Date: _____

Your Name: _____

HUBBARD BROOK RESEARCH FOUNDATION ENVIRONMENTAL LITERACY PROGRAM

NECAP Practice Test
Task & Answer Booklet

Grade 11
Science Inquiry Task

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Ice Storm Damage

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GRADE 11
PRACTICE TEST SCIENCE INQUIRY TASK
TASK & ANSWER BOOKLET

Directions:

This Inquiry Task will measure your ability to think scientifically. This task will ask you to form hypotheses, plan and critique investigations, analyze data, and develop explanations.

First you will read a short story and then you will make predictions based on the information in the story. You will have 75 minutes to answer the questions about the story.

Write your answers in the spaces provided. Explain the reasons for all of your answers. You may include drawings or labeled diagrams to help explain your answers.

Part 1:	Part 2:	Part 3:
Planning an investigation.	Evaluating explanations and making predictions.	Developing explanations and Applying What you Learned

The words and concepts listed below are used in this investigation.

Species	Group of organisms that can interbreed.
Diameter at breast height	Diameter of tree trunk at 1.4 meters aboveground.
Tree crown	The aboveground parts of the tree extending from the main stem (branches, leaves, reproductive parts).
Newton (N)	Unit of force

GO ON

Read the story below.

Ice Storm Damage

At first the students, and especially the skiers, were excited. Just when it was about time to return to school from winter break, a large winter storm appeared in the weather forecast. The forecasters were saying it was a hard one to predict since the temperature was right around the freezing mark, but the students were optimistic, and eagerly watched the weather. When the power went out, they initially thought it was a good sign and assumed it would be back on in the morning in time for the phone call cancelling school. But by morning, there was no power, no heat, and no way they would get to school. Everything they could see outside was coated with ice. An ice storm had knocked over trees and power lines in all of the towns in their school district. They were out of school, but certainly wouldn't be building any snowmen, let alone skiing.

When the students finally return to school they find their school forest a mess. Huge branches are on the ground, some trees have snapped in half, while others have tipped over. Interestingly, some trees seem fine, and some have only minor damage. Since the amount of ice that coated every surface was the same in that small area, there must have been some characteristic of the tree that determined the amount of damage each tree experienced.

The students want to know what made a tree more or less susceptible to damage from the ice storm. In class, they discuss their ideas on what might cause one tree to withstand a heavy load of ice, while a nearby tree breaks. They come up with the following possibilities:

a. **The size of the tree**
b. **The shape of the tree**
c. **The strength of each species of tree (species strength)**

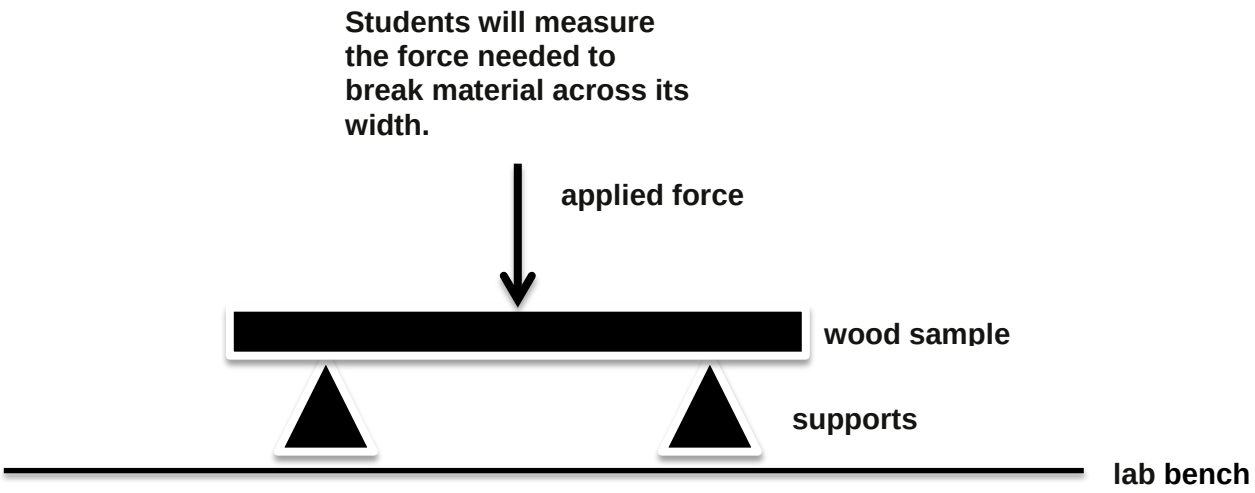
In order to determine which possibility is most important, they decide to collect data and perform experiments. They get information on tree species and tree size from data collected by the biology class the previous fall.

