ECOS
Ecologists Educators and Schools: Partners in GK-12 Education

Microclimate in the Outdoor Classroom

1. CONTRIBUTOR'S NAME: TJ FONTAINE

2. NAME OF INQUIRY: MICROCLIMATE IN THE OUTDOOR CLASSROOM

3. GOALS AND OBJECTIVES: TEACH STUDENTS ABOUT THE SIMULARITIES AND DIFFERENCES BETWEEN CLIMATE AND MICROCLIMATE AND THE VARIABILITY THAT EXISTS IN THEIR OUTDOOR CLASSROOM

a. Inquiry Questions: What is microclimate? How much variation in microclimate exists in the outdoor classroom? What biotic and abiotic factors can explain this variation?

b. Ecological Theme(s): Microclimate diversity can explain and be explained by biological diversity.

c. General Goal: Discover the diversity in microclimate in the outdoor classroom.

d. Specific Objectives:

Academic: Students learn the difference between climate and microclimate, and how biotic and abiotic factors interact to produce microclimate.

Experimental: Students learn about *apriori* predictions and testing predictions.

Procedural: Students learn how to measure temperature and humidity, make averages, and use maps.

Social: Students work in groups to develop predictions and test them.

Communication: Students must present their findings to the class.

e. Grade Level: 4th and 8th

f. Duration/Time Required:

→ Prep time: 5min

→ Implementing Exercise During Class: 10 min intro and 30-40min outdoors

→ Assessment: follow up is 30-50min

4. ECOLOGICAL AND SCIENCE CONTEXT:

a. Background (for Teachers): Most students are aware of their local weather, what they hear from the weather man on the TV. They often even have a slight understanding of the climate that they live in, but very few students understand that climate can vary on extremely small scales and that this variation can explain some of the biological diversity that we see in the natural world. To this end we are going to explore the natural variation in microclimate in the outdoor classroom by examining local temperature and humidity of different locations throughout the outdoor classroom. We will then allow the students to make associations with the microclimates that they measured and the plant and animal life they find near their measurements.

b. Background (to present to Students): Who here can tell me what the weather outside is going to be like today, how about the climate of the Bitterroot valley in the fall? Can anyone tell me the difference between weather and climate? Do you think that the climate of Florida is different that here in Montana? Do you think that this can affect what plants and animals live in the Montana versus Florida, why? Do you think that the climate is different between the tops of the Bitterroot Mountains versus down here by the river, and do you think that may affect what plants and animals we see on top of the mountains versus down by the river? What about in the outdoor classroom, do you think that the climate is the same everywhere in the outdoor classroom? How might we test whether the climate is the same or different in different parts of the outdoor classroom? Do you think that if there are differences in climate across the outdoor

classroom that they will be enough to create differences in the plants and animals found there? How might we test if different plants and animals are found in different climates in the outdoor classroom? Today we are going to explore the microclimates of the outdoor classroom and examine whether differences in microclimate across the outdoor classroom lead to differences in the plant communities. To do this we are going to use two instruments that can measure components of climate: a thermometer (which measures?), and a sling??? (which measures?). We are going to take these instruments into the outdoor classroom and measure temperature and humidity in a number of locations. While we are recording temperature and humidity we are also going to see and record what plants are growing within one meter of our measurements. We will then go back inside and map the variation we see in microclimate on our outdoor classroom maps and see if certain types of plants are more common in certain microclimates.

5. MOTIVATION AND INCENTIVE FOR LEARNING: It is important that students understand that variation exists on a multitude of levels. In this inquiry students are able to go into the outdoor classroom discover on their own the variation that exists in microclimate in the outdoor classroom and further see if that leads to variation in the plant life of the outdoor classroom.

6. VOCABULARY:

Weather: The state of the atmosphere at a given time and place, with respect to variables such as temperature, moisture, wind velocity, and barometric pressure.

