Ecology Explorers' Lesson Plan

Is It Hotter Over There?

Topics Covered
Microclimates
Surface Temperature
Air Temperature
Built and Natural Materials
Urban Heat Island
Data Collection
Data Analysis

Grades
3-12

Duration
40-50 minutes

Authors
Ecology Explorers

Overview

The contour of the land, the surfaces that cover the land, the presence or absence of plants, and time of day may result in many climates (microclimates) within one ecosystem. Comparing the land cover and temperatures in different microclimates can help students to become aware of the impacts of different surface types on air temperature and why organisms live where they do.

Why study microclimates?

- Varying types of land cover can affect temperature
- Temperature can have an impact on human health
- Relates to the Urban Heat Island effect

Facts about the Urban Heat Island In Phoenix:

- In the summertime, dark pavement surfaces may reach temperatures of 160ºF.
- Roofs can get to be 190ºF.
- 40% of the urban surface cover in Phoenix is pavement; only 15% of Phoenix's urban surface is covered by buildings.
- The average nighttime low temperature in Phoenix has increased by 8ºF over the last 30 years.
- For the months of May through September, the average number of hours per day with temperatures over 100ºF has doubled since 1948.

What kinds of scientific investigations can be developed from this activity?

Students can gather both surface and air temperature data from areas with variation in land cover, time of the day, and other variables that interest students.

Objectives

Students will:

- compare the land cover and temperature in different microclimates
- record temperature readings and detailed observations when measuring microclimates
- begin to see patterns that link temperature with land cover and consider impacts to the ecosystem.

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Is it Hotter Over There?

Materials:

- Instant read meat thermometer
- Container of ice water in which thermometer probes can be submerged without submerging display portion
- Data recording sheet
- 1.5m piece of string
- Red marker to mark string
- Google map or photo of the schoolyard projected on white board
- Optional - infrared thermometers for measuring surface temperatures
- Optional - large nails, stakes, or weights to secure string to mid-point

Advanced Preparation:

- Check thermometer calibration by placing them into a container of ice water for 5 minutes. The thermometer should read about 32.3°F. If the reading is more than a degree above or below 32.3°F, then note the difference for that thermometer. You can later add or subtract this number from the temperature reading accordingly. Example: A reading of 31°F is deviation of 1°F lower so that the corrected temperature would be the temperature reading + 1.
- Thermometers should be kept out of direct sun during all times when not in use for investigation.
- Cut a piece of string to be just over a meter long and attach to the meat thermometer.
- Measure from the tip of the thermometer 1 meter on the string and mark with a red marker

Recommended Procedure:

Engagement:

1. Guide students to think about temperatures at smaller scales like around the school campus, such as shaded areas, a playing field, and the parking lot. What are the conditions like there? Why might they feel hotter or cooler in different places? Do they wonder if there really is a difference between these places that are pretty close to each other?

2. Explain that when scientists wonder about why different areas feel differently, they measure the temperatures to find out more.

3. Explain and model the next steps before sending students on their exploration, or complete each investigation as a group, selecting two or three students as investigators at each location.

4. Students will select a midpoint on any surface and secure the string so that the red mark is the midpoint. This can be done with a partner standing on the string at the marked point.

5. At this point, lie the thermometer flat on the ground and measure the temperature of the ground surface (you may need to wait up to 30 seconds for a reading).

6. Record the reading in the table on the Data recording sheet for the 'Midpoint Surface'. Make sure to record the surface type and circle whether it is in the shade or in the sun.

7. On the map in the student worksheet, the red dot indicates the midpoint. Sketch on the map what is around you as if you were looking down on it like a bird.

8. Move to location #1-4 by extending the string outwards from the midpoint in four directions. The midpoint must remain the same. Follow the same directions 5 - 7 to record the temperature, make notes, and sketch surroundings.Allow 30 seconds between each location to let the thermometer calibrate.