Table 1. Tree species found in forest.
American Beech
Paper Birch
Yellow Birch
Red Spruce
Balsam Fir
Sugar Maple

GO ON

PART 1. Planning Investigations

The school forest will not be safe for the students to work in until the ice has melted so they decide to start by testing the strength of each tree species in an indoor experiment. They will do this by measuring the force needed to break the wood of each tree species, as shown in the diagram below. The downward arrow indicates the force. For each wood sample students will increase the amount of force until the wood breaks.



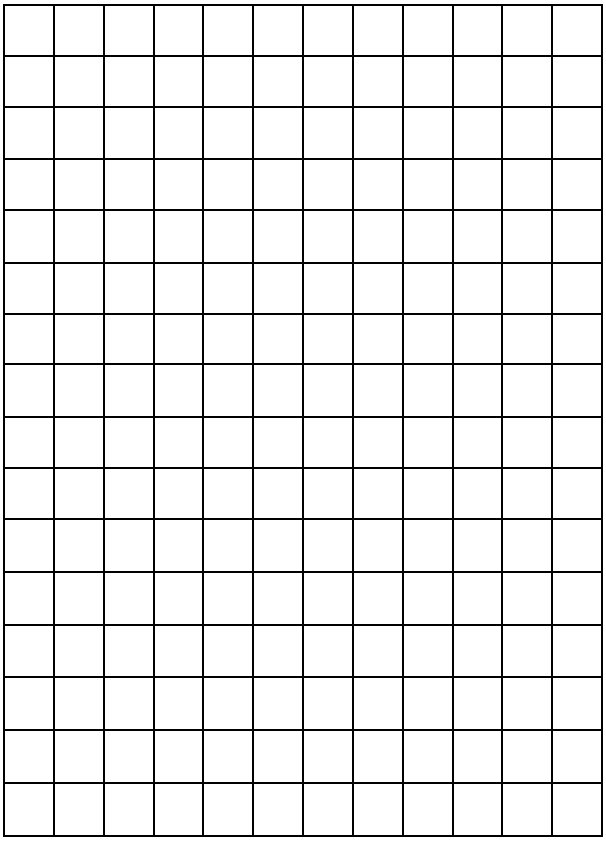
1. The students collect pieces of wood from each tree species. The pieces are all different shapes and sizes. They want to compare the strength of all these species in a controlled experiment. Describe how they should prepare the pieces of wood and how many samples of each species are needed to conduct their experiment.

The results of the strength analysis are recorded in Table 2. Stronger wood requires more force to break.

Table 2. Species strength for tree species found in the school forest.

Species	Force needed to break wood, in Newtons /sq mm
American Beech	**100**
Paper Birch	**86**
Yellow Birch	**116**
Balsam Fir	**53**
Sugar Maple	**107**
Red Spruce	**70**

2. Organize the data from Table 2 into a graph to compare the strength for each species.



GO ON

3. Use the results of the strength analysis shown in Table 2 and your graph to form a hypothesis that predicts which tree species will be more heavily damaged in the forest.

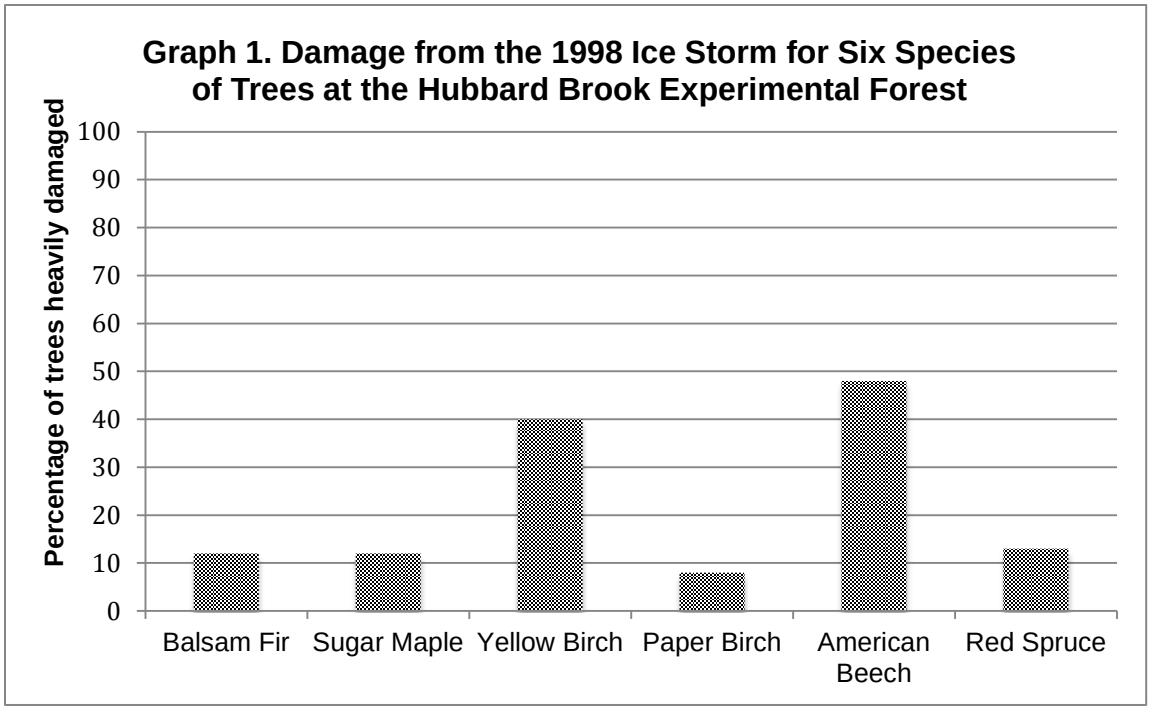
PART 2. Evaluating Explanations and Making Predictions