Climate: The meteorological conditions, including temperature, precipitation, and wind, that characteristically prevail in a particular region.

Microclimate: The climate of a small, specific place within an area as contrasted with the climate of the entire area.

Temperature: The degree of hotness or coldness of a body or environment.

Relative Humidity: The ratio of the amount of water vapor in the air at a specific temperature to the maximum amount that the air could hold at that temperature, expressed as a percentage.

Biodiversity: 1) The number and variety of organisms found within a specified geographic region.
2) The variability among living organisms on the earth, including the variability within and between species and within and between ecosystems.

Biotic: Produced or caused by living organisms.

Abiotic: Nonliving: The abiotic factors of the environment include light, temperature, and atmospheric gases.

7. SAFETY INFORMATION:
AVOID USING GLASS/MERCURY THERMOMETERS.

8. MATERIALS LIST (including any handouts or transparency masters):
4-5 MAPS OF THE OUTDOOR CLASSROOM
4-5 THERMOMETERS/HUMIDOMETER
4-5 PLANTS OF THE ROCKY MOUNTAINS
4-5 DATA SHEET
4-5 METER STICKS

9. METHODS/PROCEDURE FOR STUDENTS:

a. Pre-investigation work: Before we conduct the inquiry we will discuss the terms climate, weather and microclimate to make sure that students understand the differences and the similarities of these terms. We will also challenge the students understanding of climatic variation by having them think about climates at different scales (world wide, regionally, locally, and in the outdoor classroom). We will then direct the students to develop questions to test the variation in climate present in the outdoor classroom. Finally, we will challenge the students to ask question about how this potential variation in microclimate may affect the biome of the outdoor classroom.

b. Investigation work: Students will be broken up in to groups of 4-5. Each group will be given instruments that measure temperature and relative humidity, a map of the outdoor classroom, and a data sheet. Each group will be allowed to choose as many sampling sites in the outdoor classroom as they wish to take measurements of temperature and humidity. Students will mark the location of their sampling point on the map of the outdoor classroom. At each location students will measure temperature and humidity while recording the surrounding plant life. In lower age bands students will record plants as tree, shrub, grass, or forb; but in higher grade bands student will be expected to identify plants by species using a guide book. Once the plants in a one meter radius have been recorded in the data sheet, temperature and humidity can be recorded in the data sheet. Each number on the data sheet will then correspond with the same number in the appropriate location on the map. Once this is completed the students can move on to their next sampling point and repeat the procedure. Allow enough time so that each group can record between 5 and 10 sampling points.

1) What evidence (data, samples) do students collect? Temperature, humidity, and plant types or species.

2) How do students present the evidence (data)? For younger age bands students each group will be expected to present a qualitative descriptions of the microclimate based on an attached worksheet, this will allow them to see where they found certain types of plants (i.e. trees were in cooler, wetter locations than grasses). Older age band students will be expected to create an isocline map using the combined maps for the entire class. Then based on the data they gathered for their groups they will make predictions on the distributions of the species they sampled throughout the outdoor classroom.

3) What conclusions are drawn from the evidence students collect? That there exists a lot of variation in climate, even at small scales and that different plants grow in different microclimates.

4) Include examples of data sheets.

10. ASSESSMENT: For the younger age bands the students learning is assessed by their ability to make generalized conclusions about the types of microclimates that different plant types might grow in. For the older age bands the students learning is assessed by their ability to make predictions on the distribution of species in the outdoor classroom from data they gathered and data gathered by other groups in their class.

11. EXTENSION IDEAS: This inquiry could be extended by having the students also look at animal distribution, in particular insects. Also microclimates could further be dissected by including different mediums (air, water, soil) in the analysis. This would allow students to understand that the medium can have as important an influence on microclimate as the location of the sample.

