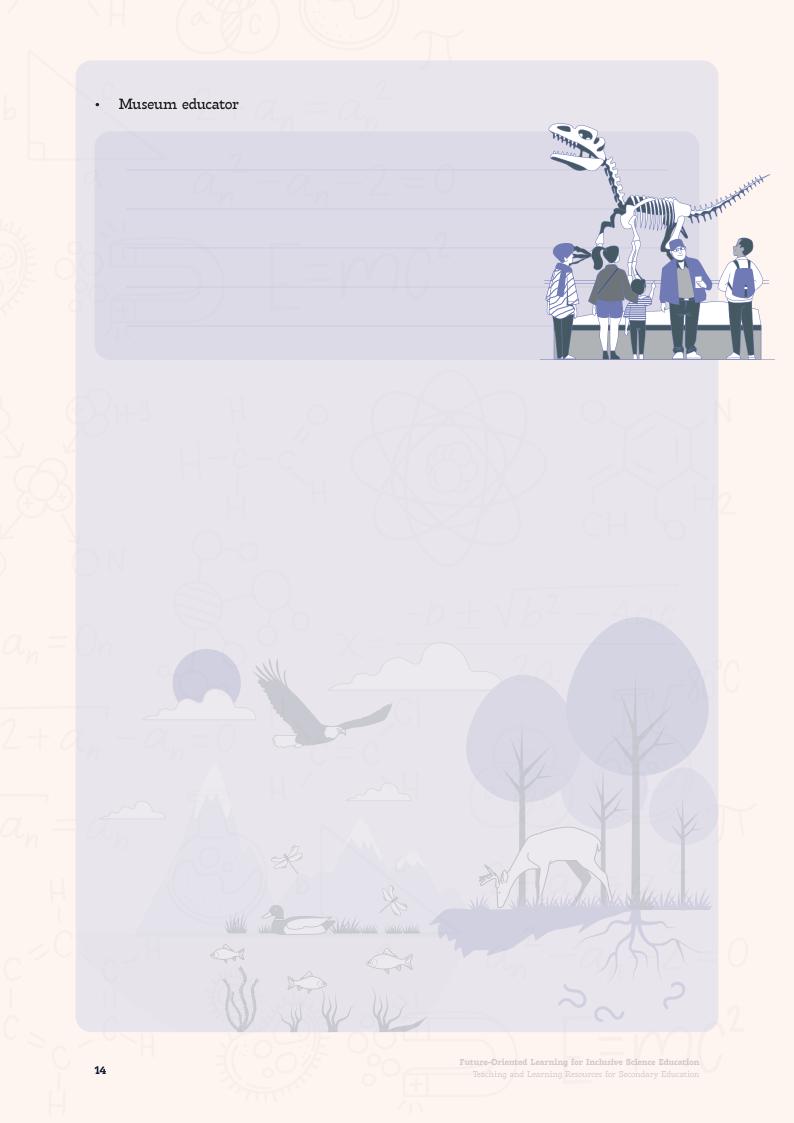
Once you finish writing your ideas about your job, discuss in your groups the others' ideas and write done some ideas that you learn about them.

• Teacher



Climate scientist





SET 2

Climate Change: The Facts



SET 2 - TEACHER GUIDELINE Climate Change: The Facts

Introduction

The lesson will introduce some key facts that are relevant to climate change. Pupils will engage with policy documents presenting scientific evidence. The activities will encourage them to select and extract the most useful information presented in the text. This will support their scientific literacy skills and their collaborative decision-making as they will reflect and decide in groups about what information to share with their classmates. The activities will also encourage pupils to use their imagination and creativity as they are asked to find effective ways of communicating important information with their peers within and outside of school.

Learning goals

Through this activity pupils will be able to -

- a) become familiar with key terms, concepts and facts related to climate change;
- c) engage with policy documents relevant to climate change;
- d) effectively present scientific evidence though illustrations.

Activity framework

The activity will cover some key facts about climate change as presented by official documents. During this activity, pupils will be familiar with key terms, concepts and documents often used in everyday life referring to climate change. This activity will help them better understand the language often used around climate change. Such exposure will empower them as it will make them feel more confident with engaging in conversations about climate change with their peers and family.