The students plan on measuring trees in their own forest to test their hypotheses, yet they need to wait for spring so the ice will be melted and the woods will be safer. While they wait, their teacher obtains a data set from the Hubbard Brook Experimental Forest, in Woodstock, NH. She asks them to use this data to test their species damage hypothesis. The forest at Hubbard Brook contains the same tree species and experienced a severe ice storm in 1998. After the storm, scientists measured over 1000 individual trees for ice storm damage. The data shown below summarize the percentage of heavily damaged trees for each species. This includes trees that lost 50 – 100% of their crown, had the top snapped off, or were completely uprooted.

Table 3. Percent of heavily damaged trees for six species at the Hubbard Brook Experiment Forest.

Species	Heavy to severe damage (%)
Balsam Fir	12
Sugar Maple	13
Yellow Birch	40
Paper Birch	7
American Beech	48
Red Spruce	11

Graph 1. This graph shows the percentage of heavily damaged trees for six species at the Hubbard Brook Experiment Forest.



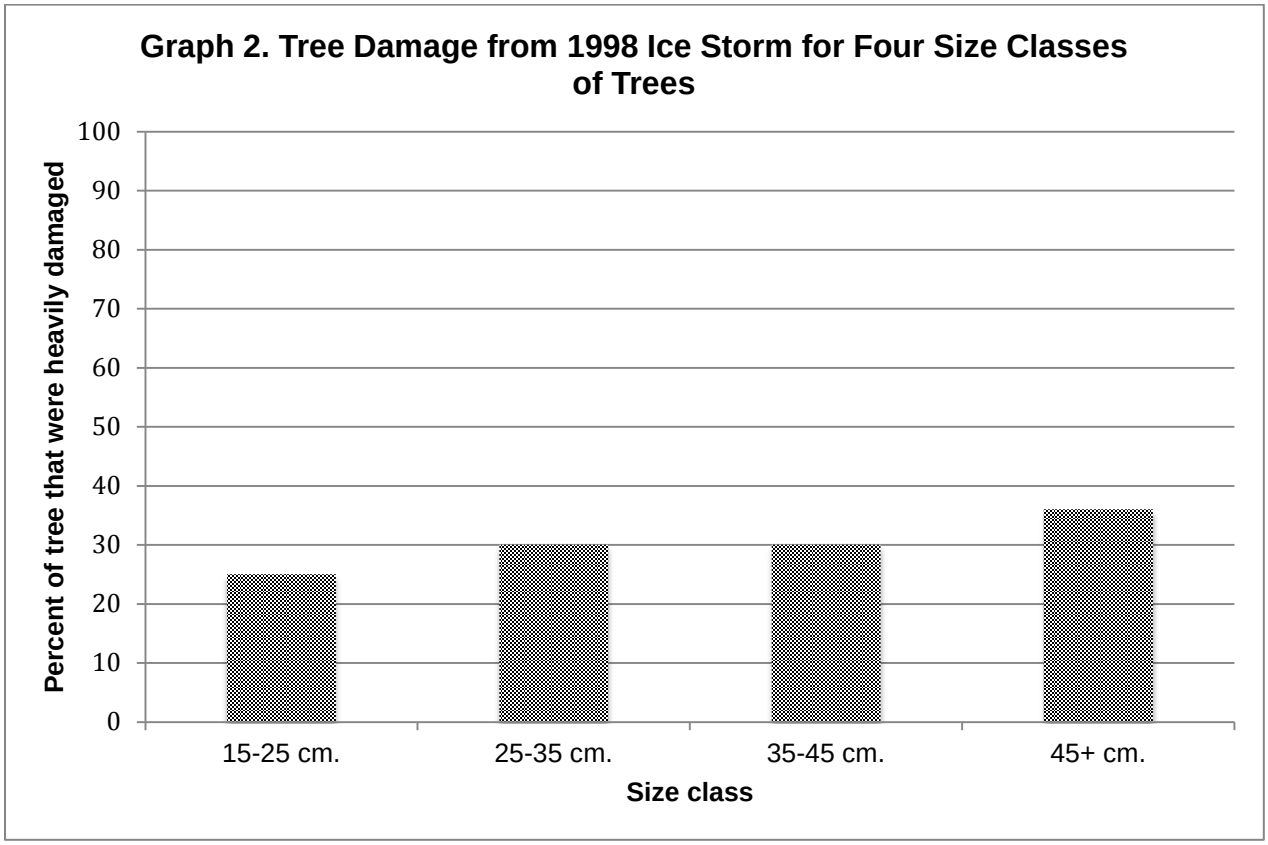
4. Use the data shown in Table 3 and Graph 1 to describe which species experienced the most damage. Do the results from the Hubbard Brook data set support your hypothesis? Explain why or why not.

