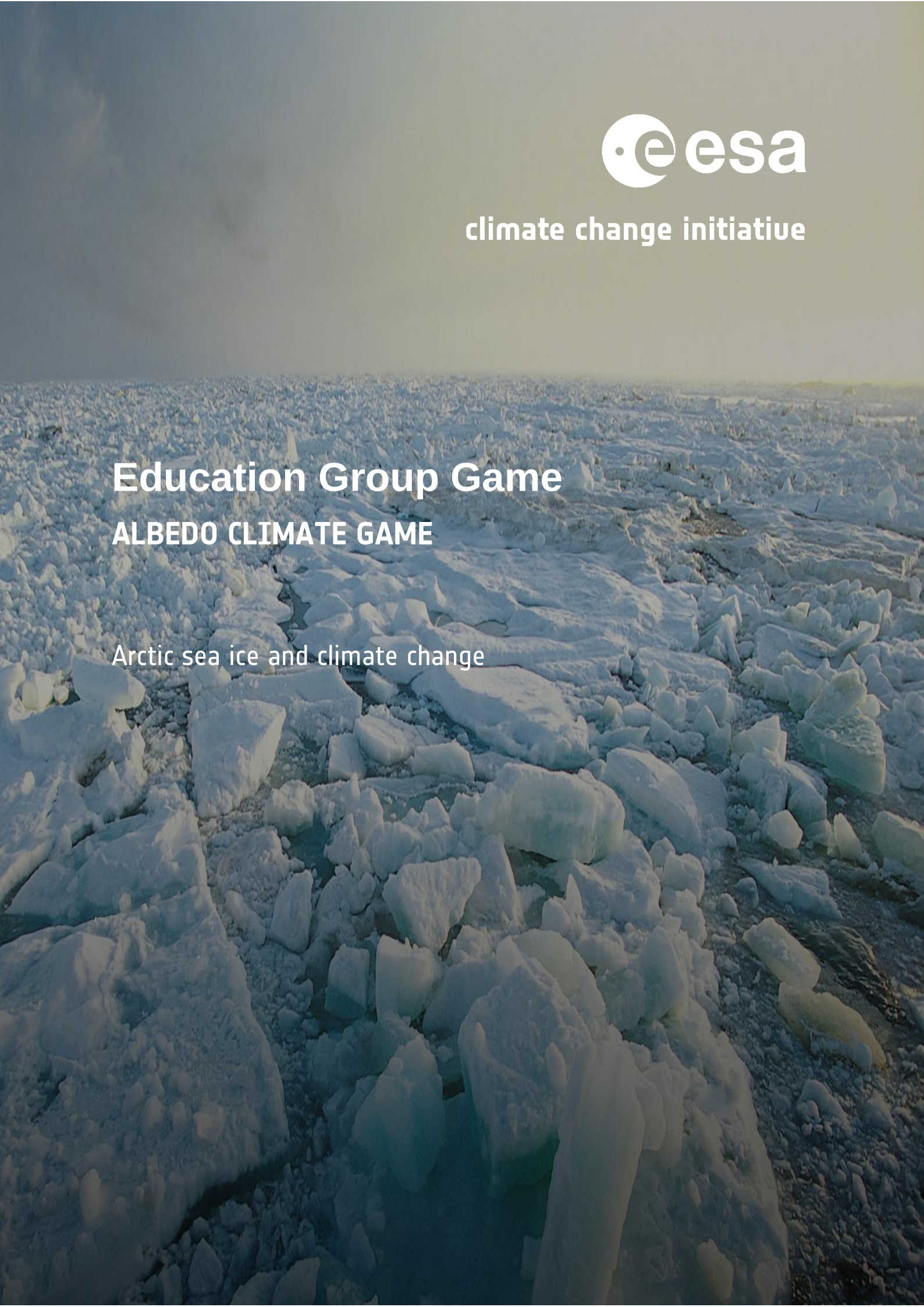

esa

climate change initiative

Education Group Game

ALBEDO CLIMATE GAME

Arctic sea ice and climate change

Contents

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https://climate.esa.int/educate/climate-for-the-public/

Activity concepts developed by University of Twente (NL)

The ESA Climate Office welcomes feedback and comments
https://climate.esa.int/helpdesk/

Produced by the ESA Climate office

ALBEDO CLIMATE GAME: Overview

Arctic sea ice and climate change

Fast facts

Subjects: Arctic sea ice and climate change

Age range: all

Type: group game

Number of players: 4+

Time required: 15-40 minutes

Cost: Low (0–20 euros)

Location: indoors

Includes the use of: pads of white and blue paper (e.g., Memo Pads 3in x 3in) and a few dice (depending on the group formation)

Keywords: sea ice, climate change, Arctic amplification, albedo

Brief description

This game lets the participants experience how changing albedo influences the rate of melting sea ice via stories and the interactive throwing of dice.

A moderator determines the pace of the game and takes the participants on an awareness journey through positive, neutral and negative climate change stories.

