

Exploring the Hubbard Brook Experimental Forest

Student Handout #1: Virtual Tour & Introduction Questions.

Student Name(s) _____

Date _____

Use the back of the page if you need more room to answer questions.

1) How big is a hectare, in acres? How big is the HBEF, in hectares?

2) Define the term “evapotranspiration.”

3) Give a reason for why there is less calcium, an element that is used by plants, in the forest soil at the HBEF now, compared to fifty years ago.

4) Define “biogeochemistry.” Explain.

5) How many marked watersheds are there in the HBEF? How many have weirs?

6) Describe one of the watershed experiments and some of the results from that experiment.

7) On the back, describe one of the shorter-term research experiments that has been conducted at the HBEF.

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Student Handout #2: Virtual Tour & Introduction Questions.

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Use the back of the page if you need more room to answer questions.

- 1) What was your favorite part of the Virtual Tour? Why?

- 2) What was the most surprising part of the Tour?

- 3) List three other things you learned by taking the Tour. Explain

- 4) During the tour did you see any words with which you were not familiar (for example, “biogeochemistry”)? List three words (or concepts) that are new to you, and explain them in your own words.

- 5) If you were a scientist working at Hubbard Brook, what would you want to study? What types of questions might you try to answer? Why? Explain.

- 6) Do scientists at Hubbard Brook work only individually, or do they sometimes work with each other? Describe why collaboration and cooperation can help scientists do better research.

Exploring the Hubbard Brook Experimental Forest

Student Handout #3: Virtual Tour & Introduction Questions.

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Use the back of the page if you need more room to answer questions.

- 1) What is an “ecosystem?”

- 2) What should scientists know about a forest before they begin to experiment with it?

- 3) What do you think would happen if scientists did not know much about these characteristics?

- 4) Which of the watersheds at the HBEF are used as references (hint: there are two)? Why are these referred to as reference watersheds? In an experiment, what is the purpose of the reference watershed?

- 5) In the early 1900’s the federal government became interested in buying private land, such as that in the Hubbard Brook Valley, in an effort to protect the large watersheds of major river systems like the Pemigewasset and Merrimack. Why do you think it might be important to protect these watersheds?

- 6) How does the type of bedrock present at Hubbard Brook compare to that found near where you live?

Exploring the Hubbard Brook Experimental Forest

Student Handout #4: Virtual Tour & Introduction Questions.

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1) Why do you think streamflow is much lower in the summer at the HBEF? Explain this pattern using the streamflow & precipitation graph on Page 4A, and then look at the answer (there is a link to the answer on the bottom of Page 4A). How did you do? Did you have other ideas?

2) As you have seen, we know that on average rainfall is about the same every month of the year at the HBEF, and streamflow levels are highest in March, April and May. And we also know if a year is drier or wetter than average. According to the graph on Page 11A, what are the three wettest years? The two driest? Was the year you were born wetter or drier than normal? What does this graph indicate about the annual variability of precipitation at the HBEF? Describe reasons why it might be important to know the Valley has received more (or less) precipitation in one year than it does in an "average" year?

3) The Scientific Advisory Committee (SAC) works to keep scientific standards high, helps prevent research duplication, and keeps forest resources intact (i.e., the SAC insures that any destructive experiments, such as forest cutting, are only conducted for very good reasons). Can you think of more reasons it might be important to have a group of concerned scientists overseeing research at Hubbard Brook?

4) What was the purpose of the "Weeks Act?"

5) What are ecosystem budgets?

6) As you might imagine, there can be problems with sampling precipitation: leaves and other contaminants fall into the funnels, and it's often raining on sampling days. Can you think of other problems with sampling precipitation? How would you solve some of these problems?

7) Explain the “Small Watershed Concept.”

8) What questions would you be interested in studying if you worked at the HBEF?

9) What did you learn by taking the virtual Tour? Explain.