Example teaching sequence

- Give the pupils the '<u>Fast Facts</u>' created by the United Nations. The document is available at the following link: https://www.un.org/sites/un2.un.org/files/fastfacts-what-is-climate-change.pdf
- 2. After reading the text divide the pupils into two groups. Present the questions in a quiz game with questions about the facts presented in the text. The questions can be read or presented through an online platform. Give 1 point for every correct answer and 1 point for every correct justification from the text. You may give bonus points for justifications from alternative sources and student prior experiences. You may give the winning group a Climate Change Excellence badge.

Quiz questions

1. Climate change mainly means warmer temperatures.

2. In a 2018 report, thousands of scientists and government reviewers agreed that limiting global temperature rise to no more than 1.5°C would help us avoid the worst climate impacts.

3. The current path of carbon dioxide emissions could increase global temperature by as much as 2.4°C by the end of the century.

4. The 10 largest emitters contribute 68 per cent of total emissions.

5. Switching energy systems from fossil fuels to renewables like solar will increase the emissions driving climate change.

6. Climate action requires significant financial investments by governments and businesses. But climate inaction is vastly more expensive.

3. Put the pupils into pairs. Assign one topic to each group and ask them to read the topic-related text and create a simple infographic that could be displayed in the classroom. This activity will ask pupils to use their creative skills to communicate scientific evidence with the rest of the group.

Topics:

Physical science | Temperature Rise | Adaptation | Finance | Economy | Renewable Energy | Food and Agriculture | Health | Nature | Ocean

4. Now gather all the groups and ask pupils to create one infographic that will include all the topics. The goal is for the whole class to create a 'knowledge mosaic' by bringing together various aspects of climate change in one poster. This can be displayed and distributed to other classes within the school.

Gender

The activity can be followed up or complemented with a further activity to stress gender issues in relation to climate change.

- After reading the 'Fast Facts' text, the pupils into groups of 3
 and ask them to complete the worksheet on gender.
 The text is available at the following link:
 https://www.un.org/sites/un2.un.org/files/fastfacts_gender_equality_february-22.pdf
- 2. After the pupils complete the worksheet individually, conduct a plenary discussion around the main questions to compare and contrast their opinions.
- 3. Another version of this activity can use the <u>Stonewall</u> Resource on LGBTQ+ Rights to raise awareness of how some people may be marginalised due to climate change related problems such as poverty, pollution, food insecurity and plastic pollution.
- 4. The Stonewall Resource is available at the following link: https://www.stonewall.org.uk/system/files/lgbt_in_britain_hate_crime.pdf



Careers

The activity can be followed up or complemented with a further activity to discuss the term 'green jobs'. Ask pupils to read the <u>Fast Facts</u> on Climate change and Jobs.

The document is available at the following link: https://www.un.org/sites/un2.un.org/files/fastfacts_jobs.pdf

Use the worksheet on careers and to get the pupils to reflect individually or discuss in groups. Divide the class into small groups and ask them to brainstorm a list of green jobs. Encourage them to think beyond obvious examples like solar panel installers or environmental scien-

tists, and consider less well-known jobs like sustainability coordinators, urban planners, or green building architects.



set 2 - STUDENT RESOURCE Climate Change: The Facts

Part 1: Quiz

After reading the text, decide if the claims below are 'true', 'false' or you 'don't know'. You can tick in one box only for each statement. Explain your reasons based on the text or your own experience.

Facts about climate change	True	False	I don't know	Reasons
Question 1				
Question 2				
Question 3				
Question 4				
Question 5				
Question 6				

Part 2: Aspects of Climate Change

In your groups, discuss one topic that is relevant to climate change. After reading the relevant text, create a simple infographic (illustration) to present the most important information. You can create this illustration using paper and pencil or software (e.g. PowerPoint). You will share this infographic with your classmates.

Topic:

Information to include (in bullet points):

1.			
2.			
3.			
4.			

Infographic	
$a_n - a_n = 0$ H $c = c$ Cl $c = c$	
	D)
$\sum_{i=1}^{n} i = i $	

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Part 3: Climate Change Mosaic

Based on what you read in the 'Fast Facts', discuss with the whole group: What are the most important aspects of climate change? What do people need to know?



