Name : ______________________________

SEND IN THE REINFORCEMENTS   PART 1

Take paper reinforcements and apply one to both sides of each hole in the notebook paper.

Hang the paper, supported by the two outside holes, on the two screws in the board

Punch a hole at the bottom of the paper, directly opposite the middle hole, and place paper reinforcements on both sides of the new hole.

Place the paperclip hook through the bottom hole of the paper and attach the 8 oz fishing weight to the hook. This will be your test load.

Holding the board at both ends, raise it so that the paper is supporting the whole load.

Make a labeled sketch of the system you have created.

Use your sketch and observe your system to hypothesize which portions of the paper are involved in supporting the fishing weight and record your hypothesis. Part of your hypothesis can be a sketch.

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While the paper is hanging begin cutting away all unnecessary paper, using your hypothesis.

Cut as much paper as you can while still supporting the load.

If paper fails, start at #1 and revise your hypothesis; repeat until successful.

When you believe you have cut away all unnecessary paper, allow your teacher to observe your paper while still hanging.

Hold the entire apparatus (load, paper, and board) upside down, by holding onto the load and allowing the rest of it to hang downward. Sketch it below. Does it resemble anything you have seen before?

Remove load from paper and then remove paper from wood frame and determine the mass of the remaining paper with the balance.

Record your observations and any conclusions below:

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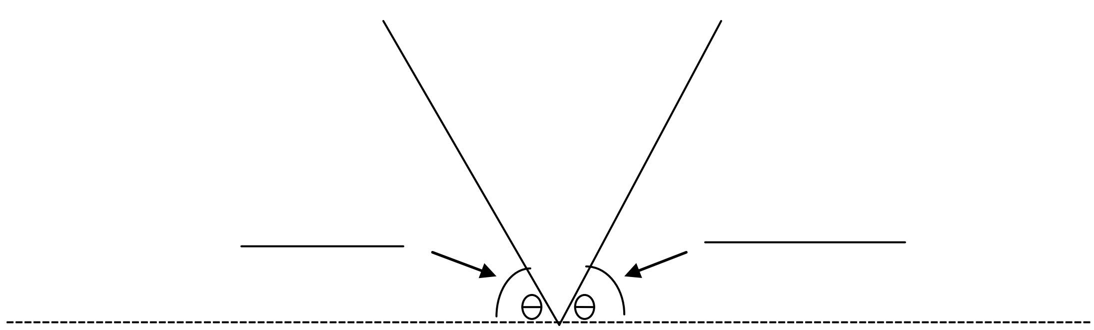
Place your paper V in the Ziploc bag provided by your teacher or place it in a safe place to be used later.

SEND IN THE REINFORCEMENTS   PART 2

Lay your paper V so that the point of the V points to the side of your desk or to another straight line. With the protractor, measure the approximate angles between each side of the V and the edge of your desk. Record your measurements below.



You will now repeat the investigation by varying the angles of the V. Your goal is to find the angles of the V where you can cut the paper the thinnest and still support the load.

Data:

Angle	Width of paper (in mm)	Can it hold the weight?	Observations: describe what happened when you added the weight to your paper V

Conclusion: Based on this simple system, what do you conclude about the best angles for distributing load?

Further exploration: What do you think would happen if you split the load? That is, instead of one 8 oz fishing weight, you had two 4 oz weights? How would the load be distributed if there were three screws supporting the weight instead of two?

If there is time, decide on a way to change the conditions of the test, make a hypothesis about design, and conduct your investigation.

Teacher facilitation: as a means of ongoing (formative) assessment during the activity:

- Variation of “scissors, paper, rock” with “scissors, paper, fishing weight” to activate prior knowledge that seemingly “weak” forces can sometimes overtake seemingly “strong” forces.
- Take a piece of notebook paper and rotate around the classroom with it. Ask how strong paper is. Take the paper between your hands and pull to demonstrate its strength, both with and against the grain. Ask why the paper doesn't tear when you pull on it, but does tear wihen you apply shear force to one of its edges or cut it with scissors.
- Ask, how a lightweight material such as paper could possibly support a heavyweight item such as a fishing weight.
- When the paper is hanging, encourage students to grab on to parts of the paper to see how tightly they are pulled. Ask what this might mean.
- Encourage the cutting away of the most possible paper, to the point that students may need to make a second attempt.
- Ask what would happen if the fishing weight was supported only by placing it in the middle hole and one of the outside holes. Instead of the two outside holes
- How can something support more than its own weight?
- How does this model relate to bridge support?
- If this activity is a demonstration of bridge support, which part of the model represents the bridge itself? Which part represents a person or car that is traveling over the bridge? Which part represents forces of nature, such as wind blowing on the bridge ,or a traffic jam that occurs on a bridge?
- Does it make a difference in the strength of a support system whether a load is pulling down or pushing down on it?
- Does the geometric shape of the resulting paper remind you of any shapes you have seen in bridge design?
- If the resulting small pieces of paper are all that are needed to support the fishing weight, how can this be?
- If you were to flip the apparatus upside down, and hold the fishing weight, allowing the rest of the structure to hang from it, would it still hold?
- If student groups are not connecting, the activity with bridge support, offer a package of K’Nex to them and have them build something that resembles the apparatus.