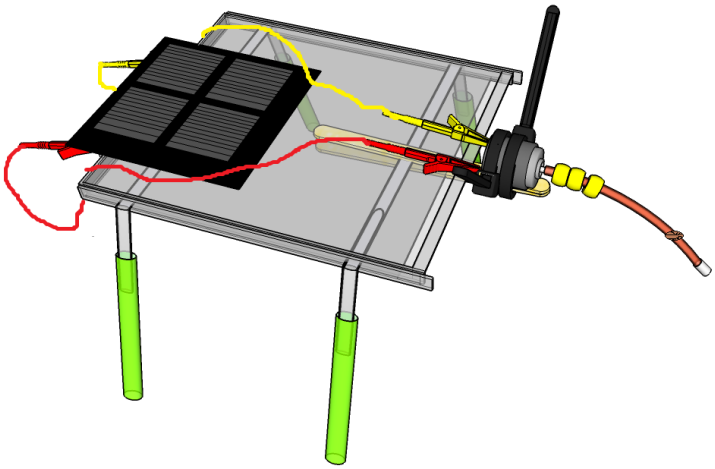
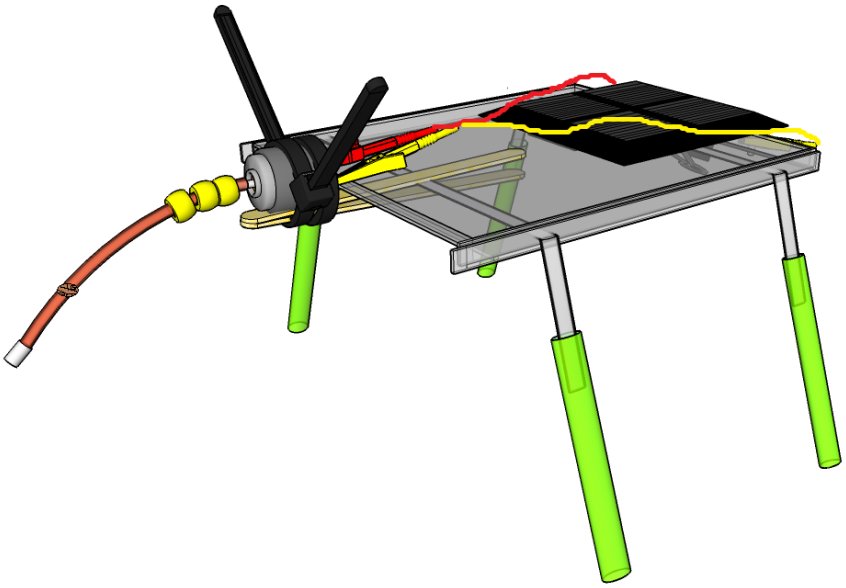
SOLAR JITTERBUG

Shake things up with the power of the Sun!



Create and decorate a “critter” whose moves are powered by sunlight. To vary the critter’s movements explore making changes to the swinging “proboscis”.



Curriculum topics

- Electrical Circuits
- Energy Conversion
- Solar Energy
- Vibrations

Subjects

- Earth & Space Science
- Engineering
- Physical Science

Grade range: 4 – 12

Who we are: Resource Area for Teaching (RAFT) helps transform the learning experience by inspiring joy through hands-on learning.

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http://bit.ly/RAFTkitsurvey

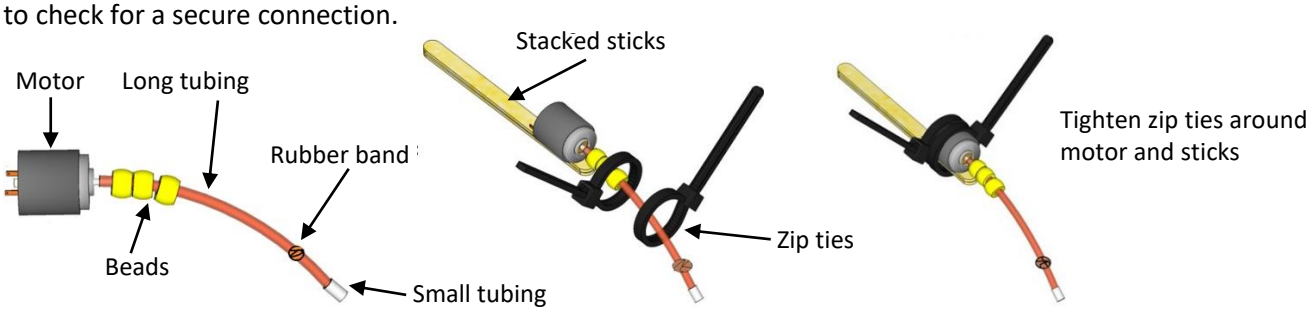
Materials

Materials in the kit may vary but generally, this kit contains the following:

- CD jewel case, regular, clear (1)
- Straws, jumbo (2)
- Straw, super jumbo, 8” long (1)
- Paper clips, jumbo (4)
- Motor, 1.5 volt (1)
- Solar cell (1)
- Craft sticks, regular (2)
- Alligator test leads, 12” (2)
- Pony beads, regular (4)
- Zip ties, releasable, 5” (2)
- Binder clip, small (1)
- Rubber band, thin (1)
- Tubing, 1/8” O.D. x 1/16“ hole x 2.5” long (1)
- Tubing, 1/8” hole x ½” long (1)
- Velcro, adhesive, hooks + loops, ¾” x 1” (1)
- **Recommended:** Eye protection

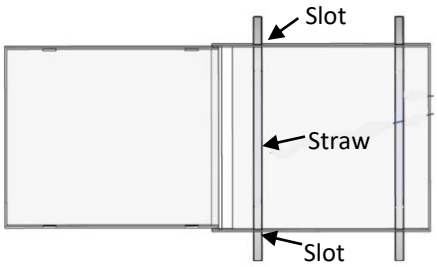
To Do and Notice

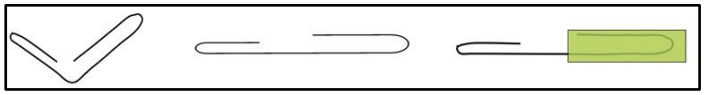
1 Motor Assembly: Push the long, narrow tubing onto the motor shaft leaving a gap; add 3-4 beads, looped rubber band, and small piece of tubing (see below left). Hold the motor assembly and tug on the tubing to check for a secure connection.



2 Stack 2 craft sticks. Add the motor so the shaft is at the end of the sticks. Loop the 2 zip ties and thread over the tubing (see above middle). One at a time, push the looped zip ties over the motor and sticks. Pull the zip tie ends to tighten (see above right).

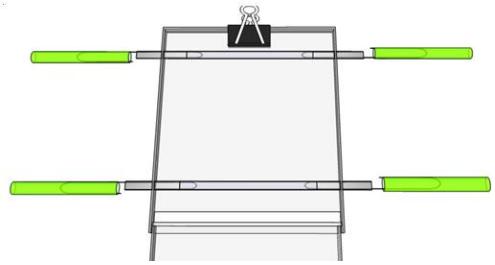
3 Body Assembly: Open CD jewel case and lay flat. Flatten the end of a clear straw and insert through the slots in the side of the CD case (see below). Repeat with 2nd straw.

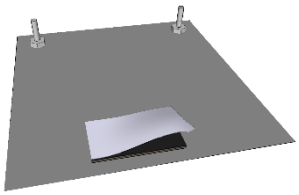


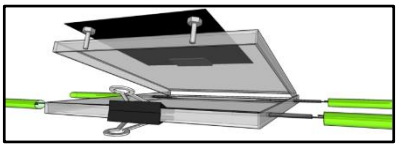


4 Cut colored straw into 4 equal pieces. Straighten a jumbo paperclip into a “C” shape (see above right). Push a piece of colored straw over the wide loop of the paperclip. Repeat for 3 more paperclips.

5 Push the narrow loop of a prepared paperclip from step 4 into a straw end in the CD case. Stop when the small part of the narrow loop is still outside the CD case. Repeat for the remaining 3 paperclips (see below left). Attach a small binder clip to the edge of the CD case.

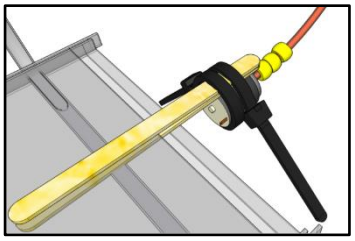


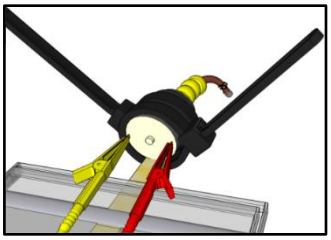


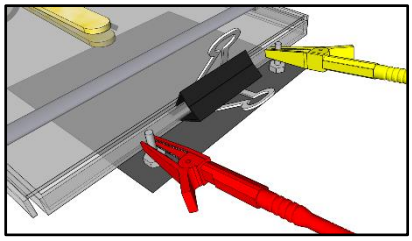


6 Solar Cell Assembly: Join the two pieces of Velcro. Peel the backing off the "loops" (fuzzy) side of the Velcro and attach to the back of the solar cell (see above middle). Peel the remaining backing off the Velcro. Place the solar cell on the CD case and press firmly (see above right).

7 Final Assembly: Turn the CD case over. Insert the motor assembly into the wide slot on the hinge end of the CD case (see below left). One stick fits between the straw and the inside of the CD case – the other stick goes outside the case. Push until the motor is next to the case. Attach wires to motor and solar cell (see below middle and right).