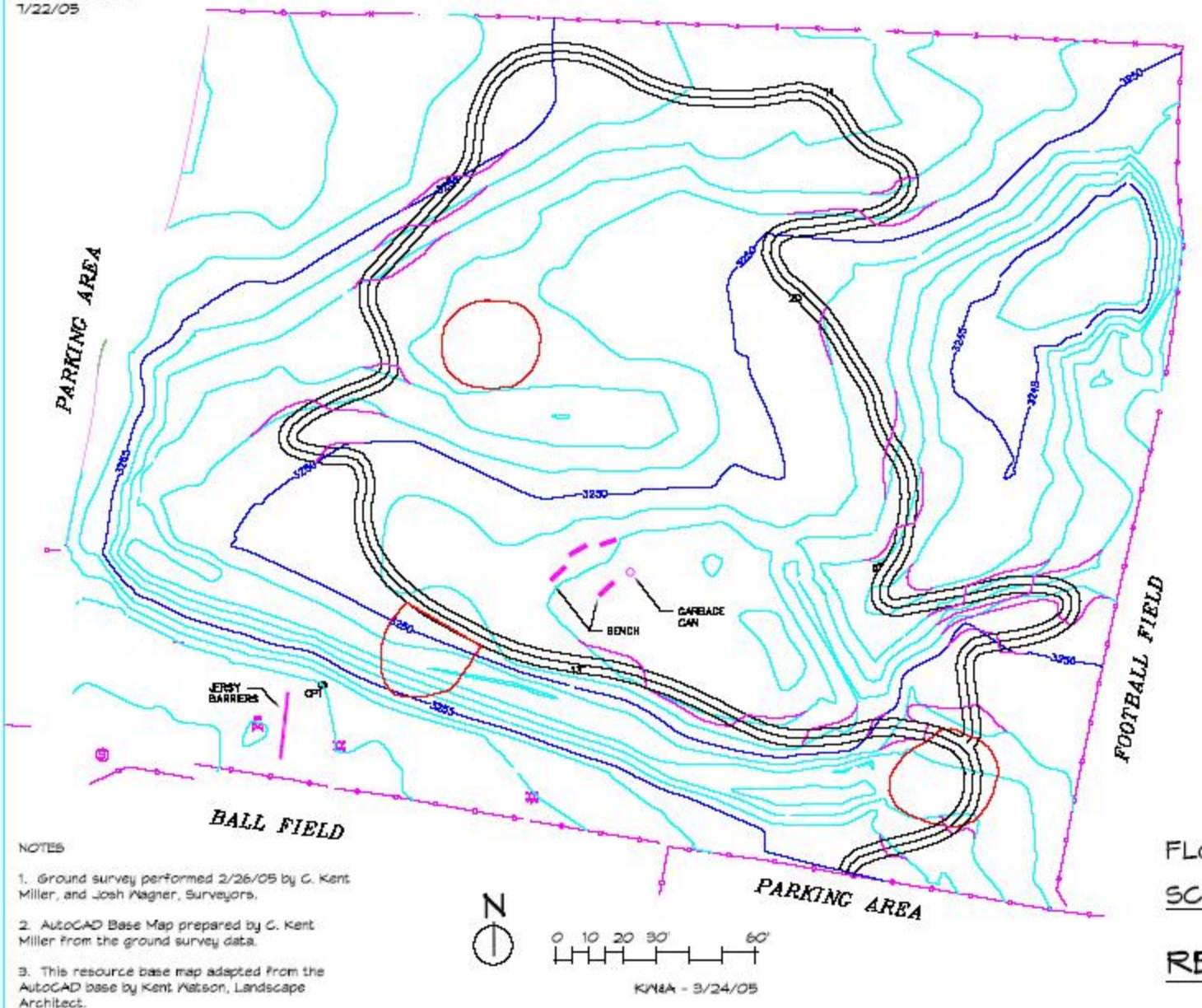
12. SCALABILITY: This inquiry could be scaled to any age group, as I believe we have shown.

