

Lesson 7: The Greenhouse Effect

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Learning Objectives	Assessment Criteria
Students will describe the greenhouse effect as a physical phenomenon.	Students should describe the greenhouse effect to be a phenomenon that results in warming of the Earth's surface due to heat-trapping gasses.
	Students should list the most common heat trapping gases: CO ₂ , CH ₄ , N ₂ O and H ₂ O.
Students will recognize the consequences of the natural greenhouse effect.	Students should describe effects of the natural greenhouse effect to be that the atmosphere traps heat from the sun to keep the average temperature of the Earth to be 60F.
	Students should recall that the temperature of the Earth would be 0F without the natural greenhouse effect.

Benchmark/Standard/Big Idea:

Greenhouse gases in the atmosphere absorb and retain the energy radiated from land and ocean surfaces, there by regulating Earth's average surface temperature and keeping it habitable. A Framework for K-12 Science Education, ESS2.D: Global Climate Change, Grade 8 Endpoint.

Relationship to the driving question:

The lesson is related to the effects that the human enhanced greenhouse effect have on climate change and how students can help to slow the process of climate change.

Prior Knowledge:

Prior to the lesson, students should have minimal understanding of the greenhouse effect and should not be aware of any of the heat trapping gases in the atmosphere.

Instructional Strategies:

In this activity, the students will perform a short hands-on demonstration of the greenhouse effect. Students will then relate what they saw in the demonstration to what occurs on the planet and answer the questions on a worksheet.

Instructional resources used:

<http://peer.tamu.edu>, a website founded by Partnerships for Environmental Education and Rural Health (PEER) by Texas A&M University. This website is dedicated to providing science resource materials and teacher resources for middle school and high school settings. This website is funded in part by the National Science Foundation.

Materials and set-up needed:

- 2 small thermometers per group
- 1 large glass jar per group

- watch or clock
- a sunlamp or access to a sunny area
- Greenhouse Effect in a Jar Worksheet

Time required:

50 minutes or one period

Cautions:

There were no specific dangerous or hazardous components of this lesson.

Instructional Sequence

1. Introducing the lesson

To introduce the lesson I must first introduce the students to some background information and important key words and concepts. First I will ask for a show of hands from the students, "Who has heard of Climate Change or the Greenhouse Effect?" When the students give me an idea of how many of them have heard of the idea before I will ask someone who raised their hand to give me a summary of Climate Change in 10 words or less. A few possible explanations may include: "Earth is getting warmer," "The planet heats up," as well as other explanations.

To introduce the idea of Climate Change I will ask the students to imagine that they live in a little wooden shack in Alaska, where it is really cold, so they build a fire and the shack warms up slowly but surely and then it's comfortably warm. The shack is warmer than the surrounding area, so the shack loses heat quickly. If the fire supplies heat at the same rate as the shack loses it, the shack stays at the same temperature, but if you make the fire too big, the shack will get hotter and hotter and hotter and you'll soon be uncomfortable, but the fire is burning big and you can't stop it, the shack will keep getting hotter even after you stop adding fuel to the fire.

I will tell the students this is kind of how Climate Change works. *Climate Change is the overall increase in the Earth's temperature.* Climate Change is exactly as it sounds, the change in climate, meaning the climate zones we learned about earlier in the unit will be altered and the plants and animals that live there will have to change, leave or die. There are many other affects of Climate Change which we will talk about later on in the unit. Climate Change is caused by something called the "human-enhanced Greenhouse Effect." The Greenhouse effect is a natural process that happens on Earth because of the presence of certain gases in something called an atmosphere. Our atmosphere is kind of like a shell around the earth that can trap heat. There are two kinds of Greenhouse Effects. There is the natural Greenhouse Effect and the human-enhanced Greenhouse Effect. The natural Greenhouse effect keeps the earth at an average temperature of 60F and is attributed to the natural accumulation of special gases in the atmosphere. The human-enhanced Greenhouse Effect causes the earth to trap more and more heat causing the average temperature to increase as we add more of these special gases into the atmosphere by driving cars etc.

2. Body of the Lesson

Students will work in groups of 2 or 3 students. Within the small groups the following roles will be assigned by date of birth, temperature readers 1 and 2 and a recorder. The student who has the birthday which is nearest to the date of the activity will be the recorder; the student who has the next nearest birthday will be temperature reader 1 and the student with the furthest birthday will be temperature reader 2. After I put the students into their groups, they will proceed to their lab bench or group space to work in where there will be a heat lamp and a bin with 2 thermometers, a glass jar and a stop watch. I will pass out the worksheets and explain the directions. "First, each group should place their 2 thermometers under the sun lamp for about 3 minutes to allow the thermometers to reach a

stable temperature. Be sure to designate the thermometers as #1 and #2. You can write this on a piece of tape and wrap it around the top of the thermometer. Observe the temperature and record this temperature and the time on worksheet. Next, place a large glass jar over thermometer #1, making sure that the jar does not cast a shadow onto either of the thermometers. The thermometer may stand against the inside of the jar. Every minute, for the next ten minutes, observe and record the temperature and time on the worksheet." Students may then answer the questions on the "Greenhouse Effect in a Jar Worksheet".