8 Bend the straw legs downward and adjust until bug does not fall over (see image below). Move the motor towards the CD case if needed. Peel the clear film off the top of the solar cell.

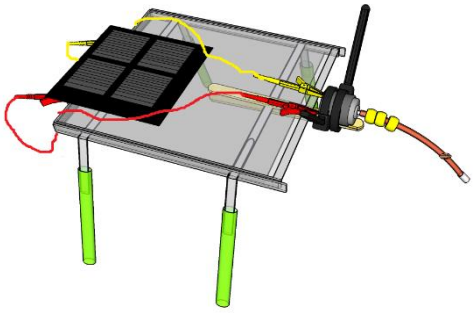
Safety Tip: Wear eye protection when using the Solar Jitterbug. Avoid contact with spinning parts.

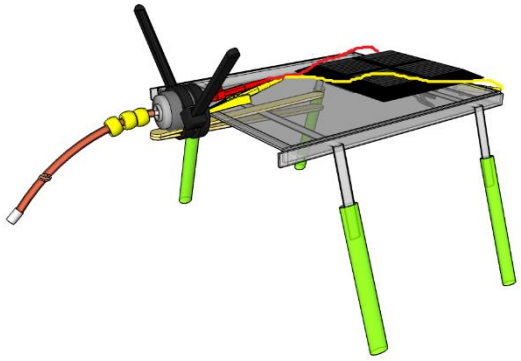
9 Place the Solar Jitterbug in direct sunlight and observe what happens. Try the following:

- Move the rubber band toward or away from the motor.
- Change the angle of the paperclip legs or cut the ends of the straw feet to a different angle.
- Tilt the solar cell by raising the jewel case cover; use the binder clip to maintain the angle.
- Reverse the wires going to the motor to reverse the way the motor spins.
- Compare the Jitterbug motion on different surfaces.

Troubleshooting: If the tubing on the Jitterbug motor does not start spinning when the solar cell is in direct sunlight, check that the alligator clips are securely attached to the metal tabs at the back of the motor and to the bolts on the back of the solar cell. If the problem persists, isolate the problem by swapping the alligator test leads, solar cell, and/or motor with an item that is known to work.

10 **Share** your learning with RAFT! Submit photos/video via email at education@raft.net or on social media (Facebook, Twitter, Instagram).





Core Content Skills:

Science & Engineering (NGSS)

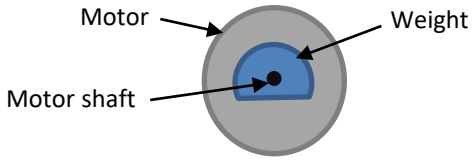
Developing and Using Models, Planning and Conducting Investigations, Forces and Motion, Cause and Effect; Definitions, Conservation, and Transfer of Energy, Constructing Explanations and Designing Solutions, Natural Resources, Human Impact on the Environment

Social Emotional Learning

- Self-awareness
- Self-management
- Responsible decision-making

The Content Behind the Activity

Things **vibrate** when there are repetitive back and forth motions. Vibration often indicates a problem - as when a washing machine vibrates due to laundry being unbalanced (offset). Vibrations can also be useful, as when a cell phone vibrates to gain attention. A cell phone vibrates when a tiny motor spins a weight which is designed so that the weight's **center of mass** is off to one side of the shaft of the motor (as shown).



In the Jitterbug the beads on the curved tubing act as an offset weight. When the beads on the tube are farther away from the motor (more offset) the motor will spin more slowly, with larger movements, as the motor must work harder to turn a weight that is farther from the motor shaft. When the beads are closer to the motor (have less offset) the motor will spin faster as the motor does less work moving the weight. When the motor spins faster the vibrations happen more often, have a high **frequency**, but the movements are smaller, have a smaller **amplitude**.

For the Jitterbug to move, rather than just vibrate in place, the feet of the Jitterbug need to be jerked out of position. The surface below a foot needs to be smooth enough so a vibration will move the foot, but rough enough so the foot does not slide back into the original position. Many variables can affect the movement of the Jitterbug along a surface.

Reuse

This kit uses 100% reusable materials designed for other uses. To continue making a positive impact in reducing waste, reuse these materials in other projects. Additionally, any unused materials can be collected and delivered back to RAFT.

Feedback

Please comment on this kit by taking this short survey: http://bit.ly/RAFTkitsurvey. Let us know of any material concerns (missing, broken, or poorly fitting parts) as well as any suggestions for improvement.

Visit https://raft.net to view related activities!
Simple Motor
Solar Cell Demonstrator
Solar Cell Sandwich

Resources

- How do solar cells work? - https://bit.ly/3rUGKH7
- How do electric (DC) motors work? - https://bit.ly/3u7Loo4