GO ON

PART 3. Developing Explanations and Applying What You Learned

The students determine that the strength of each species does not predict how severely each tree was damaged for the Hubbard Brook data set. This surprises them and they decide to see if tree size and tree shape have anything to do with the amount of damage. They ask the Hubbard Brook scientists for more data so they can analyze damage by tree size. The scientists send them a data set that groups all species of trees together into different size classes (measured by diameter of trees). The students graph the data to learn if larger trees had heavier damage.

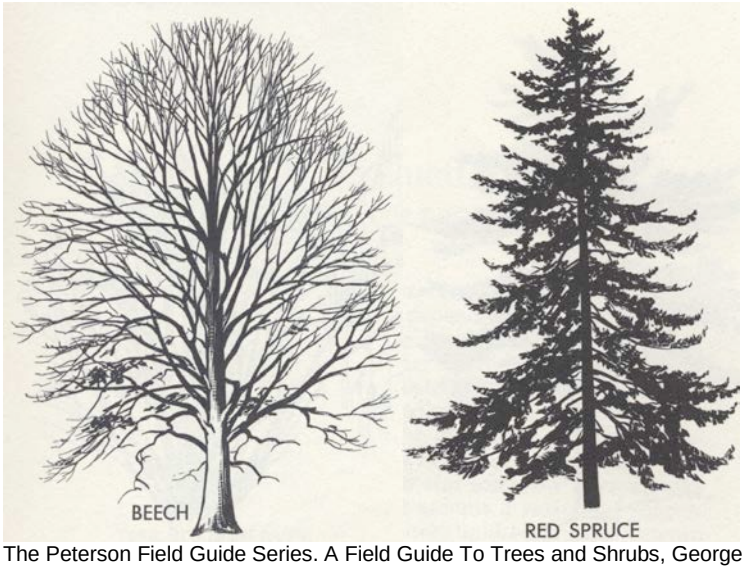
Graph 2. Results of Hubbard Brook Experimental Forest ice storm data for each tree size class. This graph shows the percentage of heavily damaged trees in different size classes at the Hubbard Brook Experiment Forest.



GO ON

5. Use the data from Graph 2 to explain if larger trees show more damage than smaller trees. Provide an explanation as to why this might be.

To investigate the effect of shape on severity of damage the students want to use data from two species with very differently shaped tree crowns. The students choose to compare data from American Beech, a tree with a broadly spreading shape, and Red Spruce, a tree with a narrowly columnar shape. A silhouette of each tree is shown below.



The Peterson Field Guide Series. A Field Guide To Trees and Shrubs, George A. Petrides. Houghton Mifflin Company Boston 1958

6. Reflect on the percent of trees that were heavily damaged for American Beech and Red Spruce in Graph 1. Describe the amount of damage for these species. How might the different shapes of these tree crowns cause the different levels of damage you observe?

7. In the beginning of their investigation, the students identified 3 factors that they thought might affect the amount of tree damage from an ice storm: tree strength, tree shape, and tree size. Briefly summarize which of these factors were good predictors of damage at Hubbard Brook and which were not. Use this information to predict which trees will be more heavily damaged in the school forest.

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