Learning Objective: Greenhouse Effect

NGSS Standard: (MS-ESS3.D) Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.

Objective:
Students will be able to:

1. Describe how Earth's natural greenhouse effect works.
2. Describe the results of an unbalanced greenhouse effect.
3. Understand methods of increasing and decreasing the the greenhouse effect.
4. Describe how the greenhouse effect is a positive feedback loop.

Time Required: 70 minutes

Materials Needed:

- Teacher computer with internet access
- Projector/Smartboard
- 1 computer/laptop/iPad per student with internet access
- Several heavy blankets
- Greenhouse Effect Handout (attached)

Teacher Preparation:

- Create Playlist 1, a 40 minute playlist in Legends of Learning with the following games found in the Greenhouse Effect objective (in order):
  - *Greenhouse Escape*
  - *The Knight of Earth*
- Create Playlist 2, a 10 minute playlist in Legends of Learning with 5 assessment questions from the Greenhouse Effect learning objective

Engage (10 minutes)

1. Explain to the class the the greenhouse effect is a naturally occurring process that helps keeps the Earth warm. Without it, the Earth would have extremely hostile temperatures like those on the moon.
2. To demonstrate this have a students come to the front of the room. Wrap a blanket around them.
   a. Explain that our atmosphere acts like a blanket around the Earth as it helps trap heat to keep the Earth warm. Our body radiates heat just like the Earth's surface.
   b. Ask: Is heat able to escape from the blanket?
      i. *Yes, some heat is able to escape.*
3. Add a second and a third blanket around the student.
   a. Ask: As more and more blankets are added, what will happen to the temperature of the students?
   b. They will begin to get warmer.
4. Explain that when we add stuff to the Earth's atmosphere it's like adding more blankets to the student.
   a. Ask: What types of gases do humans add to the atmosphere?

i. *Humans add water vapor, CO_2, methane, etc.*

b. Ask: Why did the students not become extremely hot with just one blanket, but very hot with more than one?

i. *The students become warmer with more blankets because less and less heat was able to escape the blankets.*

5. Explain to the students that they will be learning about the greenhouse effect and the effect humans have on it.

Explore (30 minutes)

1. Have your students sign in to Legends of Learning and enter your teacher code.
2. Launch Playlist 1 to your students.
3. As students complete *Greenhouse Escape*, students should fill out the Greenhouse Effect Handout.
4. Assist students as needed during game play, pause playlist if you need to address content or questions to entire class.
5. If students finish the first game and worksheet early they can continue on in the playlist and try the game *The Knight of Earth*. This game will help test their knowledge.

Explain (10 minutes)

1. Review the answers to the handout Greenhouse Effect by recreating the diagrams on the whiteboard.
2. As you review that chart and answers clarify any misconceptions that students may have.
3. Refer back to the blanket example from the start of class as you go through the diagrams.

Elaborate (10 minutes):

1. Global climate change is often discussed as a steady rise in global temperature. However, the rise will not be steady, in fact it will dramatically increase as the temperature climbs. One of the tipping points is in the arctic.
2. Show the following video to the class: https://www.youtube.com/watch?v=IrEM3LHvjI0
3. Ask:
    a. Why is the arctic considered to be our first warning sign that global climate change is irreversible?
        i. *The arctic climate has many benefits in keeping the global climate in check. If it disappears those checks and balances will no longer be available to keep global warming under control.*
    b. How does the arctic affect climate change? Think about absorption, insulation, and reflectivity.
        i. *The reflectivity caused by the ice caused a large amount of sunlight to be sent back into the atmosphere instead of being absorbed by the sea. The ice also causes a layer of insulation that allows warmer waters to stay underneath.*

Evaluate (10 minutes):

1. Launch Playlist 2 to your students. When they finish the assessment questions, any time left is freeplay.
2. Analyze student results to determine what concepts need to be a focus for reteaching.

Additional Lesson Strategies:

- To use Legends for additional instruction, create a custom playlist with an instructional game and pre and post assessment.
- To use Legends for a quick formative assessment, create a 5-question assessment in a playlist.

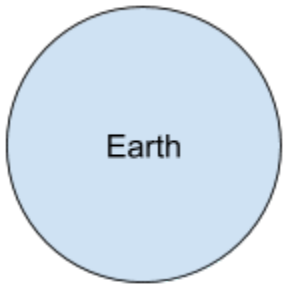
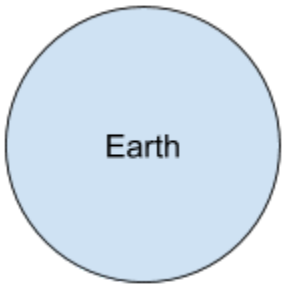
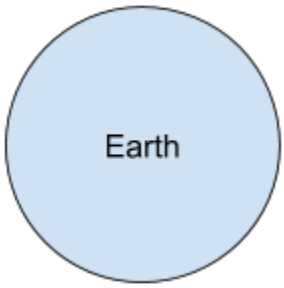
- To use Legends for a student-directed experience, create a targeted freeplay playlist.
- Encourage students to play on their own at home in Legends of Learning: Awakening for a student-driven experience including avatars, battling, and quests all centered around topics they are covering in class.

Greenhouse Effect

Name / Pd: _____

Directions: While playing the first game in Legends of Learning called *Greenhouse Escape*, use what you learn to complete the diagram.

In each diagram shade in the atmosphere around Earth that creates the greenhouse effect. The “balance” refers to the amount of heat that is reflect back to the Earth by the atmosphere. Then circle what the resulting temperature will be for each diagram.

Unbalanced: Low	Balanced	Unbalanced: High
		
Temp: Low / Normal / High	Temp: Low / Normal / High	Temp: Low / Normal / High

1. Describe the condition that forms an unbalanced low greenhouse effect.

2. Describe the condition that forms a balanced greenhouse effect.

3. Describe the condition that forms an unbalanced high greenhouse effect.

4. What type of energy enters the atmosphere and what type of energy leaves?

Enters	Leaves

5. Which diagram is the Earth most likely heading towards? (*low / balanced / high*)

6. How have humans impacted the Earth's natural greenhouse effect?

7. List and describe three methods that humans can use to help reduce the amount of greenhouse gasses in the atmosphere.

    1.

    2.

    3.

8. How is the process of photosynthesis involved in achieving a balance between the reflection and absorption of infrared energy by Earth?