Old Anchoring Phenomenon

Scenario: Mars, Earth, and Venus all receive energy from the same Sun, but scientists have observed that they retain heat very differently. Mars reaches extremely cold temperatures every night, and Venus is permanently scorching, but the Earth maintains a relatively stable, life-supporting temperature even when the Sun sets and the heat source is removed. It is like the Earth has a 'blanket' covering it, regulating the temperature. **Why does this occur? What is it about Earth that allows for this stable environment to exist? What is the 'blanket,' and what are its characteristics?**

The difference lies in each planet's *atmosphere*. Venus has a thick atmosphere that traps heat for a long period of time, whereas Mars has a very thin atmosphere, causing it to lose most of its heat after the Sun sets. Our atmosphere is thick enough to retain some heat from the Sun after it sets, but not so thick that our air becomes scorching hot.

The invisible change: Though our atmosphere is relatively stable and does a lot to protect us, scientists have observed an alarming pattern. Over the past century, local climate and weather data (they are different!) reveal that areas in students' own communities and the Earth globally are:

- Retaining more heat than they used to
- Recording higher average temperatures at the climate level, year after year
- Experiencing rising concentrations of certain atmospheric gases
- Developing a thicker atmospheric 'blanket'

The increase of one particular gas seems to correlate with the increase of Earth's average temperature: carbon dioxide (CO_2). But CO_2 is invisible, and makes up only a small fraction of the air. **How do we collect data on something that is so small, but so widespread? How can we prove exactly how surfaces and gases interact?**

The role of citizen science: Because scientists cannot test every surface, location, or condition on Earth by themselves, they often rely on citizen science. This is when non-scientists—like students, families, and community members—collect data using shared methods.

In the following investigations, you will act as citizen scientists. In groups, you will test how well different surface materials and gases absorb heat. Individually, your results may seem small—but when your data are combined with the full class set, we can look for patterns that would not be visible from a single experiment. Together, we will build a model of how heat absorption works, just like real scientists do.

Extension: Check out the National Center for Science Education's (NCSE) storyline "Back to the Future: Climate through Time Story Short" to explore the question: How does Earth's past climate compare to our current climate?

Quest for answers

Our quest for answers

Have you ever wondered...

- *If the Sun is so far away, how do we get energy from it?*
- *If all of the planets get energy from the Sun, why is Mars so cold at night, while Venus is permanently scorching?*
- *Why is Earth retaining more heat than it used to?*
- *How can we be sure what's causing it?*
- *What can we do about rising temperatures on Earth?*

In the space below, write down everything you can think of to answer these questions:

What other questions do you have about our climate?

As we go throughout this PhysicsQuest, see if you can find the answers to all of these questions, and some of your own.

If the Sun is so far away, how do we get energy from it?	
If all of the planets get energy from the Sun, why is Mars so cold at night, while Venus is permanently scorching?	
Why is Earth retaining more heat than it used to?	
How did we figure out that carbon dioxide was heating our environment?	
What can we do about rising temperatures on Earth?	

Activity 1: Heat Transfer

Explorations of heat transfer on Earth's surfaces

Key questions: What types of light does the Sun emit? Which types of light have the most energy? How does the Sun's energy transfer make the Earth's surface warmer, and how do different surface features (like ice, forests, water, rock) and human actions affect this heating process?

Station 1: What is light?

1. Make a list of everything you think you know about light and sunlight.

2. Take a look at this diagram. What do you think it is showing?

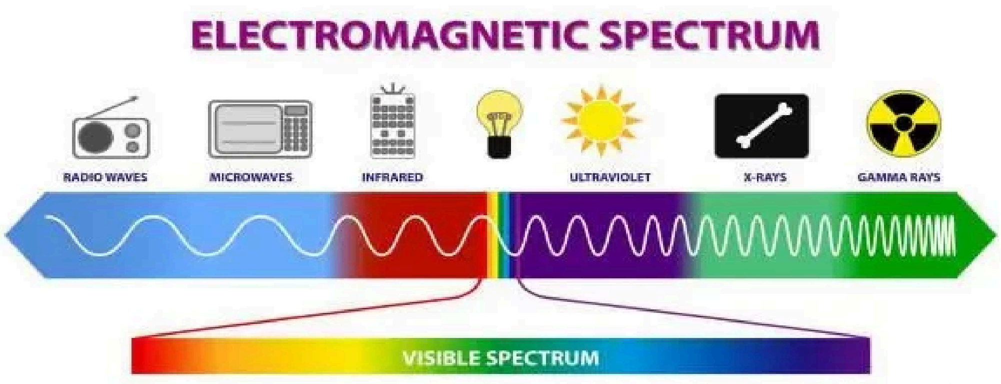


Figure 1: School of PE. (2024, January 5). Waving hello: Exploring electromagnetic radiation [Blog post graphic]. School of PE. https://schoolofpe.com/blogs/news/waving-hello-exploring-electromagnetic-radiation-html.

a. What do you notice about this electromagnetic (light) spectrum?

b. What makes one form of light (or electromagnetic radiation) different from another? For example, what makes an X-ray different from a radio wave?

