1. Contributor's Name: Mary Bricker

2. Name of Inquiry: Schoolyard Microclimates

3. Goals and Objectives:

a. Inquiry Questions:

- How much does temperature vary on small scales in the schoolyard?

b. Ecological Theme(s):

- Microhabitat and microclimate variation.
- Animal adaptations to cold weather include behavior such as choosing suitable microhabitats.

c. General Goal:

- Help students discover how temperature can change across very small scales.

d. Specific Objectives:

- Students learn how to use thermometers to measure temperature
- Students become familiar with degrees Celsius, and converting between Celsius and Fahrenheit.
- Students learn or practice graphing skills.
- Students practice the science process as they practice making and testing predictions.
- Students practice displaying and sharing scientific information.

e. Grade Level: 5^{th}

f. Duration/Time Required:

→ **Prep time:** 15 minutes (copying datasheets, finding thermometers)
→ **Implementing Exercise During Class:** about 1 hour
→ **Assessment:** included in the in-class discussion time.

4. Ecological and Science Context:

a. Background (for Teachers):

Students may have learned about, and tend to think about, climate and weather mainly at a regional geographic scale. This exercise will help them understand how temperature or other conditions can also vary across very small scales distances. Ecologists refer to these small-scale differences in temperature, moisture, and sunlight as *microclimate*. In addition to the large changes in temperature that we expect with varying latitude or altitude, surprising differences in conditions can occur at the scale of meters or even millimeters. These may be due to different amounts of sunlight, exposure to wind, or the insulating or conducting properties of a material.

These small-scale variations can play a large role in determining where animals live or chose to spend time. When we talk about how animals deal with the changing seasons, we often focus on physical changes (growing a winter coat), physiological changes (slowing down the metabolism in hibernation or in torpor) or large-scale movement (migration of birds and mammals). Another very important way that animals deal with changing temperatures is by changing their behaviors. These do include things

like starting migrations of various scales (many animals that don't fly away to southern continents do undertake large-for-their-size movements up and down in elevation) and finding dens in which to hibernate. But on a daily basis, animals also make countless decisions about where to spend their time. Choosing between the cool and the warm side of a log could make a life and death difference for something the size of a beetle that does not regulate its own body temperature the way we do.

This activity will encourage students to think about how temperature might vary over very small scales in their schoolyard. They will make predictions about the relative temperatures of different microclimates, and test their predictions by measuring temperature with thermometers.

b. Background (to present to Students):

Start with having the students discuss how animals deal with changing seasons, or with cold weather. Questions to start the discussion could be:

- What do animals do when winter comes? How do they keep from getting too cold?
    - *Answers will likely include: they grow winter coats, migrate to warmer places, go into hibernation, etc.*
- Keep encouraging them to think about things until they get to the less obvious, like:
    - *huddling together, hiding in sheltered places, living through the winter as an egg or pupae (for insects), etc..*
- What is weather?
- What is climate?
- How are weather or climate conditions different in different places?
    - *It is colder here than in the south, colder in the mountains than at low elevations, etc. Some students may notice that their house gets more or less snow than the school grounds get, or that particular parts of town are very windy.*
- How small of a distance do you think conditions can be different at?
    - *Help them work through smaller/ finer differences, leading down to the very small scale. Examples to help them think about smaller scales might include thinking about how it feels to stand in the shade, versus standing in the sun a few feet away. Emphasize to them that differences can occur over very small distances, and explain to them that that is the scale we'll be looking at today*
- Can you guess what microclimate means?
    - *Students should recognize 'micro'= very small, and come up with the meaning of this rather large word pretty easily.*

To get students thinking in more detail about the variation, and prepare them for making their predictions, try something like this visualization:

> "OK, I want you to close your eyes for a minute, and imagine…pretend that you are as small as an insect. You have shrunk way down, and you are just a tiny little thing the size of a fly. Winter is coming, there's been a bit of snow falling, and you

want to find a good place to get warm for the day. Where are you going to go? You can fly and crawl around, just like a fly. You are buzzing around outside, on the schoolyard, and checking out different places…maybe the playground, maybe the trees….. Notice what it feels like in these different places. Notice what places are nice and warm, which spots seem nice to hang out in for a while. What places are the coldest? Where do you not want to be?"

After students open their eyes again, explain that animals really do make choices like this about where they hang out, in the winter or even on days that are just a little chilly. Explain that today we are going to test some of our predictions about what microhabitats at the schoolyard will be warmer or cooler places for an animal to be.

5. Motivation and Incentive for Learning:

Students get to use their creativity to imagine and predict the relative temperatures of different microhabitats, while working together in teams outside. Our students got excited about the opportunity to use thermometers, especially when they learned that they were borrowed from the lab of a "real scientist" at the University.

