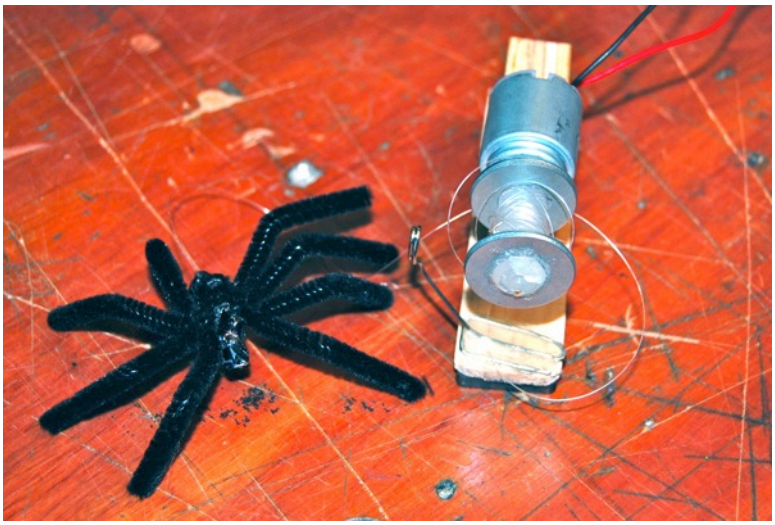
Creepy Crawler

Category: Physics: Force & Motion, Electricity & Magnetism

Type: Make & Take



Rough Parts List:

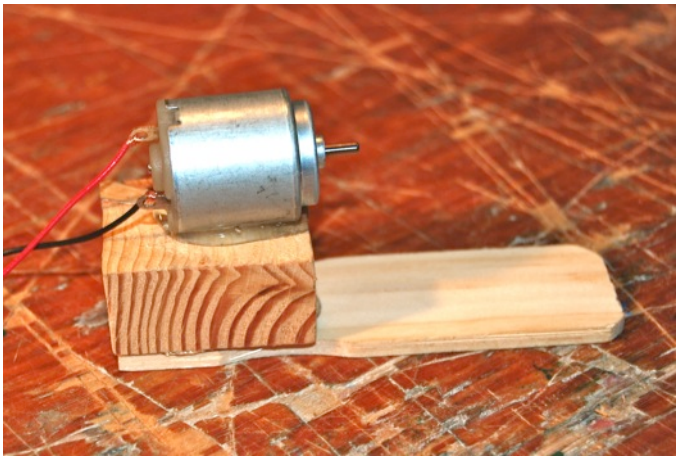
1	Paint paddle
1	Motor
1	Paperclip
1	Thick glue stick, 1”
2	Washers that fit over the glue stick
4	Pipe cleaners
1	Small block of wood
2	Electrical wires
1	Battery
1	Momentary switch, if available
1	Nut, around 5/8”
	Fishing line – as long as you want the spider’s reach to be

Tools:

Hot glue gun
Needle-nose pliers

Video: http://youtu.be/rjzgO9mILt8

How To:



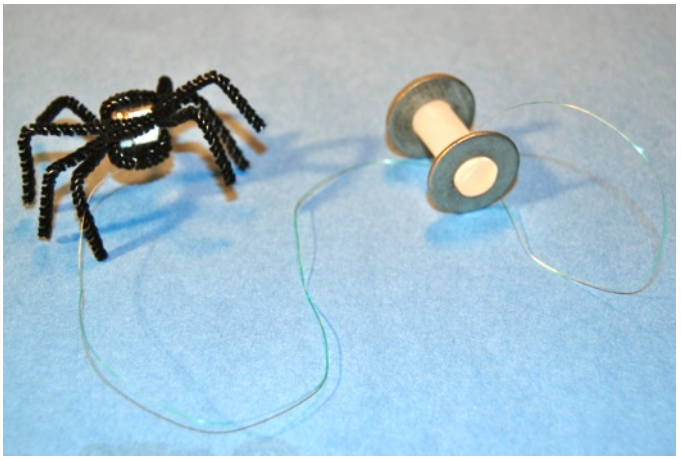
Build a base using a paint paddle and small block of wood. Glue the motor onto the base.