3. The graphic below adds more information to the electromagnetic spectrum:

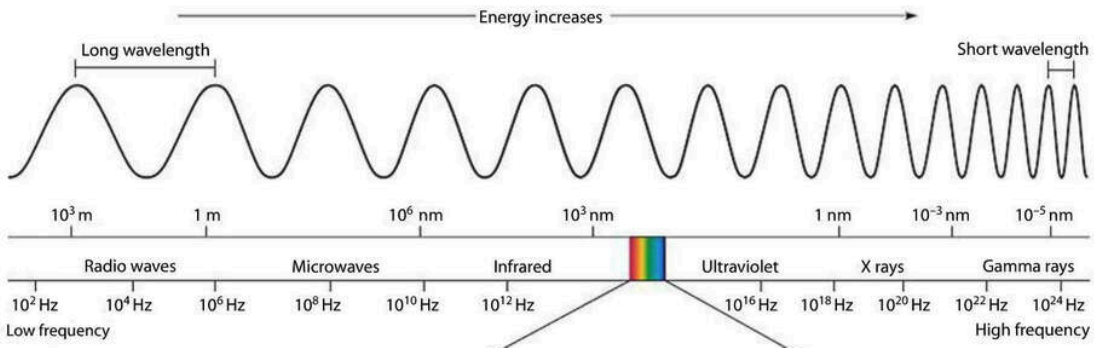


Figure 2. The electromagnetic spectrum. From "The Electromagnetic Spectrum," by NASA, 2026, NASA Science. (https://science.nasa.gov/learn/heat/resource/the-electromagnetic-spectrum/)

Based on the graphics from questions 2 and 3, describe what you think "wavelength" means, and what wavelength tells you about the different types of light (electromagnetic radiation).

4. Can we measure parts of the electromagnetic spectrum?
   a. Using the photo below for a reference, imagine you were holding a thermometer in the places listed in the table. Predict a temperature for each spot in the table below (hint - average room temperature is about 71 degrees F).

Predict the temperatures here:

Position	Temperature (°F)
Shade (not close to rainbow)	
Within the rainbow	
Next to red (Infrared)	

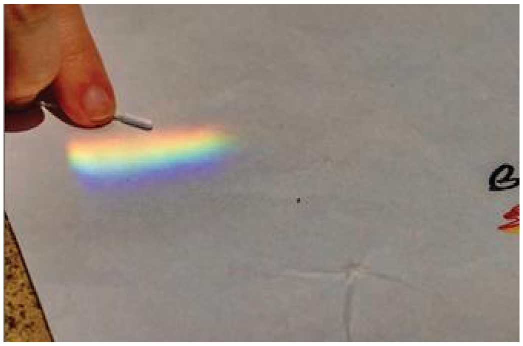


Figure 4: Lopez, R.E., Matsler, K.J. (2025, January 1). The Quantum for All Students and Teachers Project: Sample Activities and the Historical Storyline Linking Them.The Physics Teacher. Phys. Teach. 63, 26–28.

b. Compare your predictions with your classmates. Are they similar?

c. Watch these two videos. Your teacher may have them set up on computers, or will provide you with the links.
   i. https://www.youtube.com/shorts/9hMXy2-6FfQ
   ii. https://www.youtube.com/watch?v=aHQVB6qgZAU

d. Were your predications correct?

e. What conclusions can you make based on your observations? How can you connect this to the electromagnetic spectrum graphics above?

Station 2: When sunlight reaches Earth: How surfaces heat and hold energy

Use the infrared thermometer to take measurements of different surfaces near you - try your hand, your face, desk, floor, lamp, windows, etc. Make sure not to shine the lasers in anyone's eyes. Write down your observations:

Procedures:

1. **NOTE**: Each student group should only measure ONE assigned material (5 minutes under heat and 5 minutes with heat off). Data from all the materials will be pooled together from the class after testing is complete.
2. Get a data table from your teacher.
3. Take a look at the material that you were assigned.
4. Write a place in the "real world" where you find this type of material in column 2 below.
5. Make a prediction about how you think these materials will absorb and hold heat.

6. Test your hypothesis.
    a. Place your material on the marked space on the desk and/or measure the distance to ensure your material is the correct distance from the heat lamp.
    b. Take an initial measurement using the infrared thermometer and write it on the group [data collection sheet]() at time 0.0 seconds.
    c. Turn on the lamp
    d. Set a timer for one minute.
    e. After one minute, take a temperature reading. Write your data in the [table]() provided.
    f. Repeat every minute for five minutes.
    g. After five minutes, remove your material from underneath the lamp.
    h. Turn off the lamp and set a timer for one minute. After one minute, take the temperature and record it in your table.
    i. Repeat every minute for five minutes.