Combine your illustrations to create a larger 'Climate Change Mosaic' that you can share with your classmates, friends and your parents. When creating the mosaic think: How can we display all the information above so that people know what needs to be done?



Climate Change Mosaic

Gender

1. Read the 'Fast Fact' sheet in Gender equality.

2. Did you find any of these facts surprising? Why? Why not?

3. Discuss this phrase with your partner: 'Women are less able to confront climate change due to limited access to and control of environmental goods and services, less participation in decision-making and the distribution of environmental management benefits'.

Can you think of any examples to support this claim?

Careers



What is a green job?

1. Read the Fast Facts on Climate change and Jobs.

2. Brainstorm a list of green jobs. Can you think of any examples other than the ones commonly discussed (e.g. solar panel installers or environmental scientists)?

3. After creating a list of green jobs, reflect on the following questions:

- •Why is this job important for a sustainable economy?
- •What are some of the challenges and opportunities associated with this job?
- •How might this job contribute to a better future for our planet?

Once you finish writing your ideas, discuss in your groups the others' ideas and write done some ideas that you learn about them.

SET 3

Artefacts in the Museum



SET 3 - TEACHER GUIDELINE Artefacts in the Museum

Introduction

The lesson will provide a context for climate change in informal science learning environments such as museums. Pupils will be encouraged to reflect on various resources and artefacts that are available at science, art and natural history museums. In this fashion, they will be encouraged to take an interdisciplinary and cross-curricular approach to understanding an issue. There may be a field trip component of the activity to have discussions about actual artefacts as well. By engaging in discussions outside of the school and the classroom, the activity will empower pupils in being active participants in a range of initiatives about climate change more broadly in society.

Learning goals

Through this activity pupils will be able to -

- a. understand that climate change affects all of society and there are ways of expressing concern about climate change such as through art in museums;
- b. explore the concept of biodiversity and its loss due to climate change in the context of a science or a natural history museum;
- c. recognise that museums can be useful environments to learn about climate change;
- d. create and communicate their own artefacts to represent their understanding of climate change.

Activity framework

During this activity, pupils will focus on how climate change surrounds all of society and it is represented in the work of artists as well as scientists. Observing and discussing artefacts will enable pupils to see climate change in social context and producing artefacts themselves will empower them as active contributors to discussions about climate change.

Example teaching sequence

 Take the pupils to a science, natural history or art museum. If the activity is done in class, ask the pupils to research the museum during the lesson. Examples can be located from London (e.g., National Gallery, Science Museum) and Oxford (e.g., Natural HIstory Museum, the Ashmolean).

- 2. Ask the pupils to identify an object or an artwork that they found interesting and relevant to climate change. In part 1, get them to write a description about the object and explain their reasons for their choice.
- 3. Following individual work, ask the pupils to share their choice of objects with their groups. Following the group discussion, get the pupils to answer the following questions in a whole class discussion:
- How do museums tell the story about biodiversity?
- How can art and science objects help us communicate climate change?
- What are some similarities and differences between the objects you chose?
- 4. In Part 2, ask the students to share their objects with a friend in a pair discussion. Get the pupils to discuss the questions in the table and write down their responses. The aim in this activity is to get the pupils to evaluate their friends' work in order to develop their critical thinking skills and awareness of criteria (e.g., meaning, purpose, connectedness) for judging art work.

Gender

The activity can be followed up or complemented with a further activity to stress gender issues in museums.

- 1. After completing the worksheet on objects, get the pupils into groups of 3 and ask them to complete the worksheet on gender.
- 2. After the pupils complete the worksheet individually, conduct a plenary discussion around the main questions to compare and contrast their opinions.

Careers



The activity can be followed up or complemented with a further activity to raise pupils' awareness about career options and employment in relation to museums or other work environments where climate change related business is conducted. Ask the pupils to write down a role description for each job. You may get the puipls to research each job type on the internet by looking at the museum links suggested earlier. After writing down their responses, conduct a plenary discussion to summarise the ideas emerging in groups.

