Daily Plan	Instructor:
Daily Topic:	Mitigating and Adapting to Weather and Climate Extremes in Agriculture and Natural Resources
Unit Title:	Weather and Climate in Our Lives
Course:	8th Grade Physical Science

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

PowerPoint presentation, computer/digital projector or Smart TV, handheld infrared thermometer and/or digital soil thermometer, digital soil moisture meter, 6" pots, potting mix, string, 3-inch double-headed nails, metric rulers, meter sticks, tap water, watering can, clipboards, outdoor area that receives direct sunlight during school hours or a plant growth cart/light bank with an added heat lamp, and worksheets. Can add pre-painted artwork depicting pictorially, ways to mitigate and adapt to weather and climate extremes in everyday life and in agriculture and natural resources.

References:

Jonassen, R., Canes, M., Daigle, M., Alcorn, J., Bentley, J., Bostock, V., Reilly, F., Skulte, R., Wilkerson, T., & Yasalonis, J. (2012). *Climate change: What can you do now*. McLean, VA: LMI.

National Weather Service. *National Weather Service glossary.* Retrieved from http://w1.weather.gov/glossary/

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-A:** Apply scientific principles to natural resource management (Performance Standards 1-3).

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 Standard 8).

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

Plant Systems

Standard III: Apply fundamentals and harvesting to produce plants. Benchmark III-A: Apply fundamentals of plant management to develop a production plan (Performance Standard 2)

Next Generation Science Standards:

MS-ESS2-4: Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. Emphasis on the ways water changes its state as it moves through multiple pathways of the hydrological cycle. Example model here will be different colors of mulches and their effects on soil moisture.

MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. Examples of the design process include designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage, land usage, and pollution.

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 (water and temperature variability here). Example of evidence here would be soil moisture and temperature variability under different colors of mulches.

MS-PS3-3: Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy

	transfer. Example model here will be different colors of mulches and their effects on soil temperature.
Essential Question:	How can we mitigate and adapt to weather and climate extremes in everyday life and in agriculture and natural resources?
Objective(s):	1. After viewing a PowerPoint slide, students will be able to correctly match the terms climate change, adaptation, mitigation, and resiliency with their definitions. 2. After viewing a PowerPoint slide, students will be able to present one correct example each of an economic, environmental, and health concern that we have because of a changing climate. 3. After viewing a PowerPoint slide, students will be able to identify 2 of 3 ways to lower or mitigate human emissions of greenhouse gasses into the atmosphere. 4. After viewing a PowerPoint slide, students will be able to calculate the pounds of CO^2 gas produced by burning a tank of gas and over a one-year period of driving a given vehicle. 5. After viewing a PowerPoint slide, students will be able to identify 2 ways to adapt to climate change in agriculture and natural resources. 6. Given prior instruction about the scientific process and hypothesis writing, students will formulate and test their own hypothesis for temperature and moisture content of soil and/or potting soil covered with different colors of wood chip mulch that have been exposed to the sun or a heat lamp. (hypothesis written in the if/then/because format) 7. Given demonstrations, students will be able to correctly use an infrared thermometer and/or digital soil thermometer to measure soil temperatures, and a digital soil moisture meter to measure soil moisture content. 8. After conducting an experiment and viewing a PowerPoint slide, students will be able to identify 2 mitigating or adaptive qualities of garden mulch.
	Learning Strategies Used: Lecture and discussion, practice with an infrared thermometer and/or digital soil thermometer to measure soil temperatures and a digital soil moisture meter to measure soil moisture content, group work, scientific experiment, writing, and reading. Learning is differentiated through a variety of activities and exercises. **Literacy:** Understanding definitions related to climate change; economic, environmental, and health concerns with a changing climate; ways to mitigate human emission of greenhouse gasses; and ways to adapt to climate change in agriculture and natural resources. Following instructions on the worksheet for the mulch experiment, and writing a hypothesis and conclusion statements.

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:**	**15-20 Minutes**
Today we are going to learn how can cope with weather and climate extremes in everyday life and in agriculture and natural resources. 1. Show the PowerPoint slides on the definitions related to climate change; economic, environmental, and health concerns with a changing climate; ways to mitigate human emission of greenhouse gasses; and ways to adapt to climate change in agriculture and natural resources. 2. Get student responses and put them on a whiteboard or chalkboard for Slide 2 on economic, environmental, and health concerns with a changing climate. Add to the lists as needed.		

3. Have the students help you solve the slide 3 problem to calculate the pounds of CO^2 gas produced by burning gasoline over a one-year period of driving a given vehicle.

4. Ask the students for common examples of renewable energy sources used in their region or state (e.g., wind, solar, and hydroelectric).