Station 3: Hand boilers

1. Rub your hands together to warm them up.

2. Gently place your hands around the lower bulb of the hand boiler and observe what happens to the liquid inside. Write your observations and your proposed explanation below.

3. To get the liquid back down to the bottom bulb, repeat the procedure above and hold the top bulb.

4. This hand boiler shows the concept of **thermal expansion**. Do a little research on what thermal expansion is and write it in your own words here. Where else does thermal expansion exist?

5. Go to the Energy Forms and Changes PhET simulation: https://phet.colorado.edu/sims/html/energy-forms-and-changes/latest/energy-forms-and-changes_all.html
    a. Click on Intro
    b. Check the Energy Symbols box in the upper right corner

c. Put the iron block and the brick onto the heaters and turn them on for 30 seconds or so (it may be helpful to check the "Link Heaters" button for this). What similarities and differences do you see between the two surfaces?

d. Heat the iron or brick for about 10 seconds and then place it into the beaker of water. What do you observe?

e. Heat the iron or brick for about 30 seconds and then place it into the beaker of water. What do you observe?

f. Do the same for the oil. Notice any similarities and differences.

g. Based on your observations, what do you think is meant by the term "thermal expansion"? How does it differ from evaporation? Use examples from the PhET simulation in your answer.

6. Thermal expansion is part of what is making sea levels rise worldwide as a result of climate change/global warming. Explain how you think thermal expansion can lead to rising sea levels. What else do you think leads to rising sea levels?

Station 4: What type of light does the Sun emit to Earth?

1. Without looking ahead to the next page, what type(s) of electromagnetic radiation (light) do you think the Sun emits towards Earth? Provide evidence for each of your predictions.

2. Look at this graphic. Were you correct? Name all the types of light that the Sun emits that you missed.

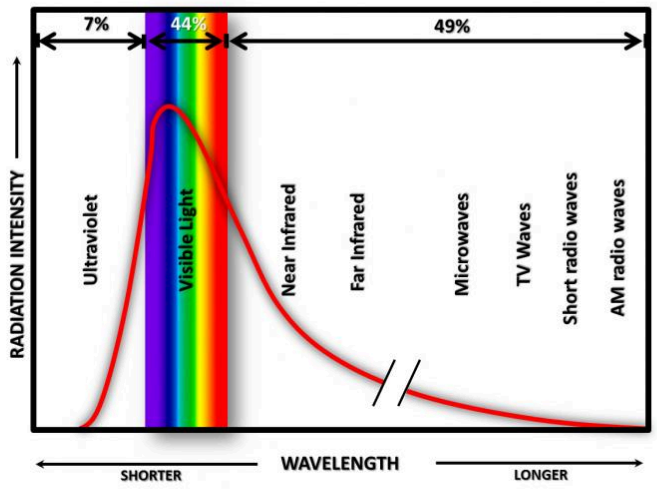


Figure 5. The electromagnetic spectrum. From "Electromagnetic Radiation," by Florida Atlantic University Center for Environmental Studies, 2023, *Climate Science Investigations South Florida*. (https://www.ces.fau.edu/nasa/module-2/radiation-sun.php)

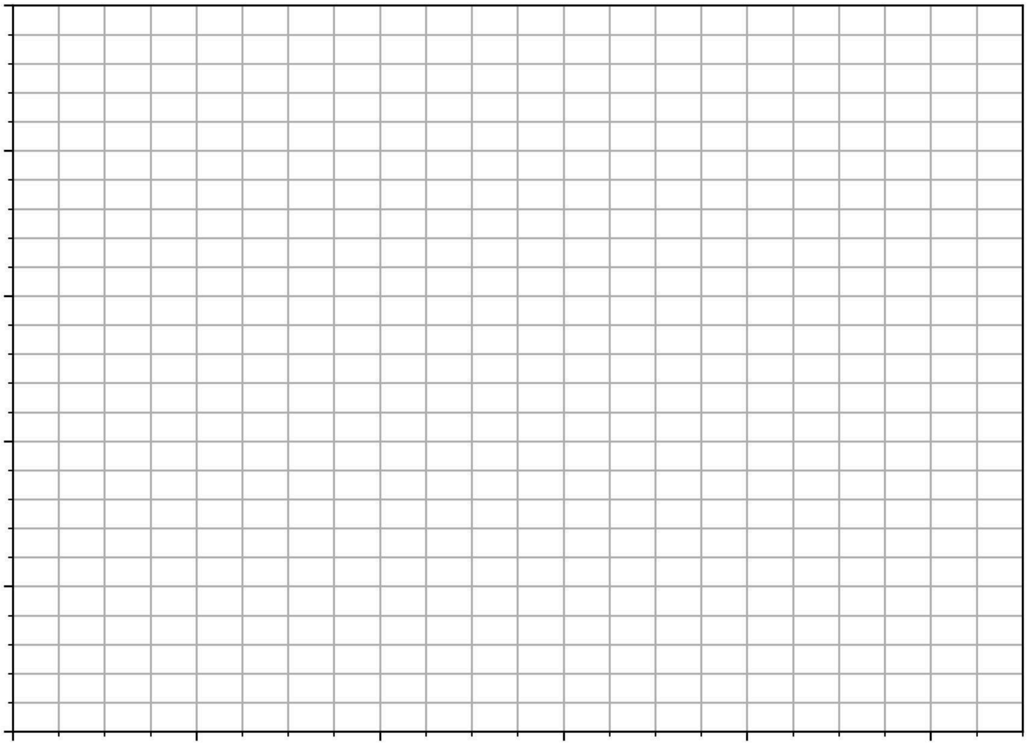
3. Watch this video: Observing the Sun Different Wavelengths of Light! Get Ready for th...