10) Consider nitrate (NO_3^-), a form of nitrogen available to plants, and at high levels is a water pollutant. If, over the course of an entire year, scientists measured 500 units of nitrate entering a watershed in precipitation, and 650 units of nitrate leaving a watershed in streamflow, they might be able to conclude that the watershed was losing nitrate and was a source of pollution to the stream. Why could it be important to know if watersheds are losing or accumulating nitrate over long periods of time?

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Student Handout #5: Virtual Tour & Introduction Questions.

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Use the back of the page if you need more room to answer questions.

- 1) What can you tell from the snowpack graph on Page 11A? Is early February snowpack variable in the HBEF, or is it the same every year?

- 2) What is the best way to describe the overall ecosystem type found at the HBEF? Explain.

- 3) According to the graph on Page 4A, in April how much does it rain on average in Watershed 3?

- 4) Describe the type of bedrock commonly found throughout the HBEF.

- 5) How old are the majority of mature trees in the HBEF? Why are they that old?

- 6) Why is there less calcium in the forest soil at the HBEF now than there was 50 years ago?

- 7) Describe two ways that Cone Pond and Mirror Lake are different from each other.

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Student Handout #6: Virtual Tour & Introduction Questions.

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1) What are some benefits to having a research site like the HBEF located far from major human activities? What are some drawbacks to having such a remote site?

2) Describe and give characteristics of two of the following at the HBEF: temperature, precipitation, soil, geology, or streams.

3) How do you think a short growing season like that in the HBEF could affect trees?

4) Why do you think it might be important for scientists to have a good understanding of the land use history in the HBEF?

5) Why do you think it could be difficult to measure how water moves through soil?

6) List and explain three other things you learned while taking the Tour.

Exploring the Hubbard Brook Experimental Forest

Student Handout #7: Virtual Tour & Introduction Questions.

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List the dates of the whole-watershed treatments. Describe each of the treatments. What were the main results of the Watershed 5 experiment?

If you were studying a certain part of a forest - for example, what types of trees grow best there - how long would you want to conduct your research? Would you be able to learn all about these trees in just one year, or would it take many years? Is it possible that it could even take decades? Explain some reasons why long-term research might help you understand more about these trees.

When precipitation was first measured in the HBEF in 1964, the pH of samples was ~ 4.0 - 4.2. Examine the graph on the Long-Term Example Page 1 (you can get to this page from Introduction Page 10). Does it appear that annual precipitation acidity decreases over the five years represented here? Can you make any conclusions from this graph?

What do the five years represented by the graph on Long-Term Example Page 2 seem to indicate? Does it appear that precipitation acidity is increasing or decreasing? How does this compare with the five years in the previous graph? Can you make any conclusions about long-term precipitation acidity trends at the HBEF based on this and the other graph?

The graph on Long-Term Example Page 3 shows all the available precipitation pH data currently available. What do these data suggest? Does it appear that precipitation acidity is increasing or decreasing at the HBEF? How is this graph different from the two previous graphs? What do these three graphs show about the benefits of long-term research?

What does the graph on Page 11 suggest about the number of birds present in the HBEF? Does it appear that bird abundance has increased or decreased since 1969? What could be some reasons for this apparent trend? Could it be that all species are following this trend, or could some be following a different trend?

Why do you think it might be important to know how much lead is present in soil? Describe what could explain the apparent decline in lead as shown in the graph on Page 11A.

Can you tell from this the graph on Page 11A alone if more snow falls now than in 1956 - or would you need more information? What are some reasons for long-term snowpack monitoring?

Read the top section of Page 14 of the Introduction. Can you think of other questions that would require you to compare other sites to the HBEF?

At the HBEF, some scientists are interested in the growth of fine roots, and are trying to answer questions like: How quickly do they grow? How long do they live? Describe why you think scientists might be interested in these questions.

While long-term research and monitoring are crucial to understanding big ecological questions, it is possible to answer some questions in a few months or years. Describe ecological research that might only take a few months or years to answer.