**Kitchen Science Experiments: Potato Arch Bridge**

**Completed By: The Chosen One**

**Presented To: Mr. Sarkar**

**Date Due: October 4th, 2010**

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**Purpose:**

The purpose of this science lab is to investigate the forces that act upon an arch bridge and determine the structural advantages and/or causes of structural failure in an arch bridge.

**Hypothesis:**

If the potato arch is built to resist rotational forces by having wide buttresses that will support the force of compression and thick abutments to span the bridge’s gap then the arch bridge may be less prone to structural failure.

**Variables:**

**Independent Variables:**

* Thickness of abutments (which determines the resistance of rotational forces)
* Wideness of buttresses (which supports the load and the compression forces)
* Number of potato wedges spanning the bridges gap

**Dependant Variables:**

* Friction acting on blocks (which determines if the middle block will push the others outward)
* Compression forces acting on blocks (which can cause the bridge collapse)

**Apparatus and Materials:**

* A potato
* A sharp knife
* A protractor
* A set square (recommended)

**Method:**

1. Using the knife, cut five (5) twelve (12)mm by twelve (12)mm blocks of potato with the set square as a template
2. Using the knife and a protractor cut the vertical sides of the five (5) blocks at an 110° angle
3. Lay two (2) potato blocks on the angled sides at the approximate distance of the other three (3) blocks
4. Lay one block, on their angled side, on top of each of the blocks that have already been laid down on a flat surface
5. Use one (1) block to seal the span of the bridge and complete your potato arch bridge
6. Observe the structural failure of the bridge when blocks are prodded and are removed

**Observations:**

**Qualitative:**

* Thick blocks span the gap of the potato arch bridge
* The potato arch bridge’s blocks are cut at an angle that creates wide buttresses
* When the middle block is removed, the four (4) other blocks continue to stand
* When the middle block is pushed downward, the structure collapses
* Described rotational force appears act on the bridge when the middle block is pushed down
* When the two blocks on the right side are pushed outward, the bridge collapses
* Described rotational force appears act on the bridge when the right blocks are pushed outward
* When the two blocks on the left side are pushed outward, the bridge collapses
* Described rotational force appears act on the bridge when the left blocks are pushed outward

**Quantitative:**

* The potato arch bridge is 6.4cm in length
* The arch potato bridge is 3.9cm in height
* The bridge can withstand a load of ten (10)g – sixty (60)g
* 70g of load are put on the middle block, the block is pushed down and the bridge collapses
* When the middle block is pushed downward the two (2) blocks on either side move in 3mm

**Conclusions:**

The purpose of the potato arch bridge experiment was to test the structure of the arch bridge and identify the forces that attribute the structures failure. The two main forces that act against the arch bridge are rotational force (torsion) and compression. The compression occurs when the bridge has to support its own weight and the weight of the load that is passing over it. If the force of compression is too great the bridge will collapse. The buttresses of the bridge should be wide and high so the weight of the load and the bridge can be distributed downwards and equally between the buttresses. The second force, torsion, can also collapse the bridge because it can twist the blocks and cause the arch to lose shape. This is why the blocks are thick and the buttresses are wide. When the load’s weight is pushed outward the thick blocks do not rotate and collapse and the buttresses can distribute the weight evenly. In conclusion, the arch bridge can be very effective if the right features are put into place to counteract the forces acting against the structure.