

Teachers' Guidelines

Title of the package: Plants adaptations to the Arctic climate

Information about the package:

Brief Description: The package concerns plants growing in polar regions and their adaptations to the Arctic climate. It contains activities connected with: tundra, plant species, types of plants adaptations.

How does the package relate to STEAM education: The package mainly focuses on science with art elements.

Science is represented by tundra and plants characteristics. There is also 3 days experiment which aim is to observe the temperature impact on soil profile. It is quite simple and may be carried out at home.

The package contains as well some activities covering art issues. There are: creating subtitles or commentary to the short film about tundra and writing an essay on topic what would happen if all carbon dioxide trapped in tundra due to it's thawing might be released into the atmosphere.

Keywords: tundra, adaptation, thawing, soil structure, permafrost, photosynthesis, vegetation period, Svalbard poppy, mountain aven, cottongrass, purple saxifrage, polar willow, biome, active layer, talik.

Age Range: 16-18

Didactical Hours: 4 hours + 3 days experiment.

Learning objectives:

The student will:

- know basic information about tundra;
- name examples of plants adaptations developed to survive in the Arctic;
- explain the role of carbon dioxide in tundra ecosystem;
- understand how living conditions may affect plants growth.

Content of the package:

Link to the package: <https://graasp.eu/s/2dkczx>

1. Welcome to tundra

- basic information about tundra – text definition (<https://polarpedia.eu/en/arctic-tundra/>) and film (<https://youtu.be/RT6x5GVPG8>);
- exercise 1 - write the descriptions to keywords: "50-60 days", "permafrost", "biome" given in the table;
- exercise 2 - look at the tundra soil profile. Explain why trees don't grow in the Arctic;
- exercise 3 – check in Polarpedia (<https://polarpedia.eu/en/>) meaning of the terms: active layer, talik;

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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.

- exercise 4 - look at the Arctic satellite map (<https://www.worldmap1.com/arctic-satellite-map>). Name the regions covered with Arctic tundra.
- 2. Coming close to the topic**
 - graphics “What factors affect plants in tundra?”;
 - 5 questions to discuss: what type of influence do the landform, animals, type of soil, temperatures and slopes exposure have on tundra plants;
 - exercise 5: fill in the mind map with what you have learned discussing 5 questions listed above;
 - pictures of 5 tundra plants: polar willow, purple saxifrage, cottongrass, Svalbard poppy and mountain aven;
 - exercise 6: join the plant picture with the proper example of adaptation to the Arctic climate.
 - 3. Is it on... Mars?**
 - short film about patterned ground (<https://youtu.be/FalYVvImFoc>);
 - exercise 7: 3 days experiment + worksheet for taking notes.
 - 4. Let’s do more activities!**
 - exercise 8: “Antarctic garden” –an experiment carried out by Polish scientists from the Faculty of Biology and Biotechnology of UWM in Olsztyn (Poland);
 - exercise 9: what are the best shoes in the Arctic?;
 - exercise 10: write subtitles / commentary to the film about tundra (<https://youtu.be/rwsoDw1MfL8>).
 - 5. Tundra and CO₂**
 - picture with photosynthesis process;
 - short film about tundra (<https://youtu.be/RT6x5GVVFG8>);
 - article “What is Arctic Tundra Doing With Carbon Dioxide?” (<https://edu-arctic.eu/news/57-what-is-arctic-tundra-doing-with-carbon-dioxide>);
 - exercise 11: write an essay on topic “What would happen if all carbon dioxide masses due to tundra thawing are released into the atmosphere?” + worksheet.
 - 6. Let’s do the sum up**
 - presentation with the most important information about tundra and plants adaptations to test the student's knowledge on that topic.

Guidelines for teachers:

- 1. Welcome to tundra – SLIDES 2-5**
Read about Arctic tundra and watch the film “What Are Tundras?”. They help you with doing exercises 1 and 2. Ask students to use Polarpedia to check terms from tundra soil profile picture they don’t understand (e.g. talik and active layer might be confusing). Enlarge Arctic satellite map and discuss about the regions covered with Arctic tundra.
- 2. Coming close to the topic – SLIDES 6-14 + plants-adaptations-worksheet1**
Study the graphics with factors that affect Arctic tundra. Then go slide by slide with your students and discuss those factors using presented pictures. Information gained would be helpful with doing worksheet 1 – a mind map that sums up first part of that phase. After that look at the pictures of five Arctic plants carefully and do together exercise 6.
- 3. Is it on... Mars? – SLIDES 15-17 + plants-adaptations-worksheet2**

Discuss with your students about patterned ground – what do they associate it with? Why it looks like this? Watch the video “How Permafrost Ice Wedges Cause Tundra Polygons and Mounds”. Pay attention what happened to the surface and active layer.

Explain the experiment to your students. It might be carried out at home and 3 days are needed to do it. You can treat it as individual project / additional homework. Full instruction you will find in EDU-ARCTIC2 plants-adaptations-worksheet2 .PDF file.

- 4. Let’s do more activities! – SLIDES 18-25 + EDU-ARCTIC2 plants-adaptations-worksheet3a/b**
You have three activities to do. They are called: “Welcome to (ant)arctic... garden”, “What are the best shoes in the Arctic?” and “Be like a screenwriter!”. Full description you will find in attached presentation. Think about involving form of doing those activities. Use EDU-ARCTIC2 plants-adaptations-worksheet3a and EDU-ARCTIC2 plants-adaptations-worksheet3b .PDF files.
- 5. Tundra and CO₂ – SLIDES 26-29 + EDU-ARCTIC2 plants-adaptations-worksheet4**
Do your students remember what photosynthesis process is? Let them describe it. Then go together through the material concerning carbon dioxide trapped in tundra. What would happen if big amounts of that gas will be released into the atmosphere due to thawing process connected with global warming? Ask students to write an essay to present their opinions. That exercise might be a homework. Use EDU-ARCTIC2 plants-adaptations-worksheet4 .PDF file.
- 6. Let’s do the sum up – SLIDE 30 + EDU-ARCTIC2 plants-adaptations-worksheet5**
Check what your students learn about tundra and plants adaptations. You can use presentation in .PDF file called EDU-ARCTIC2 plants-adaptations-worksheet5.

Additional resources and links, references:

- 1. Additional resources:**
 - Article: *Arctic and Antarctic “trees”*, <https://edu-arctic.eu/news/46-arctic-and-antarctic-trees>
 - Film: *Discovering Arctic Plants: Expedition Arctic*, <https://youtu.be/al0WkR6IXhE>
- 2. Definitions from Polarpedia – an online encyclopedia of the Arctic – used in the package:**
 - *Arctic tundra*: <https://polarpedia.eu/en/arctic-tundra/>
 - *Active layer*: <https://polarpedia.eu/en/active-layer/>
 - *Talik*: <https://polarpedia.eu/en/talik/>
- 3. Films used in the package:**
 - *What Are Tundras?*: <https://youtu.be/RT6x5GVPF8>
 - *Patterned Ground: How Permafrost Ice Wedges Cause Tundra Polygons and Mounds*: <https://youtu.be/FalYVvImFoc>
 - *Tundra on Spitsbergen*: <https://youtu.be/rwsoDw1MfL8>
- 4. Other materials:**
 - Graphics: *Arctic satellite map*, <https://www.worldmap1.com/arctic-satellite-map>
 - Article: *What is Arctic Tundra Doing With Carbon Dioxide?*, <https://edu-arctic.eu/news/57-what-is-arctic-tundra-doing-with-carbon-dioxide>