This game can be used as supporting material for the Education Resource Pack '*A Passage Opens*'.

Intended learning outcomes

Having worked through this game, participants will be able to:

explain and experience how the differing albedo of ice and ocean leads to Arctic amplification and the impact of this on climate change.

Game's goal

The goal is to retain a maximum number of ice sheets. The winner is the individual or group with the maximum number of white paper sheets.

Health and safety

In all activities, we have assumed you will continue to follow your usual procedures relating to the use of common equipment (including electrical devices such as computers), movement within the learning environment, trips and spills, first aid, and so on. Since the need for these is universal but the details of their implementation vary considerably, we have not itemised them every time. Instead, we have highlighted hazards particular to a given practical activity to inform your risk assessment.

Some of these activities use the Climate from Space online resource. It is possible to navigate from here to other parts of the ESA Climate Change Initiative site and thence to external websites. If you are not able – or do not wish – to limit the pages participants can view, do remind them of your local Internet safety rules.

Facilitator Guide

Background information

The colour of sea ice contrasts sharply with that of the open ocean and this also has an impact on climate. White ice and snow have a high albedo (reflectivity) and sea ice can reflect up to 85% of incoming sunlight, meaning this energy is no longer available to warm up the ocean. About 90% of all excess heat due to global warming is absorbed by oceans. Which, in the long term, will increase water temperature and cause the melting of sea ice sheets. The disappearance of sea ice means the Earth absorbs more energy from the Sun and accelerates global warming, causing even more sea ice to melt. This positive feedback mechanism is referred to as Arctic amplification. Sea ice also traps pockets of air, making it a good insulator. Like a swimming pool cover or a blanket, it keeps the sea beneath cooler than the exposed waters and this is another way in which it reduces the warming of the Arctic Ocean.

More information on this subject can be found in the educational resource pack *A passage opens*.

Overview

In the albedo game, participants will play with the concepts of albedo and Arctic amplification using white paper sheets to represent sea ice, and blue paper sheets to represent seawater. Each participant/group starts the game with two pads of white (ice) and blue (water) paper sheets. Via fun stories and the interactive tossing of the dice, participants experience how changing albedo influences the rate of melting sea ice. This is carried out by replacing the white (ice) with blue (water) sheets or vice versa. The winner is the participant/group with the maximum white sheets. It is recommended to play this game after the participants have been introduced to the concepts of albedo and Arctic amplification.

Materials needed

- (Recycled) pad of white paper (Memo Pads 3in x 3in)
- (Recycled) pad of blue paper
- Dice (1-6 range), the number of which depends on the number of participants

Setup

1. Make some space in the room so each participant (or group) can place the pads on the table.
2. To each participant/group, distribute two sets of white and blue pads, each containing 20 sheets.
3. Ask each participant/group to place 10 sheets of white paper surrounded by 10 sheets of blue paper. Keep the rest on the side.

Steps

1. Introduce the game and explain to the participants that they are going to simulate the effects of Arctic amplification on sea ice using white and blue sheets of paper.
2. The participant/group has to lay 10 white sheets on the table; this represents all the sea ice around the North Pole, which has a high albedo and, therefore, reflects much of the incoming sunlight. Place 10 blue sheets around the white sheets; this represents all the ocean water surrounding the ice sheets. This is the starting current situation.
3. Each participant/group chooses from the stories attached in Appendix I. By tossing the dice, the possible outcomes are:
    a. 1 → positive story, probability 17%
    b. 2, → neutral story, probability 17%
    c. 3, 4, 5, or 6 → negative story, probability 66%
4. For each story, the participant/group throws the dice to select from the possible events in the story.
5. Repeat step 4 five times (that is, toss the dice 5 times). The moderator could also choose to repeat the game from step 3.
6. Move to the debriefing and lessons learnt session.

Game's goal

The goal is to retain a maximum number of ice sheets. The winner is the individual or group with the maximum number of white sheets.

Debriefing

In the debriefing, participants reflect on the game. Example questions are:

- How did you feel? What did you experience? What made you feel good? What made you feel uncomfortable?
- How did you notice the effects of Arctic amplification?
- How does albedo affect climate change?
- Is there anything from this game that you would like to take forward?

Variations

- The moderator could skip the neutral story and focus on the positive (dice outcome 1) and negative (dice outcomes 2-6) stories. Each time the dice is tossed, the moderator can ask the participants to read the corresponding information from the neutral story.
- This game can be played in groups that each focus on one story.

Appendix I: Stories

The stories are an engaging way to show what influences the melting of sea ice and allow the moderator to determine the pace of the game. The moderator can influence the pace of the game by choosing particular stories. The moderator can slow it down by choosing positive or neutral stories or speed it up by choosing negative stories.

Positive stories

These stories are positive in the sense that they turn seawater back into sea ice.