10. Determine air temperature by returning to the midpoint and while keeping the string

anchored, lift up the thermometer into the air 1 meter above the midpoint, being careful not to touch the metal probe. The thermometer will measure the temperature of the air at this point, since it isn't touching a surface. Read the thermometer and record the temperature for the "Midpoint Air" section in the table.

10. Send students out to explore, or repeat as a group with multiple locations. Give them about ten to twenty minutes to do the activity, repeating in new locations as desired.

Explanation:

11. Once students have finished their plots it's time to share and compare data. Determine the hottest and coolest location found by the students. Go to each of these locations and use the questions below as a discussion guideline. It is OK if you are not sure of the answers yourself. This can be a great start to further investigations in your schoolyard.
    - What might be making this the hottest or coolest spot?
    - How does this spot compare to your hottest (or coolest) spot?
    - What type of surface do you notice here? What is surrounding this location? How might they influence the temperature?
    - How might the highs and lows change during the day? The year?
12. Have teams of students compare their data using the above questions as a guideline.

Elaboration:

13. Create a class data sheet to look for patterns and make more comparisons.

14. Project the image of the schoolyard on a white board. Have students mark with dry erase marker their findings on a map of the schoolyard. Do any further patterns emerge?

15. Complete the investigation by having students reflect on the activity through writing about their observations during the activity. What did they learn about microclimates? How do they know this? What further questions do they have about microclimates? (Choose some or all of the previous discussion questions to reflect upon.)

16. Now guide students to consider what variables may have impacted temperature differences: types of surfaces, surroundings of the areas beyond the 2 meters, time of day, time of year, etc. This should provoke questions that could be investigated using similar protocol.

17. Have students write questions that could be answered through further investigation. Student designed investigations are encouraged in the Extension portion of this lesson.

Evaluation:

- Student completes data sheet with detailed observations and accurate temperature readings.
- Student's verbal and written reflection demonstrates an understanding that by comparing the land cover and air temperatures in different areas one can begin to explain microclimate impacts.

Extensions:

- Input data here: ecologyexplorersdata.asu.edu link to be part of citizen science project.
- Students can go on to do more observations by varying locations or times of the day, or year, and look for any interesting patterns.

Readings:

Focus on Phoenix Scientists: Dr. David Hondula

Chain Reaction: Our Heat Habitat http://chainreactionkids.org/files/issues/7/chreact7_master.pdf

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Next Generation Science Standards		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Cross Cutting Concepts**
Planning and carrying out investigations	ESS2.A: Earth materials and systems	Patterns
Analyzing and interpreting data	ESS2.D: Weather and climate	Cause and effect
Using mathematics and computational thinking	ESS3.C: Human impacts on Earth systems	Energy and matter
Asking questions		

Common Core	
ELA	**Math Domains**
RST7: Integrate content from diverse formats	Number and quantity
WHST7" Research/investigate to answer questions	Measurement and data
SL1: Participate in collaborations and conversations	

Arizona Standards
Science
S1-C2-PO5: Record data in an organized and appropriate format S1-C3-PO2: Construct reasonable interpretations of the collected data based on formulated questions S4-C3-PO4: Describe how plants and animals cause change in their environment S6-C3-PO3: Differentiate between weather and climate as they relate to the southwest United States

