Gymnast

Category: Physics: Balance & Center of Mass

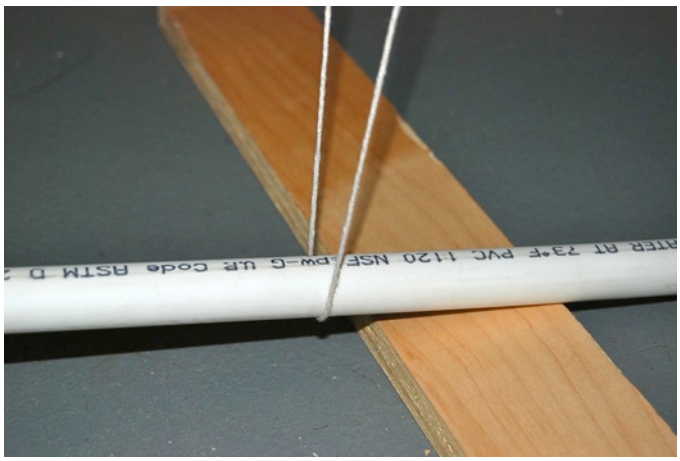
Type: Make & Take

Rough Parts List:

30”	PVC ½”
1	Clothes peg, old style one piece
1	Straw
	Wire, 16 ga. steel baling
1	Wood piece, 1”x 2” x 3”
	String, medium
	Tape, masking & electrical
	Hot glue
	Decorations

Video: http://youtu.be/SQ_NlIj1720

How To:



Cut PVC into 2-15” pieces. To cut the PVC, elevate it slightly, place a string below it, and pull the string tightly back and forth.

Drill holes at ½” and 1” from one end of each pipe.

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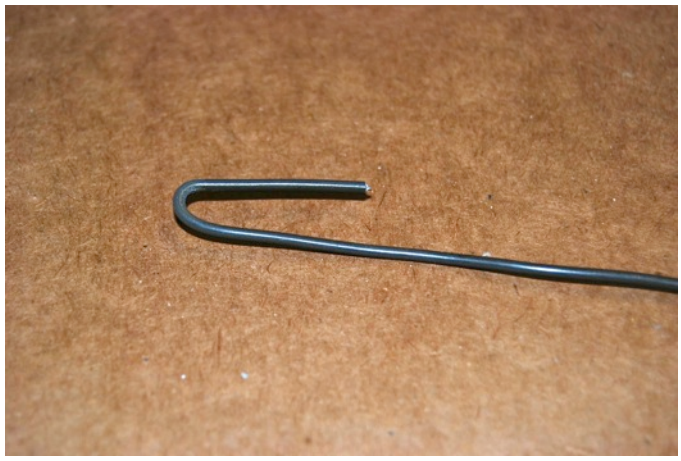
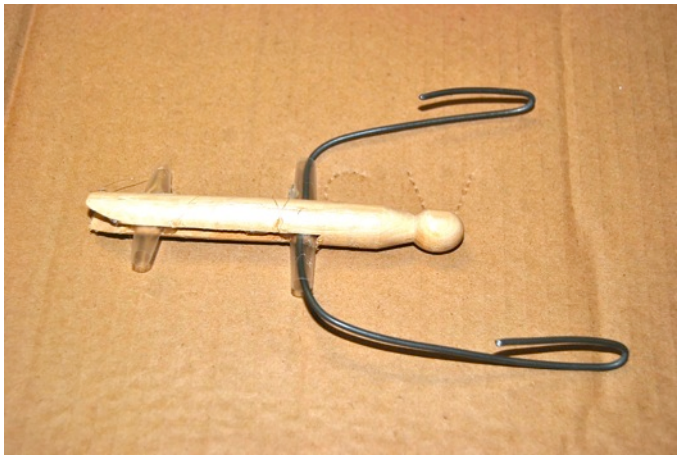
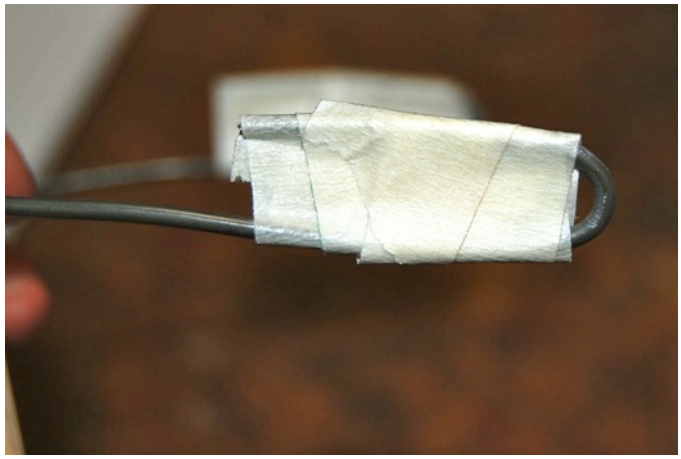
Cut two small pieces of straw, insert and glue them to the clothespin.