Toss the dice and choose an event from the outcome

1→ India becomes the Worlds' superpower. Now the cow is holy around the world and nobody eats any more red meat. No more cows are bred, and they produce a whole lot fewer greenhouse gases into the atmosphere now.

Change one water (blue) sheet into one ice (white) sheet.

2→ This year it is very sunny in Spain. The new solar panels on our roof did well this year and generated all of our electricity.

Change one blue sheet into one white sheet

3→ A YouTube star started a crowdfunding campaign to support reforestation projects around the globe. This was successful! The newly planted trees capture and store carbon and help reduce the amount of CO_2.

Change one blue sheet into one white sheet

4→ In the 'Millionaire quiz' Julia won the main prize by answering 'black' to the question: "What visible colour has the lowest albedo". This is correct; where the colour white has the highest albedo (reflectivity), the colour black has the lowest. She knew this because, in the summer, asphalt can get hot and sometimes even melts on hot days. After all, it takes in a lot of heat.

Change one blue sheet into one white sheet

5 and 6→ Scientists improve the efficiency of generating electricity from windmills and solar panels. Now everyone drives an electrical car and employs a heating/cooling system that uses green energy.

Change two blue sheets into two white sheets

Neutral stories

These stories have no effect on the game, but present some quick facts and are more educational.

Toss the dice and choose information from the outcome

1→ About 12% of the world's oceans are covered by sea ice. Even though sea ice occurs primarily in the Polar Regions, it influences our global climate. Sea ice changes the reflectivity of the ocean and acts as a barrier to the exchange of heat and moisture between the ocean and the atmosphere.

Nothing happens.

2→ Sea level is a very sensitive indicator of climate change. In ice form, sea ice is already contributing its volume to the oceans. Thus, when it melts it does not increase the volume of the oceans. However, melting sea ice changes ocean salinity, affecting ocean currents and, therefore, the global climate system.

Nothing happens

3→ About 17% of the total global energy consumption is the electricity we use. The rest is transportation and heating/cooling. Heating and cooling make up half of our total energy consumption.

Nothing happens, Source (REN21)

4→ Sea ice typically covers up to 15 million square kilometres of the Arctic Ocean, and up to 19 million square kilometres of the Southern Ocean around Antarctica during their respective winter seasons. This seasonal cycle of sea ice is one of the most dynamic components of the Earth's climate system. Satellite records from ESA's CryoSat satellite show a constant downward trend in the area covered by Arctic sea ice during all seasons, particularly in summer, with the minimum recording having occurred in the autumn of 2012.

Nothing happens Source (ESA)

5→ Arctic amplification primarily affects the cryosphere, but as this is one of five components of the climate system, indirectly, the hydrosphere, atmosphere, lithosphere and biosphere are affected, too.

Nothing happens

6→ The most abundant greenhouse gas is: water vapour. In the news, you hear mostly about CO2, methane or nitrous oxide. Why don't we try to reduce the amount of water vapour then? Source (IPCC)
This is because water vapour was always part of the natural cycle; only since the

industrial revolution, humans started to emit other greenhouse gases at an unprecedented rate into the atmosphere.

Nothing happens

Negative stories

These stories are negative in the sense that they cause sea ice to melt

Toss the dice and choose an event from the outcome

1→ Whoops! Everyone went on a summer holiday to a faraway destination with an airplane. All these airplane emissions made the global temperature rise, and the seawater temperature is also higher. Some ice is melting.

Change one white sheet to one blue sheet

2→ To increase the amount of electricity generation, the factory decided to burn wood. This increased demand for wood and resulted in deforestation in the Amazon. Since living trees capture and store carbon dioxide, and now we have fewer of these trees, this means there is now more carbon in the atmosphere. Carbon dioxide is a greenhouse gas, meaning it warms up the atmosphere. Additionally, these trees have to be transported from Latin America to Europe by ship, meaning more emissions of greenhouse gases to the atmosphere.

Change two white sheets to two blue sheets

3→ This summer was scorching! All the air conditioning used a lot of power, more than all solar panels could generate. Only 10% of cooling energy comes from renewable sources. More coal has been burnt to keep us cool.

Change one white sheet to one blue sheet, Source (REN21)

4→ A state leader who is denying that climate change exists is elected. Now restrictions for highly polluting factories are lifted. A lot more fossil fuels are burnt and not filtered from the factories' chimneys. This increases the concentration of greenhouse gases in the atmosphere, trapping more heat from the Sun and raising the Earth and ocean's temperature.

Change two white sheets to two blue sheets

5 → It is Black Friday and everyone wants to get a present for their loved ones. But we all buy cheaper goods from Asia, with one-day delivery. Thousands of cargo planes ship these goods as quickly as possible to Europe. They are not yet electric, unfortunately.

Change one white sheet to one blue sheet

6→ The government is investing in much-needed infrastructure. One of their major investments is in building a new concrete bridge. This requires a lot of cement. The production of cement is the source of 8% of the global CO2 emissions.

Change two white sheets to two blue sheets Source (BBC)