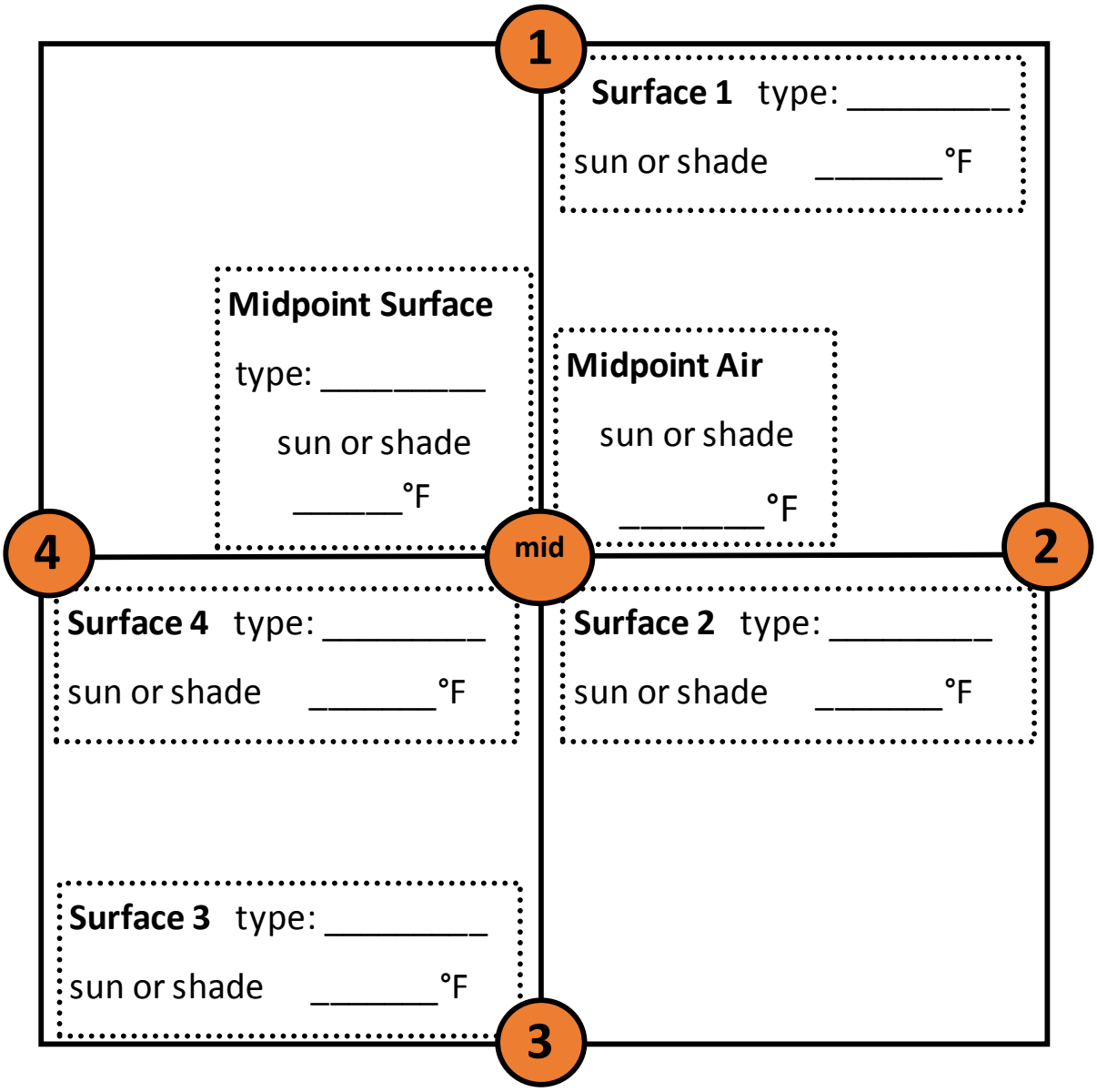
Is it Hotter Over There?

Data Sheet

Date:_____ Time:_____Weather: _____

Location (include address and/or GPS, being as accurate as possible): _____

_____



Surface Type	Description
Concrete	made of cement, such as sidewalks
Plants	such as grass, weeds, or bushes
Asphalt	dark colored, such as road surface
Sand or gravel	small, loose bits of rock material
Stone or brick	any stone material, or made of clay
Metal	any metal material
Plastic or rubber	made mostly of plastic or rubber material

Map Sketch the area around your points, including plants, path, or other items: