Name _____

Hands-on Activity
Hair Hygrometer

Background

A hygrometer is an instrument that measures humidity through changes in hair length. Hair actually stretches, or expands, when the air is humid. And you thought it just curled up! When the air is dry, hair contracts. You will be able to observe this subtle expanding and contracting by inserting a straw through the eye of a needle around which a hair has been wound. Then, you will calibrate your hygrometer to create a scale so that you can compare measurements over time. Finally, you will answer questions about your hair hygrometer.

Materials

1 empty half-gallon milk carton per group; 1 long, clean, human hair, preferably blonde, per group; soapy water in a small bowl (to wash hair); 1 5-cm (2-in) piece of pine straw or broom straw per group; 1 long sewing needle (at least 10 cm [4 in] long and with an eye that can hold the pine straw) per group; nail polish (quick-drying for gluing purposes) or hot glue gun; scotch tape or masking tape; 1 dime or penny per group; 1 paperclip per group; graph paper and markers to draw humidity scales

Procedure

- First, listen as your teacher explains the activity. Then, organize into the groups designated by your teacher.
- If the hair for your hygrometer has not yet been cleaned, someone from your group should wash the hair in the bowl of soapy water, rinse it well, and then put it on a paper towel to dry. Don't touch the hair unless absolutely necessary so as not to get any oils on it.
- Your carton should already have an H-shape cut on one side with a smaller slit above the H. Lie your carton down on its opposite side so that the H-side is facing up and the H cut is on the left side. Insert the paper clip into the smaller slit at right so that only its end is visible. You will tie the hair to that end, but not yet.
- Lift up the two flaps made by the H-shape cut. Bend them until they are perpendicular to the box side. Their job is to hold the needle in place. Push the needle through the flaps, leaving the eye of the needle extending—but just barely—over the side of the box closest to you. Move the needle in and out of the holes until it turns in the holes without too much resistance.
- Insert the straw through the eye of the needle. The straw will act as an indicator needle. It should be long enough to hang down and sweep the side of the box facing you. Once the straw is in position, use a bit of glue or nail polish to hold it in place.

- Cut out a rectangle of graph paper and tape or glue it along the side of the box where the straw rests. You will be drawing a scale on the graph paper when you calibrate your hair hygrometer. The units marked on the graph paper will give you a well-defined scale.
- Your hygrometer is complete, except for one major part—the hair. First, attach the hair to the paper clip. Then, gently pull it down through the flaps and under the needle. Wind it up and once around the needle. Then drape the remainder of the hair strand over the bottom of the carton at left. Tape the end of the strand to the penny and let the penny hang down, pulling the hair taught. The penny should hang several centimeters over the end, but no more.
- Now it's time to calibrate your hair hygrometer. First, you want to find out the position of the straw when the air is 100% humid. This can be accomplished in a couple of ways, one at school and another at home. At school, the easiest way to create a humid environment is to place your hygrometer in a shallow pan of warm water and cover it with a towel, being careful not to touch the hygrometer with the towel. Wait for 15 minutes. Then, remove the towel. Where is the straw pointing on the graph paper? Mark its position on the graph paper and label it "humid." Then, place your hygrometer in a cool, dry environment for another 15 minutes. Now where is the straw pointing on the graph paper? Its position should be marked and labeled "dry."
- Another way to calibrate your hair hygrometer is to take it home with you (or another volunteer from your group) and bring it into the bathroom when you're taking a shower. After 15 minutes in this moist environment, mark the straw's position on the graph paper and label it "humid." Then, move your hygrometer to a cool, dry place for another 15 minutes. Note the straw's position, mark it on the graph paper and label it "dry."
- Take hygrometer readings several times a day for several days and record your data so you can refer to it while answering the activity questions. You may even want to place your hygrometer outdoors in a shaded and wind-protected spot.
- Finally, answer the following questions.

Questions

1. Why did the straw move?
2. What if the instrument had no scale? Would it still be useful?
3. Does a change in temperature affect your hygrometer?
4. What were the weather conditions outdoors when your hair hygrometer showed a "humid" condition? A "dry" condition?
5. Draw and label a diagram that illustrates how a hair hygrometer works. Did your hair hygrometer work well? What might have made it work better?