4. Explain why looking at the Sun is dangerous. Do you think it would be dangerous to look at the Sun if it only emitted visible light? What about just visible and infrared? What about just visible and ultraviolet?

Discussion and Conclusions

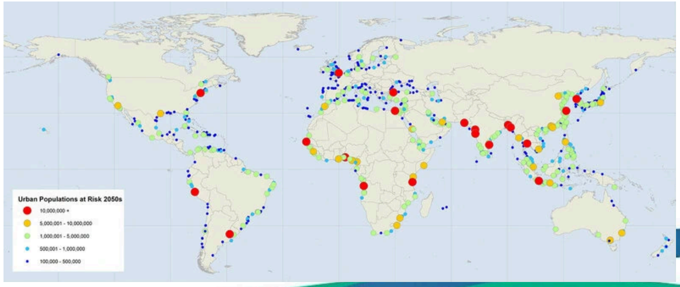
Your teacher will lead you through a discussion and conclusion based on the prompts below:

1. Share your results from Station 2 with the rest of class. Graph your data using the space below or a computer program as your teacher instructs. Discuss how the different materials absorb and store heat. Make analogies to actual surfaces on earth (forests, cities, rivers, oceans, etc.).



2. What are some human activities that drastically change the heat absorption of surfaces on Earth? Be specific and use evidence from the activity to support your claims.

3. Based on what you have learned, describe what you think is meant by the term “urban heat island”. Knowing that the following cities are within a mile of



the coastline, what are the implications of urban heat islands on the oceans and the people living nearby?

4. Write a sentence or two linking the ideas of material qualities, heat absorption, and natural and human made surface features on Earth. *Example: "If a material like concrete is near a river, the concrete will absorb lots of the Sun's energy, making it heat up, which could make the water molecules in the river expand and could cause floods."*

5. How might you use these concepts of heat transfer in different jobs like HVAC, architecture and building design, and city planning? What kinds of scientists help understand Earth's heat transfer processes?

Data Table - Activity 1

Material:								
Distance from lamp to material:								
Real-world applications of this material:								
Predicted temp absorption (high, low, medium):								
	Time (min)	**Temperature (degrees F)**						
Room temp	0.00							
Heat applied	1.00							
	2.00							
	3.00							
	4.00							
	5.00							
Heat removed	6.00							
	7.00							
	8.00							
	9.00							
	10.00							

Activity 2: Eunice Newton CO_2 experiment

CO_2 and our climate

Eunice Newton Foote & her groundbreaking discovery

Key questions: What is CO_2, and how does it affect the climate? How does CO_2 compare to air as a greenhouse gas? How does CO_2 in the atmosphere interact with infrared light (heat)?

Brainstorm: If you wanted to figure out how well CO_2 holds onto heat compared to regular air, how would you design an experiment to test it?

Intro: Who was Eunice Newton Foote? Describe her experimental setup.

Hypothesis: What do you think will happen when both bottles are exposed to light? Which bottle do you expect to heat up faster? Why? Why might the composition of the gas make a difference?

Data Table: Temperature of CO_2 vs. air

Minute	CO_2 bottle temperature (in ℃)	Air bottle temperature (in ℃)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Analysis

1. Graph your data below or by using a computer program as instructed by your teacher.

2. Open the Molecules and Light PhET simulation and only focus on CO_2. How can you relate what you learned in this experiment to what you see in the simulation regarding CO_2?

Discussion and Conclusion - Your teacher will lead you through a discussion and conclusion based on the prompts below.

1. Did your evidence support or refute your hypothesis?
    a. If you were right, try to explain what causes the differences in temperature and how it can relate to the climate.
    b. If the results did not follow your hypothesis, then where did your hypothesis go wrong? Or, were there errors in the experiment that could be improved on in the next run?
2. What do you think would happen if we removed all of the CO_2 in the atmosphere? Would our climate remain the same?
3. Try to predict, using evidence from your experiment and the simulation, what will happen as more carbon dioxide gets added to the atmosphere.
4. When sunlight hits the ground, it turns into invisible heat called infrared radiation. How do greenhouse gases like CO_2 'catch' this heat and scatter it back toward us, and what does that mean for our global climate?
5. Have you heard about the increase of CO_2 in the atmosphere? If so, where do you think the excess CO_2 is coming from? If not, can you predict where you think excess CO_2 is coming from?

Activity 3: The Atmospheric Greenhouse Effect

The atmospheric greenhouse effect

Why do planets have different temperatures even under the same Sun?

Key questions: What is the greenhouse effect, and how does it actually work? How do certain gases in our planetary atmosphere trap heat?

Station 1: What is the atmosphere, weather and climate?

1. Take a look at this atmosphere simulation. Write **three observations** and **two questions** that stem from your participation with the simulation.

2. Review the difference between weather and climate by watching this video. While watching, define **weather** and **climate** here.

3. Describe the weather conditions around you today:

4. Describe your state's overall climate:

Station 2: PhET simulation: Molecules and light

1. Open the [Molecules and Light PhET simulation].
2. Choose a molecule and a type of light.
3. Move the dial on the light beam to the midway point.
4. Send that type of light toward your chosen molecule for at least 5 seconds. Write down your observations in the table below.
5. Do this for the other types of light, while keeping the same molecule.
6. Choose at least **three additional molecules** and shine microwave, infrared, visible, and ultraviolet light at them.
7. Record your observations below.

Molecule (choose at least 4)	Microwave	Infrared	Visible	Ultraviolet

Station 3: Why do planets have different temperatures even under the same Sun?

1. Decide which group member will measure the heat from their palm for this experiment.
2. Place your hand at the bottom of the popsicle structure, against the table, with your palm facing up. Don't put any plastic sheets on top of the popsicle structure yet.
    a. Make sure the infrared laser is NEVER pointed towards someone's eyes.
    b. Hold the thermometer just above the top level of the structure.
    c. Point the infrared thermometer to the middle of the test subject's palm and record the temperature readout below.
3. Place the 0.002 inch thick plastic film on top of the popsicle stick structure. Make sure to only handle films by the edges.
    a. Check that the film is smooth and even.
    b. Hold the thermometer just above the plastic sheeting and take a measurement of the palm's temperature THROUGH the plastic sheet.
    c. Record your measurement in the table below.
4. Make sure to use the same hand, the same distance from the sheeting, and the same position of the thermometer for each measurement.
5. Repeat for each plastic thickness.
6. Calculate the difference in temperature when the film is and isn't present.
7. If time allows, place different thicknesses together, calculate the thickness, and repeat steps.
8. If time allows, try measuring the temperature of different hands.

Film thickness [inches]	Temperature of palm without film [°C]	Temperature of palm with film [°C]	Difference in temperature [°C]
0.002			
0.005			
0.01			

Describe your observations in terms of atmospheric thickness. How does this relate to the concept of the "greenhouse effect"?

Station 4: Atmosphere on different planets

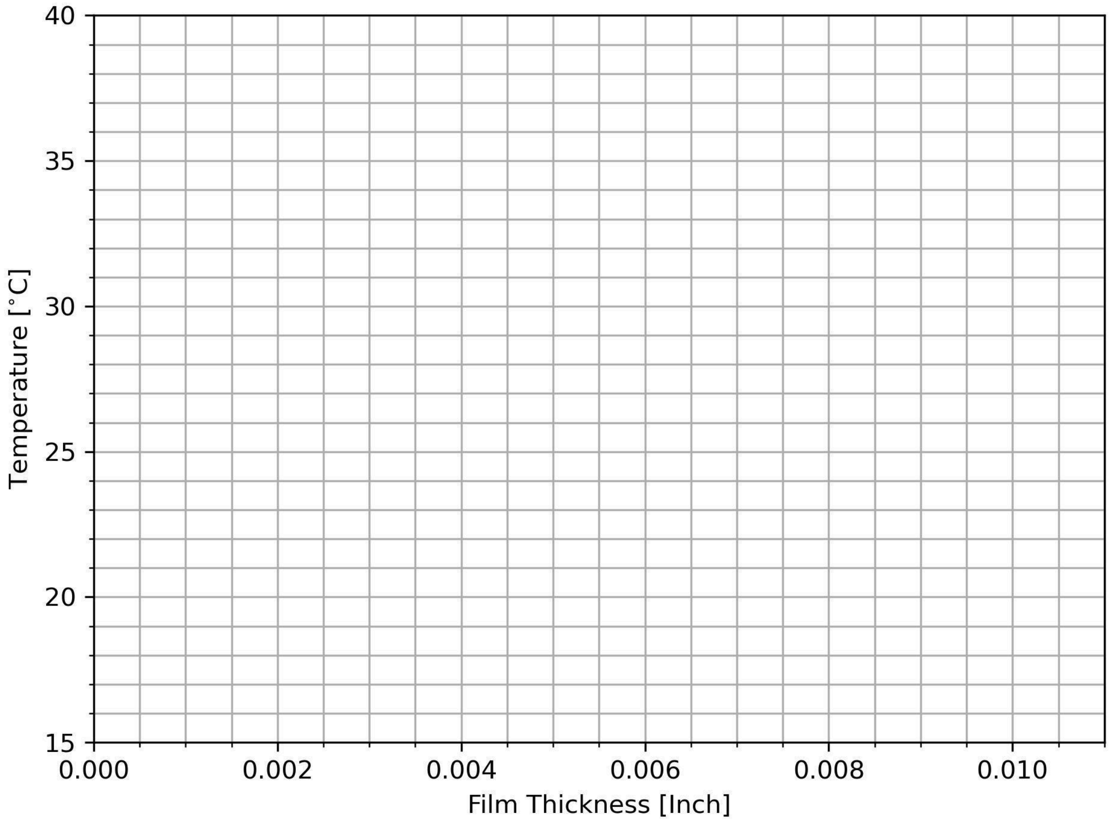
Research aspects of these planets' atmospheric makeup and temperature. These data will be discussed by the whole class later.

