LESSON PLAN

Title

ARCTIC ISSUES:
THE CHANGING ARCTIC

Subject

Geography, Science

Keywords

* Arctic
* climate change
* Arctic amplification
* sea ice
* albedo
* thawing permafrost
* sea level rise

Aim of the lesson

Student will:

* learn what kind of feedback loops affect the weather and climate in the Arctic;
* understand, what positive and negative feedback loops are and how they affect the processes;
* understand how the changing sea ice extent influences the polar regions and the whole planet;
* learn what is Arctic amplification and what are its main reasons;
* learn what are the effects of thawing permafrost and how it connects with the permafrost carbon cycle;
* become familiar with the main challenges that the Arctic faces due to climate change;
* be able to explain why the changes in the Arctic influence the weather patterns far beyond the Arctic.

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Trends *http://www.allourideas.org/trendiez/results*

* STEM learning
* GAME-based learning and gamification
* Project-based learning

Age of students

* 13-19

Time

* Preparation time: 45 minutes (teacher); 30 minutes (all students); 45 minutes (volunteers)
* Lesson duration: 45 minutes (alternatively: 60 minutes, depending on duration of lesson unit)
* Homework: 35 minutes
* Follow-up lesson: 30 minutes (not obligatory; alternatively, in case of 90 minutes session (science club or 2 units combined – all activities during 1 session)

Teaching materials and tools

Online materials:

INTERACT & BBC Arctic Climate Magnification (video): https://youtu.be/xCqofgFN7CA?si=Z4dxWq3F9jfNiexV

INTERACT & BBC Extreme Causes For Concern (video): https://youtu.be/Dfx1KLzRdso?si=MYEROgVSQdOltNM4

TED-Ed animation: Why the Arctic is a canary in a coal mine: https://youtu.be/lrEM3LHvjI0?si=gFEwGOA0-Z1Fa-9C

National Snow and Ice Data Center: https://nsidc.org/

Interactive sea ice chart (by NSIDC): https://nsidc.org/arcticseaicenews/charctic-interactive-sea-ice-graph/

Arctic sea ice 1984-2018 (video): https://youtu.be/dIQi64EudeA

Fill in the Blanks Game: Arctic amplification: https://www.educaplay.com/learning-resources/3440315-complete_polarpedia_term.html

Fill in the gaps game: Sea ice extent: https://www.educaplay.com/learning-resources/3441572-complete_polarpedia_term.html

Polarpedia glossary:

- Albedo
- Arctic
- Arctic amplification
- Climate
- Emission scenarios
- Greenhouse effect
- Greenhouse gas
- Permafrost

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- Permafrost Carbon Cycle
- Sea ice
- Sea ice minimum
- Weather

For the experiment:

2 empty glasses or plastic containers of the same size (e.g. empty ice cream boxes)	One glass	Ice-cube tray
2 thermometers	Desk lamp with a bulb (or two lamps with bulbs of the same power)	Water and access to freezer

21st century skills *http://www.p21.org/our-work/p21-framework*

* Critical thinking and problem solving
* Global awareness
* Environmental literacy

Activities

	Name of activity	Procedure	Time	Resources
BEFORE THE LESSON A	1 BEFORE THE LESSON – PREPARATION ACTIVITY for teacher	Do a quick brush-up of your own knowledge about climate change and feedback loops. Polarpedia terms are useful here. The tool-kit contains all you need to complete a full lesson. You may check the additional resources (especially the videos) to extend the lesson or to meet questions from particularly inquiring minds.	45’	• Powerpoint presentation, including notes • Webinar recording • Additional resources (listed above and in the Syllabus) • Polarpedia terms (links are provided above and in the Syllabus)
	2 BEFORE THE LESSON – PREPARATION	2-4 volunteers prepare an experiment according to the scenario (at school or at home). They may work in 2 groups or individually. All students conduct the same experiment. Depending	60’	• Experiment scenario

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	ACTIVITY for 2-4 volunteers	on initial conditions, time of melting will differ.		
DURING THE LESSON B	1 Kick-start	Students do a quick brush-up on climate change, greenhouse gases and greenhouse effect. They may write down their definition or present them orally.	5’	
	2 Introduction	Teacher introduces the topic using some parts of .ppt presentation (e.g. slides 1-8) or by presenting a recording from topic expert scientist’s lesson.	15’	• Powerpoint presentation • INTERACT & BBC video Part 1 • Webinar recording
	3 Investigation	Students, who volunteered to conduct the experiment at home, make a short presentation on the results. Teacher moderate a discussion on feedback loops connected with decreasing sea ice extent. Students may do the tasks 1-3 from the worksheet (worksheet may be also used as a homework, depending on available time during the lesson).	15’	• Experiment scenario • Students’ worksheet
	4 Conclusion	Teacher wraps up the take-home messages from the lesson. He/she may use the .ppt presentation with slides 9-16.	10’	• Powerpoint presentation
HOMEWORK C	1 Homework for students	If students don’t complete the worksheet in the classroom, they may finalise it at home (either individually or in groups). Suggested tasks: 1-3.	At home – 35’	• Students’ worksheet
	2 Homework for volunteers	3 groups of students prepare short (3’) oral presentations regarding following topics: • Feedback loops with examples • Greening vs. browning the Arctic • Why are record cold events and record heat waves present nowadays in various parts of the world?	30’	• INTERACT & BBC videos • Additional resources (research by students)

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FOLLOW -UP LESSON D	1 Introduction	Teacher starts the follow-up lesson with information on other challenges in the Arctic environment (melting glaciers, sea level rise, fires, thawing permafrost). Teachers may use .ppt presentation (slides 17-25), the webinar recording or INTERACT & BBC video – Part 1.	15’	• Powerpoint presentation • INTERACT & BBC video Part 1 • Webinar recording
	2 Investigation	3 groups of students present shortly following topics: • Feedback loops with examples • Greening vs. browning the Arctic • Why are record cold events and record heat waves present nowadays in various parts of the world? After the presentation a short discussion is organised by teacher. If some additional questions appear, teachers help students answer them (if necessary). Additionally, students do the tasks 4-5 in the worksheet.	20’	• Students’ worksheet
	3 Conclusions	Teacher concludes on the consequences of the changes present in the Arctic. He/she may use the .ppt presentation (slides 28-32). As the final step students explain, how they understand the sentence: “What happens in the Arctic, doesn’t stay in the Arctic.” Teacher ends with a reverse evaluation, where the students evaluate the lesson instead of being evaluated.	10’	• Powerpoint presentation • Students’ worksheet

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Assessment

############################## AFTER IMPLEMENTATION ##################################

Student feedback

3 boxes or jars are prepared, one marked: **INTERESTING**, the second – **UNDERSTANDABLE**, the third one – **CHALLENGING**.

In the box next to the jar there are post-it cards in 3 colours:

GREEN – HIGH

ORANGE – AVERAGE

RED – LOW

As students leave they choose 3 cards and put one into each box, depending on how they assess the lesson.

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