SET 3 - STUDENT RESOURCE Artefacts in the Museum

In this activity, we will consider artefact from museums and how they might help us learn about climate change and how they might help us talk about climate change.

Part 1: My artefact

Choose an artefact from the museum and describe it. Explain your reasons for your choice.

My artefact is	I chose my artefact because

Part 2: My friend's artefact

Now have a look at your friend's artefact. Describe the artefact and discuss the following questions.

My friend's artefact is...

I discussed the following questions with my friend:

What is the meaning of the artefact?

What is the purpose of the artefact?

How does the artefact make connections to climate change?

What is the cultural importance of the artefact?

Does the artefact bring together science and art? YES NO

If so, how?

If not, could you suggest how the artefact could combine art and science?

Gender

Choose an artefact that was produced by a woman.

What do you notice about the artefact?

Do you think it is any different from an artefact produced by a man?

An LGBTQ+ individual?

Why? Why not?

Examine the website of the museum.

Can you identify any gender-inclusive statements on the website?

If so, what are they? If not, what would you recommend the museum to write on their website to communicate gender inclusion?

Careers

Consider the different jobs that one can do in a museum.

Describe the main activities that an artist, a scientist, an educator and a fund raiser would do in a museum.





• Scientist



• Educator





Future Scenarios

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SET 4 - TEACHER GUIDELINE

Future scenarios

Introduction

The lesson will introduce the aims and goals of Paris Agreement, as part of global targets to address climate change. As pupils will become more familiar with key terms and global initiatives for fighting climate change. Pupils will be presented with alternative scenarios and they will be asked to thinking critically about the challenges and opportunities presented by climate change, and to encourage them to consider their role in shaping the future of our planet.

Learning goals

Through this activity pupils will be able to—
a) become more familiar with Paris Agreement and its goals;
b) consider alternative future scenarios about climate change;
c) foresee the impact of climate change for themselves and their community.

Activity framework

This activity will provide an overview of Paris Agreement as an example global policy to fight climate change. As pupils will become more familiar with the decision-making processes and governance around climate change they will develop their systems thinking skills. This will help them better understand their own position and power within the decision-making system. Through the future scenarios activities, pupils will use their imagination to predict possible futures based on current scientific evidence. By thinking through the scenarios they will reflect on the possible impact of climate change on their own lives and the lives of people in their communities.

Example teaching sequence

- Ask pupils to read the 'Paris Agreement for young people'. After reading the text, ask pupils to rank and summarize the 5 most important articles of Paris Agreement (pages 13-16). The Paris Agreement for young people is available at the following link: https://www.unicef.org/lac/media/19316/file/paris-agreement-for-young-people.pdf
- 2. Divide the class into small groups (3-4 pupils), and assign each group a scenario related to climate change.

Group A: Carbon-neutral future Group B: Catastrophic climate change

Give each group time to research their assigned scenario and create a presentation summarizing the key features and implications of that future.

Ask each group to present their scenario to the class, using visual aids. After all groups have presented, lead a class discussion about the different scenarios and their implications.

You can use the following questions:

- Which scenario do you think is most likely to occur, and why?
- What are the potential benefits and drawbacks of each scenario?
- How might society respond to the challenges presented by each scenario?
- What can we do now to steer towards a more desirable future scenario, and avoid the worst outcomes of climate change?
- 3. Ask pupils to write a letter from the future (e.g., 2050 or 2100) that describes the impacts of climate change in that region. Encourage pupils to use their research to make their letter as grounded as possible, while also allowing them to be creative. After pupils have finished their letters, have them share them with the class in a storytelling or reading session. Encourage classmates to ask questions and engage in a dialogue about the potential impacts of climate change and the urgency of taking action to address it.

Gender

Ask pupils to find any references to 'gender' or 'equality' in <u>Paris Agreement for young people</u> document. Through this activity, the pupils will think critically about the gendered impacts of environmental challenges and solutions. Here resources from Stonewall used in Set 2 of this booklet can be used to diversify the discussion about gender and highlight how LGBTQ+ people may be disadvantaged by environmental challenges.