13. REFERENCES:

14. LIST OF EXPERTS AND CONSULTANTS

15. EVALUATION/REFLECTION BY FELLOWS AND TEACHERS OF HOW IT WENT: As difficult as it may be to believe, the students were actually able to produce quality isocline maps from the data that we collected in the outdoor classroom. Both the 4^{th} and 8^{th} graders seemed to appreciate the process and the data came out in such a way that we were able to show most of the classes that vegetation did vary predictably with microclimate and for those few classes for which the data did not come out, the students were able to come up with great reasons why.

PLOT: 5/18/05;
7/22/05



LEGEND

- Control Point Monument - 1/2" diam. rebar w/ 1-1/2" dia. aluminum cap
- Chainlink fence
- Barbwire fence
- Woven wire fence

NOTES

1. Ground survey performed 2/26/05 by C. Kent Miller, and Josh Wagner, Surveyors.
2. AutoCAD Base Map prepared by C. Kent Miller from the ground survey data.
3. This resource base map adapted from the AutoCAD base by Kent Watson, Landscape Architect.

N

0 10 20 30' 60'

K/W&A - 3/24/05

FLORENCE-CARLTON SCHOOL

SCHOOLYARD HABITAT AREA

RESOURCE BASE MAP

Sample #	Plant Form (Tree, Shrub, Grass, Forb)	Temperature	Humidity	Light Reading

Climate and Weather Worksheet

1) What was the highest and lowest temperature for your class for each plant type?

	Highest	Lowest
Conifer Tree	_____	_____
Deciduous Tree	_____	_____
Shrub	_____	_____
Forb	_____	_____
Grass	_____	_____

2) What was the highest and lowest humidity for your class for each plant type?

	Highest	Lowest
Conifer Tree	_____	_____
Deciduous Tree	_____	_____
Shrub	_____	_____
Forb	_____	_____
Grass	_____	_____

3) What was the highest and lowest light level for your class for each plant?

	Highest	Lowest
Conifer Tree	_____	_____
Deciduous Tree	_____	_____
Shrub	_____	_____
Forb	_____	_____
Grass	_____	_____

4) Which plant type lived in the coldest area? (circle one)

Conifer Tree Deciduous Tree Shrub Forb Grass

5) Which plant type lived in the warmest area? (circle one)

Conifer Tree Deciduous Tree Shrub Forb Grass

6) Which class recorded the highest and lowest reading for each measurement and what was the reading?

	Highest	Lowest
Temperature	_____	_____
Humidity	_____	_____
Light Availability	_____	_____

7) Why do you think that the classes were so different in temperature, humidity and light availability?

Sample #	Plant Form	Temperature	Humidity	Light Reading
1	Conifer Tree			
2	Deciduous Tree			
3	Shrub			
4	Forb			
5	Grass			
6	Conifer Tree			
7	Deciduous Tree			
8	Shrub			
9	Forb			
10	Grass			
11	Conifer Tree			
12	Deciduous Tree			
13	Shrub			
14	Forb			
15	Grass			
16	Conifer Tree			
17	Deciduous Tree			
18	Shrub			
19	Forb			
20	Grass			
21	Conifer Tree			
22	Deciduous Tree			
23	Shrub			
24	Forb			
25	Grass			

Please enter the average reading for each measurement for each plant type for each group.

Temperature	Group 1	Group 2	Group 3	Group 4
D. Tree				
C. Tree				
Shrub				
Forb				
Grass				

Humidity	Group 1	Group 2	Group 3	Group 4
D. Tree				
C. Tree				
Shrub				
Forb				
Grass				

Light Availability	Group 1	Group 2	Group 3	Group 4
D. Tree				
C. Tree				
Shrub				
Forb				
Grass				

Question 1: What are the potential sources of bias and/or error in the microclimate measurements that we conducted in the outdoor classroom?

Question 2: How could you use the data in the worksheet above and the isocline map to predict plant distribution in the outdoor classroom.