Daily Plan	Instructor:
Daily Topic:	The Greenhouse Effect
Unit Title:	Weather and Climate in Our Lives
Course:	8th Grade Physical Science

Materials, Supplies, Equipment, References, and Other Resources:

Greenhouse effect PowerPoint presentation, pre-painted greenhouse effect artwork (various brushes, poster paints, and butcher paper), student greenhouse effect role cards (5"x7" blank index cards, string, stapler, and colored markers), mini-greenhouses (6" pots, potting mix, metric rulers, bean or corn seeds, labels, pencils, medium gauge wire, wire cutters, twist ties, plastic wrap, large rubber bands), greenhouse or plant growth cart/light bank with incandescent bulbs or heat lamps replacing or in conjunction with fluorescent or wide spectrum bulbs, digital probe thermometer, worksheets, and computer/digital projector or Smart TV.

References:

Environmental Protection Agency. (2016). *Climate change indicators: Sea surface temperatures*. Retrieved from https://www.epa.gov/climate-indicators/climate-change-indicators-sea-surface-temperature

National Climate Assessment. (2014). *Human influence on the greenhouse effect*. Retrieved from https://nca2014.globalchange.gov/report/appendices/faqs/graphics/human-influence-greenhouse-effect

National Oceanic and Atmospheric Administration (NOAA). (2018). *Climate change: Ocean heat content.* Retrieved from https://www.climate.gov/news-features/understanding-climate/climate-change-ocean-heat-content

Intended Outcomes

What do you want students to know (K), understand (U), and be able to do (D)?

AFNR Standards and Benchmarks:

Natural Resources and Environmental Services Systems

Standard III: Apply scientific principles to natural resource management activities.

Benchmark III-C: Examine natural cycles and related phenomena to describe ecological concepts and principles (Performance Standards 6 and 8).

Standard VII: Apply scientific principles to environmental services. Benchmark VII-A: Apply meteorological knowledge to recognize weather systems and weather patterns (Performance Standards 1 and 2).

Standard VIII: Understand environmental service systems. Benchmark VIII-A: Understand pollution control measures to maintain a safe environment (Performance Standards 1 and 2).

Plant Systems

Standard I: Apply principles of anatomy and physiology to produce and manage plants in both a domesticated and natural environment.

Benchmark I-A: Analyze and evaluate nutritional

Next Generation Science Standards:

MS-ESS3-5: Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. Examples of factors include human activities such as fossil fuel combustion and agricultural activity, and natural processes such as the decay of organic matter. Evidence can include atmospheric levels of gasses such as carbon dioxide and methane and the rates of human activities.

MS-LS1-5: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. Local environmental conditions could include availability of food, light, space, and water (temperature variability here). Examples of evidence could include temperature extremes decreasing plant growth.

MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Emphasis is on describing the flow of energy into and out of various ecosystems.

requirements and environmental conditions to develop and implement a fertilization plan (Performance Standard 4).	**MS-PS1-1: Develop models to describe the atomic composition of simple molecules and extended structures.** Examples of simple molecules are water, carbon dioxide, nitrous oxide, and methane. **MS-PS3-3: Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.** Example here will be the mini-greenhouses the students construct. **MS-PS4-2: Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials**. Emphasis here is on light and heat waves.
Essential Questions:	What is the greenhouse effect? What impact does the greenhouse effect have on plant growth?
Objective(s):	1. After viewing greenhouse effect PowerPoint slides, students will correctly order 4 of 6 steps in the greenhouse effect and identify 4 of 6 greenhouse gasses. 2. Through a greenhouse effect drama, students will demonstrate their knowledge of the greenhouse effect by playing their roles correctly during the drama. 3. Within a small group setting, students will be given 6" pots, potting mix, metric rulers, bean or corn seeds, labels, pencils, medium gauge wire cut in 2-foot lengths, twist ties, plastic wrap, and large rubber bands to set up an experiment on the greenhouse effect. Students will be able to complete all seven steps correctly. 4. Given prior instruction about the scientific process and hypothesis writing, students will formulate their own hypothesis for a variable temperature/plant height experiment (or another variable like number of leaves) over a 4-week period. (1 hypothesis written in the if/then/because format) 5. Given greenhouse effect instruction and the learning activities presented in this lesson, students will score at least a 4 out of 6 on two science knowledge, science skills, and reasoning ability multiple choice questions for this lesson that are on the unit test. **Learning Strategies Used:** Lecture and discussion, greenhouse effect drama exercise, group work, scientific experiment, writing, and reading. Learning is differentiated through a variety of activities and exercises. **Literacy:** Understanding the steps and contributors to the greenhouse effect, following instructions on the role cards in the greenhouse effect drama, following instructions for the bean or corn growth experiment, and writing a hypothesis.