The extension activity about careers will get the pupils to recognise the decision-making around some critical issues related to the Paris Agreement. The themes cover key stakeholders in policymaking and implementation of policies. Overall the activity is intended to enhance pupils' understanding of how political systems influence decision-making about climate change.

SET 4 - STUDENT RESOURCE Future scenarios

Part 1: The Paris Agreement

After reading the text, discuss:

Which articles of the Paris Agreement (pages 13-16) you think are more important? Select the **5 articles** that you think are most important and summarize them in bullet points.

1. Article	• • • •		
2. Article	• • •		
3. Article	• • • • • • • • • • • • • • • • • • • •		
4. Article	• • • • • • • • • • • • • • • • • • • •		
5. Article	• • • • • • • • • • • • • • • • • • • •		

Part 2: Future Scenarios

Group:

Look up for possible consequences of your scenario.
 What will be the impact on economy, society and vulnerable groups?
 Create a presentation summarizing the key features and implications of that future.

Part 3: A Letter from the Future

Having a future scenario in mind, write a letter to yourself from 2050. In your letter, you should include:

- A description of what your region looks like, including physical changes to the landscape and built environment.
- An overview of how people's daily lives have been impacted by climate change, including changes to the economy, social structures, and cultural practices.
- Personal experiences and reflections on how climate change has affected your own lives and those of your loved ones.
- A message to your present-day self.

Gender

Is the word 'gender' or 'equality' included in the Paris Agreement for young people'? Why? Why not?

Discuss the following with your partner:

A scenario in which rising sea levels, drought, and other climate-related events force millions of people to leave their homes and communities. Women and girls are often disproportionately affected by displacement, as they may face greater risks of violence, exploitation, and limited access to education and healthcare.

How can we ensure that climate action and adaptation strategies take into account the needs and perspectives of women and girls, and promote gender equity?

Careers

Who decides?

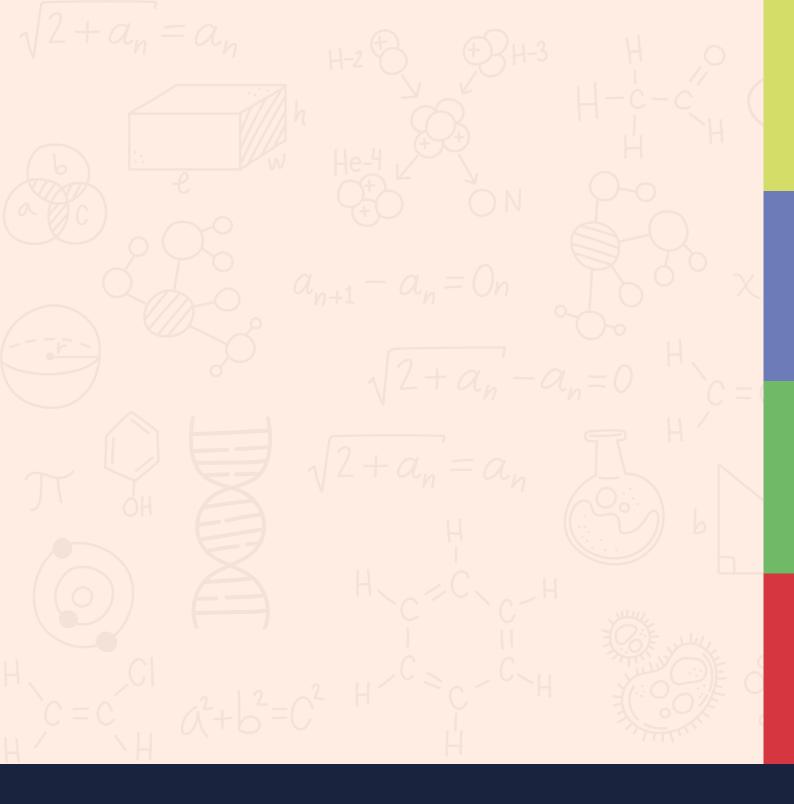
After reading the <u>Paris Agreement for young people</u>, discuss with your partner what kind of professionals are involved in...

a) deciding on the topics described.

b) putting together the document.

c) making sure that countries apply the recommendations.

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