	Venus	Earth	Mars
Distance from the Sun/solar constant			
Planet radius			
Surface temperature			
Surface pressure			
Atmospheric composition			

Research or remind yourself of the concept of the "greenhouse effect". How does this relate to the data you collected above?

Conclusions/Discussion: Your teacher will lead you through a discussion and conclusion based on the prompts below:

1. Plot your data from Station 3 on the provided graph.



2. What patterns can you identify in the data?

3. Connect your data from Station 3 to the information you gathered about Mars, Venus, and Earth in Station 4. Which level of plastic thickness matches with each planet?

4. Based on Station 3, what do you think optical thickness means? How can you connect to what you learned about the greenhouse effect in a few of the stations?

5. Connect greenhouse gases to the Molecules and Light simulation. Which types of light interacted most with certain molecules, and how does that relate to heat being trapped in Earth's atmosphere?

6. What final conclusions can you make? Support your conclusions with data.

7. What careers might involve studying how energy moves through the atmosphere or analyzing climate data, and what skills from this activity would be useful in those jobs?

Activity 4: Carbon Capture

Carbon capture & storage

Mitigating environmental impact

Key questions: How can we capture CO_2 gas and cycle it naturally on Earth? What impacts could that have on Earth and to humans/wildlife?

Initial Ideas

1. What do you think chemical weathering means?

2. What is basalt, and where does it form?

Materials

- Flask
- 200 mL of distilled water
- 2 small water bottles
- 2 bags of basalt rocks per group
- 5 g (1 teaspoon) of baking soda
- 60 mL (¼ cup) of vinegar
- Balloon

Procedures

1. Gather two plastic water bottles.
2. Pour 200 mL of distilled water into each of the two plastic water bottles. Label them "control" and "experiment".
3. Pour 1 bag of basalt into each of the water bottles. Swirl to mix.
4. In a separate flask, put ~1 teaspoon of baking soda.
5. Have someone in your group prepare to stretch a balloon over the top of the flask.
6. Over a sink or tray, pour ~60 mL vinegar into the flask with the baking soda and immediately stretch/secure the balloon over the mouth of the flask. Swirl the bottle to keep the reaction going until complete. The reaction (baking soda + vinegar) makes CO_2 and inflates the balloon.
7. When bubbling stops and the balloon is well inflated, pinch the balloon opening closed so the gas doesn't escape.

8. Take the pinched balloon to the "experiment" bottle. Secure the end of the balloon over the mouth of the bottle and release the pinch. Allow the CO_2 to be released into the bottle. This will happen because CO_2 is more dense than air, so it will fall and displace the air.
9. Close the carbonated experimental bottle and shake. The walls will shrink as CO_2 dissolves in the water.
10. Make sure both bottles are fully closed and leave them out for 3 days.

Predict

What do you think will happen in the "experiment" bottle vs. the "control" bottle? What kind of changes do you think will take place?

Results

Record observations of your bottles every day. Notice changes in color of solution, appearance of basalt rocks, appearance of bottles, etc.

In each box, draw what you see inside the bottle. Look for:

- **The air:** Is the bottle tight/inflated or flexible to the touch?
- **The water:** Is it clear, cloudy, or bubbly?
- **The rock:** Do you notice any changes in the color or texture of the rock?

Day 1	Day 2	Day 3
Bottle Feel: [ ] Firm [ ] Soft Water Color: __________	Bottle Feel: [ ] Firm [ ] Soft Water Color: __________	Bottle Feel: [ ] Firm [ ] Soft Water Color: __________

Discussion and conclusion

1. Relate your observations back to their hypothesis. Were you right or wrong?
   a. If you were right, explain what caused the observed changes in the CO_2 bottle.
   b. If the results did not follow your hypothesis, was your hypothesis wrong or were there errors in the experiment that could be improved on in the next run?

