Albedo Effect & Earths Climate	Grade 7 – Heat in the environment

Lesson Plan	**Safety Notes**	If performing 'Cloud in a Jar', please have adult supervision while using matches and the kettle

Description

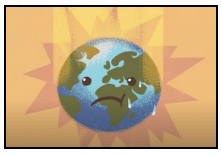
This lesson will reinforce teachings within the realm of biology, chemistry, and earth sciences, by taking a look at the albedo effect and climate change. It will lay the foundation of how the reflective power of surfaces influences Earth's climate, and will tackle questions on cloud formation, glacial melting, rising sea levels, and overall climate change.

Materials

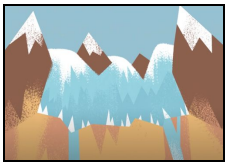
- Ice
- Paper Towel
- White Cloth & Dark Cloth (T-shirt, face cloth)
- Small Funnel
- Drinking Glass (2)
- Water
- Matches (Adult supervision)
- Kettle
- Mason Jar with Lid
- Oven Mitt

Science Background

As sunlight reaches the Earth's atmosphere and surface, some of it is absorbed while some of it is reflected back into space. Albedo is the ratio of light that a surface, like a cloud or an ocean, reflects, compared to the total amount of sunlight. If a surface has a high albedo, they are bright as light falls onto them. This can be seen with freshly fallen snow. On the other hand, surfaces that do not reflect a lot of light and have a low albedo, remain dark. This can be seen with forests.



As Earth's climate is changing and showing a rapid increase in overall temperatures, we see a loss of reflectivity by the Earth's surface as we continue to lose glaciers and sea ice.



As weather patterns begin to shift, even cloud formation has an impact on Earth's albedo. Clouds are formed by water vapour and tiny aerosol particles produced by various sources, including trees. Different types of clouds have different ratios of reflectivity, or, albedo.

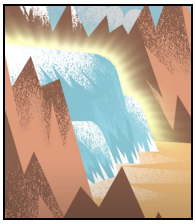
When it comes to global warming, and the melting of sea ice, since this ice is already present within the oceanic body of water, they do not contribute to the rising water levels. On the other hand, glaciers and ice fields that are found on land contribute to the rising ocean levels as their waters make their way to the ocean.

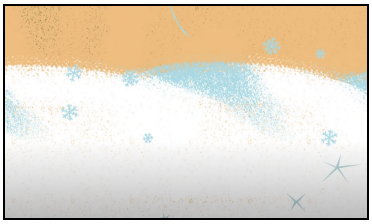
What is Albedo:

- Reflective power.
- The fraction of incident radiation (such as light) that is reflected by a surface or body (such as the moon or a cloud)
- Amount of solar radiation reflected back out to space is called Planetary Albedo

Albedo, Colors, & Climate:

- Surface of the earth a patchwork of many colors
- Dark colors have an albedo close to 0
- Dark Surfaces retain much of the energy in solar radiation

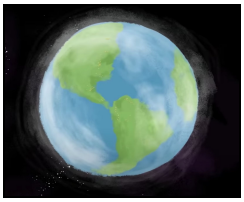




Snow, Glaciers and climate:

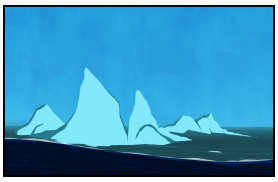
- Albedo effect high on snow, glaciers, and ice caps

- Fresh snow has an albedo of close to 90% where solar radiation is reflected back out to space
- Ice-Albedo feedback occurs when snow and ice melt exposing dark colored surfaces



Clouds and affect on climate:

- The water cycle, along with aerosol particles, allow for cloud formation.
- Cloud albedo varies according to the type of cloud. Thick stratocumulus have a high albedo.



Rising Sea Levels:

- Melting of sea-ice does not change ocean levels
- Melting of glaciers and other land-ice will raise ocean levels
- Loss of albedo in the Arctic will accelerate warming in permafrost regions

Albedo & Climate Change:

- Increase in Greenhouse Gases diminish the Planetary-Albedo
- Climate feedbacks are Earth system interactions that are set in motion from the effect of a forcing factor on one part of the system.
- Positive feedback amplifies the effect in another part of the system ; Negative feedback dampens does the reverse

Activity Procedure

Activity 1: Albedo Effect

1. Grab 2 colored cloths/material, preferably white and black.
2. Place in the sun, side by side
3. Place an ice cube on each of the materials and see which one melts fastest
4. Record your observations

Activity 2: Ocean Level Rise

1. Grab 2 drinking glasses of the same size
2. Place 2 Ice Cubes in one of the glasses and fill with water to the top.

3. In the second drinking glass, fill with water to the top
4. Above Glass number 2, hold a small funnel containing 2 ice cubes and allow them to melt
5. Record your observations

Activity 3: Cloud in a jar (Adult supervision required)

1. Grab a mason jar with its lid
2. Pour water into a kettle and turn it on until it is hot
3. Pour the hot water from the kettle into the mason jar 2/3 of the way up. Be careful, the mason jar will become hot.
4. Put your oven mitt on, and pour out part of the hot water from the mason jar into the sink
5. Place the mason jar back down in a safe place. Remember, it is still hot!
6. Remove the oven mitt and put aside
7. Light a match above the mason jar and allow for some of the smoke to enter it. You can drop the match into the water found in the mason jar.
8. Take the mason jar lid and close the mason jar.
9. Take several ice cubes and place them on the mason jar lid.
10. Record your observations.

Debrief

Earth's climate is a very complex system that includes many different feedback loops, be it positive or negative. The effects of Albedo, from snow to clouds, all play a role in how our earth retains heat, and reflects energy back into space.

As a follow up activity, use the Cloud Identification chart, get outside and note the types of clouds you can see over the course of the next month!

Albedo Effect — Grade 7: Heat in the environment

1. What is a simple definition of the Albedo Effect?

2. What is the relationship between the color of a surface and its ability to absorb solar energy?

3. As ice melts, exposing darker surfaces of the earth, this decreases the planetary albedo, would this be a positive (amplification) or a negative (dampening) feedback ? Explain.

4. Match the correct Definitions in column A to the Terms Listed below in column B, by writing the corresponding Letter into the brackets of the First column:

Definition (Column A):		Term (Column B):
Reflective power: ( )	A	Dampens effect
Absorption: ( )	B	Retains energy
Positive Feedback: ( )	C	Albedo
Negative Feedback: ( )	D	Enhances effect

5. Why does melting sea ice not raise the level of ocean water? Why does land-based ice raise it?

Albedo Effect — Grade 7: Heat in the environment

1. What is a simple definition of the Albedo Effect?

   Reflective power

2. What is the relationship between the color of a surface and its ability to absorb solar energy?

   Dark colors retain solar energy ; Light colors reflect solar energy

3. As ice melts, exposing darker surfaces of the earth, this decreases the planetary albedo, would this be a positive (amplification) or a negative (dampening) feedback ? Explain.

   Negative (dampening) feedback. As our world increases average temperature and ice melts away, the planetary albedo decreases.

4. Match the correct Definitions in column A to the Terms Listed below in column B, by writing the corresponding Letter into the brackets of the First column:

Definition (Column A):		Term (Column B):
Reflective power: (C)	A	Dampens effect
Absorption: (B)	B	Retains energy
Positive Feedback: (D)	C	Albedo
Negative Feedback: (A)	D	Enhances effect

5. Why does melting sea ice not raise the level of ocean water? Why does land-based ice raise it?

   Melting sea ice is already present within the body of water and already displaces water. Land-ice melts and makes its way into the ocean system adding to its existing mass.