5. Have each student do Activities 1 and 2 on their worksheet.

Learning Approach 1	**Estimated Time:**	**10-20 Minutes**
Teaching Strategy / Materials	**Brief Content Outline**	
Practice with an infrared thermometer and/or digital soil thermometer to measure soil temperatures and a digital soil moisture meter to measure soil moisture content.	*K: What do you want students to know (facts, figures, vocabulary, etc.)?* 1. How to use an infrared thermometer and/or digital soil thermometer to measure soil temperatures and a digital soil moisture meter to measure soil moisture content.	
	U: What do you want students to understand (what is the big picture)? 1. They will be using an infrared thermometer and/or digital soil thermometer to measure soil temperatures and a digital soil moisture meter to measure soil moisture content in 3 to 5 days when they take measurements for their experiment.	
	D: What do you want students to be able to do (tasks, skills, etc.)? 1. Demonstrate an infrared thermometer and/or digital soil thermometer to measure soil temperatures and a digital soil moisture meter to measure soil moisture content on outside plots of loose, dry and moist soil or dry and moist soil in 6” pots brought into the classroom. 2. This part of the lesson can be enhanced for the infrared thermometer by taking a number of outside temperatures of surfaces in the sun or shade. A data sheet can be made for the surface temperatures the teacher wants students to compare. Some recommended surfaces are: a. Dry concrete or asphalt in the sun b. Dry concreted or asphalt in the shade c. Wet concrete or asphalt in the sun d. Wet concrete or asphalt in the shade e. Dry compacted soil in the sun f. Dry compacted soil in the shade g. Wet compacted soil in the sun h. Wet compacted soil in the shade i. Dry loose soil in the sun j. Dry loose soil in the shade k. Wet loose soil in the sun l. Wet loose soil in the shade m. Grass or soil covered in leaves in the sun n. Grass or soil covered in leavers in the shade o. Different colors of construction paper on the ground in the sun. Because the mulch experiment will involve reddish brown, brown, and black bark mulches, the colors of construction paper most like the three mulch colors can be tested in full sun or indoors on the	

	ground next to the plant growth cart/light bank with added heat lamp that will be used for the experiment if done indoors. Outdoors or indoors the reddish brown paper should be the coolest, the black paper the warmest, and the brown paper in the middle when their surface temperatures are measured with an infrared thermometer. 3. A class set of clipboards will be useful for recording outside surface readings. 4. As each student gets to take a reading, make sure students don't aim the infrared thermometer at each other. It is a scientific tool, not a toy. 5. For this enhancement activity, on warm sunny days, concrete or asphalt surfaces and compacted soil will usually be warmer than loose soil, grass, or leaves because compacted surfaces have a lower specific heat capacity than loose surfaces. In other words, it takes less heat energy from the sun for them to reach a given temperature. Dry surfaces will be warmer than wet surfaces because of the cooling effects of moisture evaporating as water vapor from the wet surfaces. Sunny surfaces will be warmer than shady surfaces because of their direct exposure to the sun's energy. Generally, darker colors like black will be warmer than lighter colors like white because they absorb and retain more energy from the sun. However, some yellow or green shades (example: AstroTurf®) can absorb and retain as much heat as black. Because specific heat capacity, moisture, color, and exposure to the sun can all impact surface temperature, this enhancement will produce interesting results and discussion. 6. This enhancement is wonderful for having students practice writing and testing a number of hypotheses that will help them learn about surface temperatures and how this knowledge might apply to adapting to temperature extremes.

Learning Approach 2	**Estimated Time:**	**20-30 Minutes**
Teaching Strategy / Materials	**Brief Content Outline**	
Activities 3, 4, and 5 on the Mitigating and Adapting to Weather and Climate Extremes Worksheet for groups of 4 students Worksheets and all of the materials for the experiment depending if it is being conducted inside or outside	*K: What do you want students to know (facts, figures, vocabulary, etc.)?* 1. To formulate and test a soil temperature and moisture hypothesis for soils covered by different colors of mulches and exposed to the sun or a heat lamp. *U: What do you want students to understand (what is the big picture)?* 1. That garden mulches (or leaves under forest trees) insulate the soil, providing a buffer from extremely hot and cold root temperatures that are unhealthy for plant growth. Keeping roots at the right temperature when the air is very cold or hot is an adaptive strategy.	

(handheld infrared thermometer and/or digital soil thermometer, digital soil moisture meter, 6" pots, potting mix, string, 3-inch double-headed nails, metric rulers, meter sticks, tap water, watering can, outdoor area that receives direct sunlight during school hours or plant growth cart/light bank with an added heat lamp)	2. That garden mulches (or leaves under forest trees) retain moisture in the soil, helping to keep roots moist and plants healthy. Conserving water is a mitigation strategy. 3. Setting up and conducting an experiment following the scientific method. The teacher will monitor student groups to make sure they do all steps correctly and safely.
	D: What do you want students to be able to do (tasks, skills, etc.)? 1. Groups of four students will develop their hypothesis for soil temperature and moisture for soils covered by different colors of mulches and exposed to the sun or a heat lamp (Activity 4). You can have the students do Learning Activity 1.2.o above with red, brown, and black construction paper to help them make their hypotheses. You can also shred construction paper of different colors and use it as the mulch in the indoor experiment if the colored bark mulches can't be found at a local department store or nursery. 2. The groups of students will then follow Activity 3 directions to set up the experiment. 3. In 3 to 5 days, Students will complete Activity 5 with handheld infrared thermometer and/or digital soil thermometer, digital soil moisture meter. 4. 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 and how results outside may vary by time of day. 5. After cleanup, colored mulches, potting soil, pots, double-headed nails, and string 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 Minutes**
1. Ask the students what they think will happen in the experiment: Which treatment (or control) will be the coolest or warmest, the wettest or driest when measurements are taken in 3-5 days? 2. Show slide 5 called "Fun Facts About Mulch" and ask students to raise their hands if they thought the treatments will have cooler soil than the control and if the treatments will have wetter soil than the control?		

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 identify definitions of climate change terms; present correct examples of economic, environmental, and health concerns that we have because of a changing climate; identify ways to lower or mitigate human emissions of greenhouse gasses into the atmosphere; calculate the pounds of CO^2 gas produced by burning a tank of gas and over a one-year period of driving a given vehicle; identify ways to adapt to climate change in agriculture and natural

resources; correctly use an infrared thermometer and/or digital soil thermometer to measure soil temperatures, and a digital soil moisture meter to measure soil moisture content; and identify mitigating or adaptive qualities of garden mulch. They will set up and complete the experiment, 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)