Activating Strategy **Preflection/Introduction (Interest Approach)** *How will you prepare students for what you want them to learn today and link today's activities with previous classes?*	**Estimated Time:**	**10-15 minutes**
Along with precipitation and the water cycle, temperature is a very important part of weather and climate science. An important determinant of temperature is the Greenhouse Effect. Show a short PowerPoint presentation (see attached PowerPoint) introducing the greenhouse effect. Students will complete an ordering of the steps in the greenhouse effect starting at the sun and identify four greenhouse gasses from a list of six gasses found in the atmosphere. (See attached greenhouse effect worksheet)		

Learning Approach 1	Estimated Time:	15-20 minutes

Teaching Strategy / Materials	Brief Content Outline
Greenhouse Effect Drama Teacher will coach students during the drama to play all different roles in the greenhouse effect.	*K: What do you want students to know (facts, figures, vocabulary, etc.)?* 1. Make a set of 5"x7" reusable greenhouse effect role cards (3-foot long pieces of string stapled twice to the two top corners of each card so students can wear them around their necks during the drama). Students will read from their card what role they have in demonstrating the greenhouse effect. (See attached list and pictures of a set of cards, and pictures of example student artwork) a. To start, half of the class is wearing a solar and heat energy card and standing on one side of the classroom under the painting of the sun with the solar energy side of their card showing. One fourth of the class is standing in the middle of the classroom (atmosphere) wearing a greenhouse gas card, particulate card or cloud card (contributor card). The other quarter of the class is also wearing a contributor card, but standing in reserve to be added later to the atmosphere. b. The solar energy students move toward the contributors. ½ get through the contributors and continue to the earth painting on the other side of the classroom. ½ bounce off of a contributor and back into space. c. The solar energy students who make it to the surface of the earth, turn around their card to the heat energy side and join hands to represent a slower and hence, longer, wavelength of heat energy. d. The heat energy wave moves back toward the contributors and has trouble getting through and back into space. The wave will have to enter the contributors from an end of the wave to make it through. The heat wave can end up trapped inside the band of contributors. **Be sure students are gentle and not aggressive in their collisions between energy waves and contributors.** e. Start over again with the solar energy students back at the sun. This time, add the other contributors to show that it is even harder for the heat wave to get back through to space when there are more contributors in the atmosphere. That is the greenhouse effect in action! Poster paintings depicting contributors to the greenhouse effect can be created by the students, attached to classroom walls, and reused for this activity. Be sure the students move following the teacher's direction and that after each move the class gets quiet so the teacher can explain what has just happened before going to the next step.
	U: What do you want students to understand (what is the big picture)? 1. Students will be able to identify steps and contributors to the greenhouse effect. Students learn by doing and moving around the room to visualize the greenhouse effect.
	D: What do you want students to be able to do (tasks, skills, etc.)? 1. Through repetition, students will be able to play both the solar/heat energy roles and the role of a contributor to the greenhouse effect in the Greenhouse Effect Drama.

Learning Approach 2	Estimated Time:	20-30 minutes

Teaching Strategy / Materials	Brief Content Outline
Bean or Corn Growth and Greenhouse Effect Experiment	*K: What do you want students to know (facts, figures, vocabulary, etc.)?* 1. In small groups of two or three, students will follow a set of directions on how to set up and conduct the experiment. Each group will plant and label one control or one treatment pot (or more pots depending on class size and space availability on a plant growth cart, under a light bank, or in the greenhouse. (See attached greenhouse effect worksheet for directions)
	U: What do you want students to understand (what is the big picture)? 1. Setting up and conducting an experiment following the scientific method. The teacher will monitor student groups to make sure they do all steps correctly.
	D: What do you want students to be able to do (tasks, skills, etc.)? 1. After the experiment is set up, students will formulate on their worksheets a clear hypothesis (in the if/then/because format with teacher guidance) about plant height in centimeters (or another variable like number of leaves) depending on the layers of plastic wrap on their mini-greenhouses surrounding the plants over a 4-week period of time. (See attached greenhouse effect worksheet for directions and how to coach students on writing their hypothesis) 2. At the end of four weeks, the corn or bean plants will be ready to measure. It is recommended that the teacher assist the students in developing a table for recording their data based on the dependent variable or variables studied and their units of measurement. Once data and averages across control pots and the three treatments are obtained for the class, have a discussion about the results. Have the students write if their hypotheses were correct or incorrect and why on the data recording sheet. (Estimated time: An additional 50 minutes) 3. If more than one class does the experiment, data and averages across all classes for the control and the three treatments can be calculated and discussed. This approach highlights the value of being able to replicate an experiment. 4. After cleanup, wire supports, pots, and potting soil can be saved for future use.

Summarizing Strategy (Reflection) *How will you have students reflect on what they have learned today and prepare them for the next class?*	Estimated Time:	5-10 minutes

Two truths and a lie activity: Student groups have to give two truths and one lie about the greenhouse effect while other students raise their hands and guess what the lie is.

The teacher can also have the students discuss their hypotheses as a summarizing strategy.

Assessing Strategy (Evaluation) *How will you determine if students know (K), understand (U), and can do (D) what you intended?*
Students will be able to order the steps of the greenhouse effect starting at the sun, identify four greenhouse gasses, participate in the greenhouse effect drama, set up a greenhouse effect experiment, develop a data recording sheet, and formulate and test a hypothesis. Two science knowledge, two science skills, and two science reasoning multiple choice questions are on the unit test for this lesson. (See unit test)