6. Vocabulary:

- **Weather**: Weather is made up of all the conditions in one place (temperature, wind, precipitation, humidity, etc.) at a particular time. Weather changes often
- **Climate** Climate is the average of weather conditions in a place over a long time
- **Microhabitat**: A very small or specialized part of the habitat, or the immediate surroundings of an organism. Depending on the size of the organism, this could refer to a particular tree, a particular branch, or the particular part of a single leaf.
- **Microclimate:** The climate of a particular, small area. Often this is in comparison to the larger habitat. (i.e., the microhabitat under a log might be warmer and damper than the surrounding forest)

7. Safety Information:

- Avoid glass thermometers if possible. If using glass, discuss the dangers with students beforehand, emphasizing how easy it can be to for them to break, and supervise groups closely.
- Students will see and feel the differences between microclimates more dramatically on particularly cold (or hot) days—be sure they are adequately dressed for the time outside.

8. Materials List:

- Thermometer for each group. (*If available, thermometers than can measure wind chill would be even better than standard thermometers, and using both could create good comparisons for discussion.*)
- Datasheet for each student (attached at end of the directions)
- Graph template for each student.

9. Methods/Procedure for students:

a. Pre-investigation work:

- Discussion of weather variables and microclimate, as outlined in background section.
- Spend some time indoors demonstrating how to use and read the thermometers.
- Discuss degrees C and F, and how to convert (optional)

b. Investigation work:

1) What evidence (data, samples) do students collect?

Groups of students will take the "predictions and measurements" worksheet out to the schoolyard. As a group, they will chose 4 different microhabitats in which to measure temperature. They'll describe each of the areas, and based on their observations, predict which will be the warmest and the coldest (rank them from warmest to coldest). They'll then come and get a thermometer, and measure the actual temperature in each of those places. Not handing out the thermometers at the start will help students focus on predictions first, and allow you to check that groups have made their predictions, and put some thought into the reasoning behind their predictions.

2) How do students present the evidence (data)?

When groups are done with their measurements, they'll come back inside and graph (as a bar graph) the temperatures that they measured. Each team will present their graph to the class.

3) What conclusions are drawn from the evidence students collect?

As they share their graph with the class, students will explain which area was coldest, warmest, and whether these matched their predictions. They will name which places would be best an animal trying to stay warm for the winter. Encourage students to explain the reasoning behind their predictions, and why results might not have matched their original prediction.

4) Include examples of data sheets.

At end of document.

10. Assessment:

- Students should be able to list some reasons behind their predictions about which areas will be warmer and colder.
- Students should be able to interpret the data off of their own graphs or those of other groups, to rank the places from warmest to coldest, and make conclusions about which places would be good microhabitats for an animal trying to stay warm.

11. Extension Ideas:

Have students make predictions about what caused the differences they saw (shade, type of material, location relative to the ground, etc.) and have them create

microhabitats that would be warm or cold, compared to the ambient air temperature, by manipulating those variables.

12. Scalability:

Could be used in grades 3-5.

13. Science Standards Accomplished:

Content Standards for grade 5-8 met:

- A. Science as inquiry—use appropriate tools to gather, analyze, and interpret data. Develop explanations using evidence. Communicate scientific procedures and explanations.
- B. Life Science—diversity and adaptations of organisms. (animals use behavior to regulate their temperatures)

14. References:

A good website for doing conversions from C to F quickly:
http://www.onlineconversion.com/
(also converts all kinds of units, for other lessons)

15. List of Experts and Consultants:

16. Evaluation/Reflection by Fellows and Teachers of how it went:

We did this inquiry in mid-November at Hellgate Elementary, when students in one class were starting a weather unit, and both classes had recently learned about graphing. In general the inquiry went well, and students enjoyed it. I was surprised by how much they liked the "imagination" exercise in the classroom before we went outside, and how involved they got as groups, in choosing what areas to test and how to rank them.

One thing I would suggest changing is that if at all possible, I would do this with instruments that could measure wind chill. On a cold windy day, a lot of the variation in temperature that students can feel in different areas is due not to actual temperature differences, but differences in wind chill. This is important to animals trying to preserve heat too, and measurements of wind chill might reveal more dramatic differences in temperature, making for more exciting results. Also, in general the students in these classes get excited about getting a chance to use equipment, and learn new measuring instruments. So they loved using the thermometers and most groups that finished early went on to measure many more areas out of curiosity.

Testing Predictions about Microclimates

Name: _____

Date: _____

Table Number: _____

Directions:

- **Choose four places to test the temperature in.**
- **Before you measure with the thermometer, describe each place you are going to measure.**
- **Next, make a prediction: Which will be the warmest and the coldest places? Number the places from warmest to coldest on your sheet.**
- **Now, measure the temperature in each place with the thermometer. Record the measurement on your sheet. DO NOT CHANGE YOUR PREDICTIONS!**
- **Finally, look at your measurements of temperature and number your places from warmest to coldest.**
- **Did the measurements match your predictions?**

Describe the place	**Prediction**: number from warmest (1) to coldest (4)	**Measu** record C