Teachers' Guidelines

Title of the package: Arctic hydrology

Information about the package:

Brief Description:

Water in the Arctic that either fell as rain or melted from snow and ice, flows via different paths before reaching the ocean. The flow of water in rivers in the Arctic has a seasonal character. During late autumn, winter and early spring, most arctic rivers freeze. There is a typical large variation of flow of water during ablation season, with very high discharge during the snowmelt and decreases during summer. Runoff regime and hydrological processes shape the landscape and influence the dynamics of glaciers.

Groundwater movement in permafrost terrain is limited, cause frozen soil is practically impermeable. Above the permafrost is the active layer which freezes in winter but thaws in summer, allowing infiltration and groundwater recharge. This package will allow students to understand some of the most important hydrological processes in the Arctic.

How does the package relate to STEAM education: The thematic scope of the package is science-centered and includes recognition and inquiry activities. The package is interdisciplinary as it uses hydrological, climatological, and glaciological concepts and terminology.

Keywords: Arctic, Svalbard, hydrology, water cycle, runoff, catchment, climate change, sea ice, glaciers

Age Range: 14-18

Didactical Hours: 2 hours.

Learning objectives:

The student will:

- understand what characterizes the hydrological cycle in the Arctic;
- know how the clouds are formed;
- know what is precipitation, evaporation, catchment runoff and how to measure all of them;
- know what is the hydrological regime of arctic rivers;
- learn how climate change has affected the water cycle in the Arctic, glaciers, sea ice, and continental ice sheets worldwide;

EDU-ARCTIC 2: from polar research to scientific passion – innovative nature education in Poland and Norway receives a grant of ca. 240 000 EUR received from Iceland, Liechtenstein and Norway under EEA funds. The purpose of the EDU-ARCTIC 2 project is to: enhance the knowledge about nature, geography, natural resources, political specificities concerning polar regions and increase awareness of environmental issues and climate change, increase of interest in pursuing STEM education and careers due to enhancement of knowledge about scientific research, and their place in the modern world, familiarizing young people with scientific career opportunities; introduce innovative tools by way of an e-learning portal and effective methods of teaching science in schools.

- learn the crucial role of the water cycle in our climate.

Content of the package and guidelines for teachers:

Link to the package: https://graasp.eu/spaces/6102867aaa5af6346d277056

We encourage teachers to copy the graasp package to their own graasp space in order to become “owner” and be able to modify the content, hide or unhide some materials, add quizzes etc. Moreover, teachers may share the package with their students and check the progress of each student.

A short video tutorial on how to do it is available at: https://view.genial.ly/5f7ef81f1b2b330d2efa3411/video-presentation-tutorial-graasp

If you don’t have access to the graasp package, contact us: edukacja@igf.edu.pl

The package consists of 4 sections described in detail below. In the end, there is a short quiz summarizing the knowledge.

1. **Arctic Hydrology - introduction**

First, introduce the students to Arctic Hydrology and water cycle using ppt presentation. Then watch a short video on “the Earth’s water cycle”. Then ask the students to name the frames in the provided interactive material. Then answer the questions from the provided quiz

Suggested resources:

- PPt presentation on the Arctic Hydrology https://graasp.eu/resources/610d709bcf3d667f8bfd36a2
- Name the frame – interactive game https://graasp.eu/resources/610d82f39b1b9c07d3aa8f8f
- Video: https://graasp.eu/resources/610d80a39b1b9c07d3aa8e1a
- Quiz: https://climate.nasa.gov/quizzes/ocean-quiz/

Estimated time: 20 minutes

2. **Evaporation, condensation, and precipitation**

The water cycle is powered by the sun's energy and by gravity. The sun kickstarts the whole cycle by heating all the Earth's water and making it evaporate. Gravity makes the moisture fall back to Earth. Students will learn more about evaporation, condensation, and precipitation using the provided materials.

Using ppt presentation explain the evaporation, condensation and precipitation processes. Watch two provided videos – making clouds and what is precipitation. Check the precipitation forecast for the Arctic and the entire globe on the website www.windy.com

Suggested resources:

- Presentation on evaporation, condensation, and precipitation https://graasp.eu/resources/610d7de99b1b9c07d3aa8a96

- Video on YouTube on clouds formation: https://www.youtube.com/watch?v=mJxQ7ErLtvo&t=25s
- Video on YouTube on precipitation https://www.youtube.com/watch?v=SesRrocIFtc
- Check the precipitation forecast on www.windy.com

Estimated time: 15 minutes

3. **Water storage and runoff**

Terrestrial hydrology is central to the Arctic system and its freshwater circulation. Water transport and water constituents vary, however, across a very diverse geography. From this section, students will learn about water storage and runoff processes. Use the provided ppt presentation and then check learn more from the provided quiz.

Suggested resources:

- Ppt presentation https://graasp.eu/resources/610d7f9a9b1b9c07d3aa8cb7
- Quiz: https://climate.nasa.gov/quizzes/quiz-ice/

Estimated time: 10 minutes

4. **Climate change impact on arctic hydrology**

In this section, students will learn about climate impacts on the water cycle in the Arctic. Watch the video on YouTube "The State of the Global Climate 2020". Then watch the "Arctic Sea Ice Trend Since 1979". There is approximately a 13.1 per cent per decade decrease in annual Arctic sea ice extent minimum. Read the short scientific communication on "Disappearing Arctic ice that increases extreme events worldwide". Then discuss the topic with the students using provided poster.

Suggested resources:

- Video on YouTube: "The State of the Global Climate 2020" https://www.youtube.com/watch?v=pmUCGcBy8tM
- Website https://climate.nasa.gov/interactives/global-ice-viewer/#/3/7
- Short scientific communication: https://scienceinpoland.pap.pl/en/news/news%2C83633%2Cwalking-thin-ice-disappearing-arctic-ice-increase-extreme-events-worldwide.html
- Poster https://www.canva.com/design/DAEmWS6V_04/NH6xXsKoFQeb2snDnZ7C2Q/edit

Estimated time: 20 minutes

5. **Summary quiz**

Read the conclusions from the provided poster
https://graasp.eu/resources/610d98debd4afc6ae29809f3

and then check the students' knowledge by a quiz on water cycle:
https://climate.nasa.gov/quizzes/water-cycle/