2. **The invisible change:** Why did the bottle get softer even though no gas was let out?

3. **The new rock:** Look at the white grains mixed with the black basalt dust. What are these called?

4. The law of conservation of matter says that matter cannot be created or destroyed. If the CO_2 gas is no longer in the bottle, what do you think happened to it?

Linking to the real world

5. What produces basalt rock? Could this already be happening all around us?

6. What other carbon capture processes are happening around us?

7. Can we do basalt carbon capture on a large scale? If we spread basalt dust on a giant farm, what impact would that have on the farm?

8. How can you engineer a solution to take more CO_2 out of the atmosphere, and what effect do you think this would have on climate?

Critical Conversations Guide

Critical Conversations Guide

Ethical questions related to human choices that impact Earth's climate may generate controversy. However, engaging in these critical conversations can help challenge students to work on evidence-based reasoning, listening skills, and intellectual humility. Critical conversations can help communities to engage in shared understanding and seek balance among competing values and priorities, which can often lead to long-term solutions. In this guide, you will find **broad tips** for fostering productive, trust-building discussions with your students, as well as **specific discussion questions** for each PhysicsQuest activity.

Tips for critical conversations

1. Consider arranging desks in a circle or square to facilitate open dialogue.
2. Establish a set of group norms to make sure all students feel respected and taken seriously. These [STEP UP discussion guidelines] may be a good place to start. These norms can include:
   - Use reflective listening. Ask clarifying questions and explain what someone else said in their own words.
   - Use real-world examples and evidence from class to explain your ideas.
   - Share air time equitably. Balance listening and talking.
3. Establish shared definitions of key words that are important to the discussion.
4. Acknowledge any emotions that may arise with empathy, humility, and curiosity, rather than dismissing emotions or passing judgment.*
5. Use wait time appropriately; do not be afraid of silence in between speakers to allow students to collect their thoughts at their own pace.
6. Ask for student feedback about the discussion process at the end of class to allow students to give their perspectives and identify highs and lows.

***** *For more resources on cultivating healthy discussions and managing emotions that may surface about climate change, see the "Additional resources" section at the end of this document.*

Discussion guide: Activity 1

In this activity, students conducted an experiment to understand how solar energy transforms into heat. Now that students have explored the physics of heat transfer, we can begin to explore the causes and effects of human actions, and link these to values and personal choices.

Have students spend time reviewing and discussing the values found on the NISE network page, then choose two values they connect with the most.

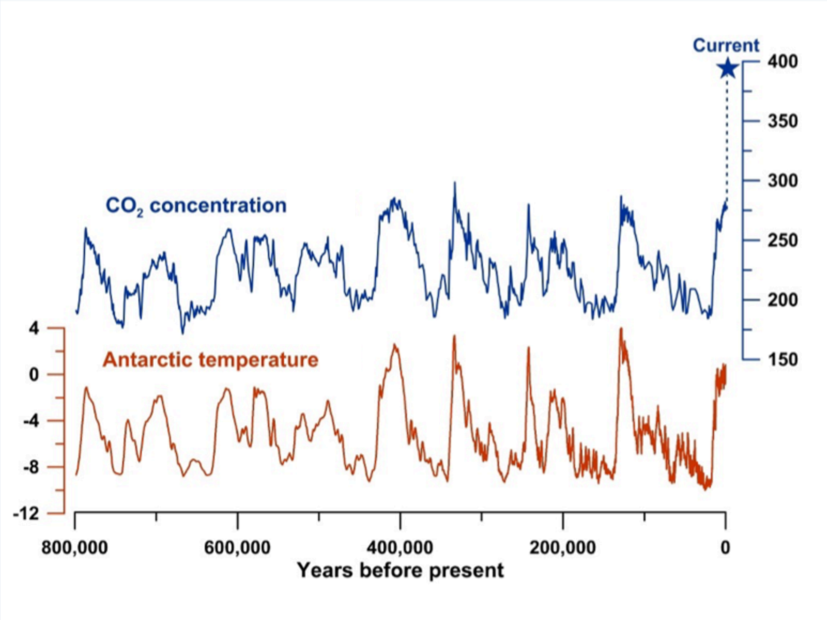
Discussion questions

- *Why are these values important to you?*
- *How do you think some of your actions, as a human who interacts with your environment, might contribute to the change of heat absorption of the surface of the Earth?*
- *Which actions are in conflict with your values, and which actions are in agreement with your values?*
- *Are there any actions that simultaneously conflict with one of your values and support another one of your values?*

For example, cutting down forests may help provide certain resources for things like houses or boats for fishing, which could support values related to "growth" and "wealth," but deforestation also creates a landscape that is more susceptible to extreme heat. Prioritizing the forest to reduce heat might elevate the values of "stability" and "responsibility."