3. Wrap up lesson

To wrap up the lesson I will begin by going over the three questions on the worksheet. I will ask students for their responses to the first two questions to be sure their demonstration gave them the numbers they should have seen. (Remember, Thermometer 1 has the glass jar over the top of it) The first question, "What happened to the temperatures over 10 minutes? Did one thermometer show a quicker rise in temperature? Did either of the thermometers show a drop in temperature?" should elicit responses such as: "Thermometer 1 reached a higher temperature than Thermometer 2" or "Thermometer 2 heated up faster than Thermometer 1" or "Neither thermometer showed a drop in temperature."

When sufficient responses are discussed I will move onto the second question, "Which thermometer showed a greater rise in temperature? Why do you think one thermometer showed a different temperature reading than the other?" The students may be tempted to answer this question during the first question; in that case, I will use that response to move onto the second question. I will ask the students why they think there were different temperature changes. I will point out that the thermometers were under the same lamp, weren't they? The students might be stumped or they may suggest that it is because of the glass jar.

Then I will move onto the final question where students should pull on knowledge from what I explained to them at the beginning of class about how the Greenhouse Effect works. "Using what you know about the Greenhouse Effect, how do you think the jar and the thermometer inside relate to what is happening on our planet?" An appropriate student explanation might include that the air was trapped inside of the jar started to warm up. As a probing question to get the students to expand on that answer I might ask "But, why didn't the air above the other thermometer heat up too?" Pushing students to explain this phenomenon will challenge them to think more about what is happening inside the jar. Students might answer this question with an answer such as "but the air can't move around inside the jar, when there is no jar, the air can move around more." It is this answer that will signal to me that I should go into my own explanation to clarify and organize the student's answers and thoughts. I will give the following explanation, "The air over the exposed thermometer is always moving; as it gets warm it is replaced by cooler air. Because the air in the jar cannot circulate, this air stays in the sunlight and gets warmer and warmer." Next I will ask students how this is like the Greenhouse Effect. Appropriate answers include that "the glass jar is like the atmosphere."

Then I will explain more clearly how the model is like the system by saying, "A similar trapping of heat happens in the Earth's atmosphere. Sunlight passes through the atmosphere and warms the Earth's surface. The heat radiating from the surface is trapped by greenhouse gases. Without an atmosphere, the Earth's temperature would average about 0° F. This warming due to heat-trapping gasses is called the "Greenhouse Effect." Both the atmosphere and the jar allow light to enter, but then trap that energy when it is converted to heat." To finally close the lesson I will ask the students to write an exit slip "I used to think, but now I know." The students will write down their thoughts on the back of their worksheet and hand them to me as we finish the lesson.

4. Evaluating Learning

In asking the following questions throughout the lesson I will be evaluating the learning objectives: As the relationship between Climate Change and pollution is still unknown, hypothesize what you think pollution has to do with the atmosphere and how this affects Climate Change? How could we introduce the effect of pollution in the jar? How do you think this would change our results? Possible student answers to the first question might include students making connections from the opening of the lesson to this question when they might answer "The 'special' gases which exist in the atmosphere naturally are good when there is only a little of them, but when we put more of these gases into the atmosphere by polluting when we drive cars etc we increase the effects of the natural greenhouse effect." A possible student answer to the second question which would help to determine if students met the second listed learning objective where students might suggest that if we add water vapor (a special heat trapping gas) to the jar, and students should speculate that when they would compare the temperatures over time the jar with the water vapor inside would be warmer than the jar without the water vapor. Additional evaluation of learning will occur during the discussion of the final questions on the worksheet.

Design Rationale

I chose to design my demonstration lesson in such a way that students might have the opportunity to build some prior knowledge regarding greenhouse gases and the greenhouse effect (both human enhanced and natural) and their roles in Climate Change and then observe some phenomenon in the form of student led demonstration of how the atmosphere traps heat. By allowing students to observe phenomenon first hand and without my explicitly stating what the model is to represent and I will challenge students to come up with their own ideas of what this model representative of and then to discuss as a class the strengths and weaknesses of each of the ideas presented. As I have just learned about a new method of vocabulary introduction, I imagine that time permitting, a good modification to this lesson would be to teach the students the vocabulary at the start of the lesson, using a shared reading technique, in the context of some short reading where the unknown terms would be brought to light and the students could formulate their own definitions for the words with my help and therefore conduct meaningful learning and very likely get more out of the lesson as a whole. Using this technique not only will I model my reading and understanding so that students can begin to read more comprehensively, but the students will have built a prior knowledge relating to the new terms that will allow them to speak knowledgeably about them in the future.