Bend a paperclip into the shape shown here.

Glue the paperclip onto the base as shown.
Wait for glue to cool and dry.

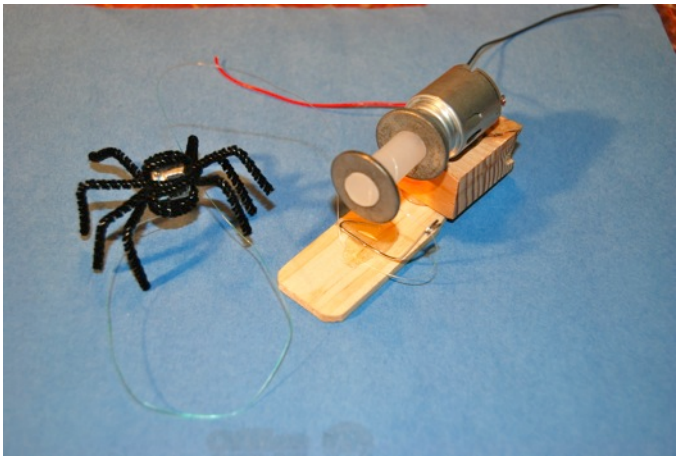
Slide a washer onto each end of the gluestick.

Build a spider by wrapping
pipe cleaners around a nut.



Attach one end of the fishing line
to the spider and the other end to the gluestick.

Push the center of the gluestick onto the motor.
Thread the wire through the
small loop in the paperclip.



Connect the electrical wires to a battery. Put a momentary switch in the system if you have one – if not, you can always manually connect and dissconnect the wire to the battery. Hang the spider over the edge of a table and turn on the motor to watch it crawl upwards!

Fine Points:

→ The end of fishing line attached to the glue stick must stay put! If it spins around the glue stick, then the spider will not move up and down.
→ The weight of the spider needs to be just right so that gravity can pull it down but the motor can wind it up.

Concepts Involved:

- The motor generates a force- a push or pull - on the spider that causes it to accelerate and move up.
- The spider's weight affects how quickly it drops down.

Focus Questions:

1. How heavy would the spider have to be before the motor could no longer pull it up? Try experimenting by adding small weights such as paperclips, binder clips, or more nuts to the spider.
2. How does the weight of the spider affect the speed it is pulled up by the motor?
3. If you connect the motor to the battery in the opposite direction, can you make the spider fall down faster?

Elaboration:

The motor is what causes the spider to "crawl" or be pulled upwards. The motor is using energy from the battery to generate a force. A force is a push or pull. The motor then exerts a force on the string, which in turn exerts a force on the spider. The motor is actually rotating, but the fishing line going around the wheel of the glue stick allows the force to be converted into a linear (up and down) force.

The weight of the spider affects how quickly it moves up and down. The weight of the spider depends on gravity, the mass of the nut and of the pipe cleaners. Force is the product of mass and acceleration. Since neither gravity nor the force created by the motor can be changed, the only way to change the speed of the spider is to change it's mass. With a constant force from the motor, a larger mass will result in slower acceleration, while a smaller mass will result in faster acceleration. At a certain weight, the mass of the spider will exert a larger force on the motor than the motor can exert on the spider which may cause the spider to pull the motor right off the table and fall to the ground!

Heavy items fall almost the same as lighter-weight items, when there is no air to slow them down. We don't usually notice this, because we always have air to slow things down. For thousands of years people – even scientists – thought that heavy things fall faster and light things fall slower. Galileo showed that this was because of air resistance. Take away the air and everything falls the same. Astronauts did this experiment on the moon and found that a feather falls at the same rate as a hammer. Check it out on youtube!

Links to k-12 CA 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.

<u>Grade 2 Standard Set 1. Physical Sciences:</u>
The motion of objects can be observed and measured.
1.c Students know the way to change how something is moving by giving it a push or a pull. The size of the change is related to the strength or the amount of force or the push or pull.
1.d Students know tools and machines are used to apply pushes and pulls (forces) to make things move.

<u>Grade 8 Standard Set 2. Forces:</u>
2.a Students know a force has both direction and magnitude.