Discussion guide: Activity 2

This graph shows actual climate data scientists have collected through studying ice cores in Antarctica. Ice cores form due to the large accumulation of snow on Earth's North and South poles. The weight of each year's snowfall compresses the snow, and after many years, it forms glacial ice. As these sheets of ice are formed, they preserve tiny air bubbles from the atmosphere that give insight into what the atmosphere was like when the ice formed. Scientists use these ice cores like a "time machine" to measure the CO_2 concentration over time by analyzing the gasses trapped in the air bubbles.



United States Environmental Protection Agency

Discussion questions

- *What do you notice about Earth's temperature over time?*
- *What relationships do you observe between Earth's carbon dioxide levels and temperature? Does this mirror the evidence you collected during the experiment?*
- *What is similar or different about our current carbon dioxide concentrations and the range of natural cycles on Earth?*
- *What do you think could be a reason that our temperature is not currently following natural climate cycles on Earth?*

Discussion guide: Activity 3

In this activity, students learn how CO_2, a greenhouse gas, causes the greenhouse effect, leading to the planet retaining heat in its atmosphere. Many members of the general public, including teachers, students, and parents, may experience strong reactions to this topic.* Research shows that over 97% of scientists agree that climate change is being caused in part by the greenhouse effect, but only 55% of the public thinks that scientists agree, and a quarter of United States adults think that climate scientists are debating human-caused climate change. This is known as the "Consensus Gap" of climate change. Identifying this gap and thinking about ways to close it through these discussions is important to finding solutions for human-caused climate change. Use this next activity to help students discover the beliefs surrounding climate change, and connect those results back to their own values and beliefs.

Have students choose a location within their state or community and investigate local climate beliefs using the Yale Climate Maps. Then, have students take the SASSY, and individually explore where they fall in their own climate beliefs.

Reflection questions

- *How does the consensus gap present in your community?*
- *What issues do people in your community care about?*
- *Does the belief distribution in your area line up with what you thought?*
- *When you think of the term "climate change", no matter which side of the spectrum you fall, what portions of the topic do you think about or feel most connected to?*
- *How might you explain your beliefs to someone who believes differently than you, using evidence from class or personal experience?*

* *For more resources on cultivating healthy discussions and managing emotions that may surface about climate change, see the "Additional resources" section at the end of this document.*

The following is a sample worksheet that can be used to lead students through this reflection.

Choose a location within your state or local community and investigate local climate beliefs using the Yale Climate Maps. Pick a few statements or beliefs that are interesting to you, and record them below.

Statement	State/Region	Opinion findings
Most scientists think global warming is happening		

Do these percentages line up with what you thought that region would believe?

Now take the Six Americas Super Short Survey (SASSY), and describe where you fall in your own climate beliefs:

When you think of the term "climate change", no matter which side of the spectrum you fall, what portions of the topic do you think about or feel most connected to?

How might you explain your beliefs to someone who believes differently than you, using evidence from class or personal experiences?

Discussion guide: Activity 4

In this lesson, students learn about one type of carbon capture that can have positive effects on the Earth's climate as a solution to climate change. Focusing on solutions is more likely to cause them to become motivated and empowered. However, it is also important to acknowledge the full emotional landscape that comes from thinking about climate change, including negative emotions. Then we can identify our role and what unique strengths we bring to the table. Talking about emotions in class can help students with emotional processing, open dialogue with those who might feel similarly or differently about the situation, and deepen their understanding about the topic.

Have students discuss the following in small groups.

Discussion questions

Consider your own backyard, school, or community.

- *How have you observed climate change in your own community?*
- *What are some small solutions that you can do in your community to help make change in the climate or environment?*
- *How can these small actions have an overall larger impact on climate?*

Have students take this Climate Warrior Archetypes quiz to better understand how they can use their strengths and values to contribute toward climate solutions. Consider having them decorate the classroom with their ideas.

Additional resources

Fostering effective discussions

- Controversies in the Classroom: Strategies for managing climate change discourse
- Talk Science Primer
- Managing Difficult Classroom Discussions
- Guidelines for discussing difficult or high stakes topics
- Teaching Environmental Issues and the Affective Domain
- Listen To Your Own Listening
- Ethical Decision Making Framework

Managing emotions about climate change

- Climate Mental Health Support Activities Guide
- Climate Mental Health Network Resource
- A Whole Lot: Climate Emotions Video
- Climate Emotion Wheel by Abby Van Muijen

Brainstorming solutions

- Project Drawdown: Science Based Climate Solutions
- Climate Solutions for All
- Dreaming in Green: Young Voices for the Planet
- United Nations Climate Action Superheroes
- Climate Action Venn Diagram

Supporting information

- Climate Change Evidence & Causes 2020 Report (National Academy of Sciences)
- United Nations Sustainable Development Goals