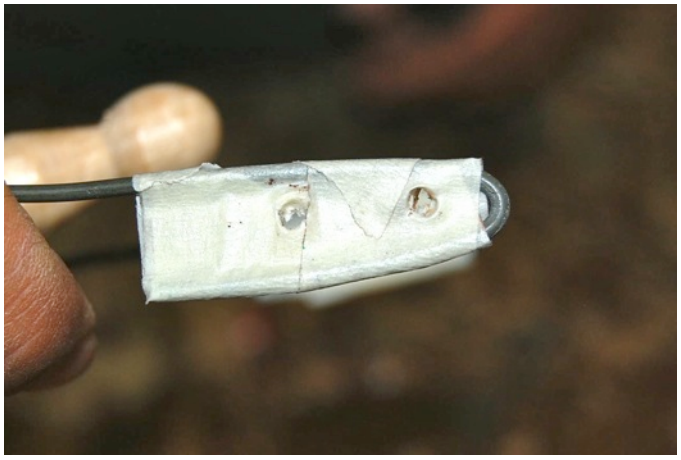
Bend 1 end of the 12” wire.



Insert the wire through the top straw, then bend the other end of the wire.



Wrap tape around the bent ends of wire.



Poke 2 holes through the tape.

Thread the 10” wire through the bottom straw and bend both ends to create feet.

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Glue the wood block
between the 2 PVC pipes.

Wrap electrical tape around the PVC pipes
and wood block to form a sturdy base.

Line up the 2 holes in the PVC with the 2
holes in the gymnast's masking tape arms.

Fold and cut a piece of masking tape
to create a "needle" on the string.

Thread the string through the
bottom hole of the left PVC and
cross it over to the top hole on the right PVC.

Continue to thread the string
through the bottom hole
from the outside of the right PVC.

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Continue into the top hole of the left PVC. The cross between the arms works well but is not necessary. Cut and knot the string so that the entire threading is a little loose.

Squeeze the PVC pipes together at the bottom to make the gymnast swing around.

Decorate the gymnast.

Fine Points:

→ If the arms are long enough and the legs are short enough, they'll make complete circles giving a nice motion.

→ A longer block of wood makes more space for the gymnast, but it also makes it hard for small hands to use.

Concepts Involved:

- A lever is a simple machine. There are three levers in this project: the arms of the gymnast and the two pipes.

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- A lever has three parts: the place where the force goes in, the place where the force come out and the fulcrum, or pivot point.
- A bit of force at the two holes in the gymnast's hands makes the arms push the whole body around. Likewise a bit of force inward at the bottom of the pipes pulls the strings outward at the top.

Elaboration:

Levers are some of the simplest and most important machines that humans use. We use them in all kinds of situations, from crowbars and wheelbarrows to tweezers and seesaws. All levers have three important parts: the resistance arm, the force arm, and the fulcrum. These three parts can be arranged in any position relative to each other – the resistance arm and the force arm can even be the same part of the lever.

A fulcrum, or pivot, is a place where something is connected, and yet can still move. You can demonstrate a pivot by swinging your arm from the elbow – your arm is connected, but it can still move freely. The resistance arm of a lever is the length which is doing the action – lifting, moving, or throwing. The force arm of a lever is the length where the force is applied – the handle of the wheelbarrow, the center of the tweezers, or the handle of the car jack. Levers can multiply motion – a short movement at the middle of a broom makes a long movement at the bottom – or force – a car jack is lifting the whole car, but using only the force from your hand.

Our gymnast is swung through the air by the action of two sets of levers: the long PVC pipes and the little person's arms. The PVC levers have their resistance arm above the block of wood, their fulcrum at the block of wood, and their force arm below the block of wood, where we apply pressure to make the Gymnast move.

The gymnast's arms are also levers, but since both strings are moving, it is a bit more complicated. But it is simple to see what is happening: when the string is put under tension by the force from the PVC pipes, it attempts to return to a straight line, bringing the little person with it. Though the strings only move a bit, the long arms are connected to the body, and the person moves a lot. This is another example of a lever multiplying motion.

Focus Questions:

1. Real gymnasts can stand on their hands at the top of a pole. Why can they do it but this gymnast can't?
2. What are other places we use levers in daily life?

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3. What would happen if you made the gymnast twice as big?
4. What would happen if you put the holes in the hands farther apart?

Links to k-12 California Content Standards:

Grades k-8 Standard Set Investigation and Experimentation

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other strands, students should develop their own questions and perform investigations.

Grades k-12 Mathematical Reasoning:

1.0 Students make decisions about how to approach problems:
1.1 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, sequencing and prioritizing information, and observing patterns.
1.2 Determine when and how to break a problem into simpler parts.

2.0 Students use strategies, skills, and concepts in finding solutions:
2.1 Use estimation to verify the reasonableness of calculated results.
2.2 Apply strategies and results from simpler problems to more complex problems.
2.3 Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.
2.5 Indicate the relative advantages of exact and approximate solutions to problems and give answers to a specified degree of accuracy.

3.0 Students move beyond a particular problem by generalizing to other situations:
3.1 Evaluate the reasonableness of the solution in the context of the original situation.
3.2 Note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems.
3.3 Develop generalizations of the results obtained and apply them in other circumstances.

Grade 2 Standard Set 1. Physical Sciences:

The motion of objects can be observed and measured.
1.c Students know the way to change how something is moving is by giving it a push or a pull. The size of the change is related to the strength, or the amount of force, of the push or pull.
1.d Students know tools and machines are used to apply pushes and pulls (forces) to make things move.

Grade 3 Standard Set 1. Physical Sciences (Energy & Matter)

1.d Students know energy can be carried from one place to another by waves, such as water waves and sound waves, by electric current, and by moving objects.

Grade 8 Standard Set 2. Forces:

Unbalanced forces cause changes in velocity.
2.a Students know a force has both direction and magnitude.
2.c Students know when the forces on an object are balanced, the motion of the object does not change.

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