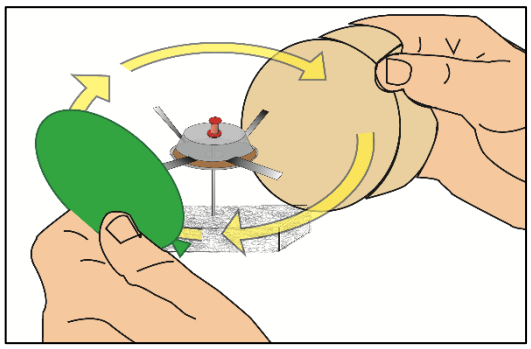
STATIC MERRY GO ROUND

Make and power a version of the first electric motor!



This unique adaptation of the world's first electric motor lets students create spinning motion using only hand-generated static electric charges.

Curriculum topics

- Static Electricity
- Experimental Variables
- Momentum
- Electrically Charged vs. Uncharged

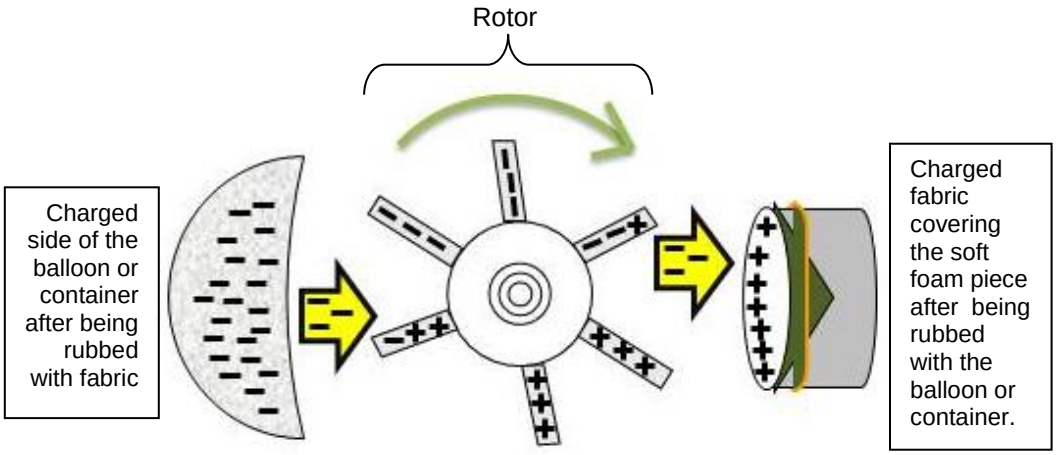
Subjects

Physical Science

Grade range: 4 – 12

Serves: Each kit can be used for individual students or small groups depending on the intended outcomes determined by the facilitator.

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



Tip: The ability to produce a sustainable a static charge varies with temperature and (especially) humidity! To double check: 1) Rub inflated balloon on clean fabric or hair; 2) Place rubbed side of balloon against a wall; 3) Let go! 4) If the balloon stays in place – then the static motor should rotate.

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Materials required per static motor

- Thin straw section, 3 ½" long (x1)
- Wood screw, Philips head size #4 (x1)
- Stiff foam base (x1)
- Pushpin (x1)
- Sports bottle cap (x1)
- Reflective Mylar (x1)
- Rubber band that fits around cap rim (x1)
- Fabric square, 4" x 4" (x1)
- Soft foam piece (to hold fabric) (x1)
- Rubber band for soft foam piece (x1)
- Container, polystyrene (x1)
- Balloon (x1)
- Tools: Scissors, ruler, poking object (not included)

WARNING: Children under 8 yrs. can choke or suffocate on uninflated or broken balloons. Adult supervision required. Rubber bands and balloons contain natural rubber latex which may cause allergic reactions.

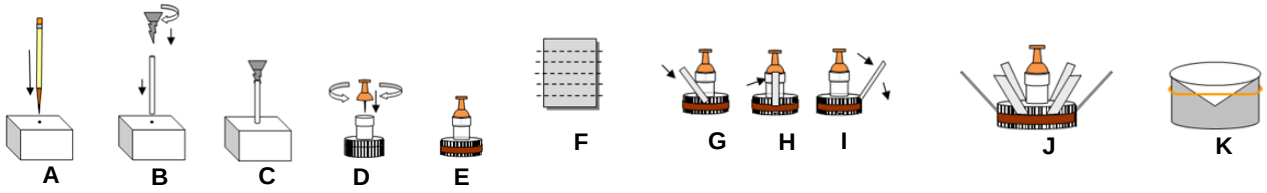
Set-Up

1. Make a small starter hole in the center of the stiff foam by poking it with a pencil or similar object (**A**). Insert the thin straw into the starter hole so that the straw stays upright (**B**). Twist the pointed end of the screw **part way** into the end of the straw (**C**).

2. Position the pushpin over the center of the sports cap and slowly push the pushpin straight down (**D**). Place the rubber band around the cap rim (**E**).

3. Cut the Mylar® rectangle to make 6 vanes, each ¼" wide by 1¼" long (**F**). Position one vane at a 45° angle (**G**). Tip the strip upright and bend it to create a crease (**H**, **I**). Insert and bend the remaining vanes under the rubber band. The completed merry go round looks like (**J**) below.

4. Drape the fabric square over the soft foam piece, letting the corners hang over the sides. Place a rubber band over the corners to secure the fabric to the foam (**K**).



To do and notice

1. Assemble the motor by tipping the cap and inserting the point of the pushpin into the cross on the head of the screw. Hold the pieces together to retain the alignment while placing the base onto a flat surface.

2. Hold the foam piece in one hand so that the fabric faces outward. In the other hand hold the balloon or container. Briskly rub the fabric and the balloon/container together. Note: The rubbing process will need to be repeated frequently.

3. Touch each vane with your finger to neutralize any charge imbalance. Bring the freshly charged balloon/container very near to one of the vanes (see illustrations on title page). What happens?

4. Rub the balloon/container with the fabric again and place the balloon/container on one side of the motor and the fabric on the other. Vary the position of the fabric and balloon/container for best effect. Repeat the rubbing as needed. With practice, the motor will rotate continuously!

Core Content Skills:

Science & Engineering (NGSS)

Definitions of Energy

Conservation and Transfer of Energy

Forces and Interactions

Defining Engineering Problems

Planning and Carrying Out Investigations

Applying Scientific Ideas to Solve Design Problems

The Science Behind the Activity

Touching two items together and then separating them can move electrons from one item to the other. The item that gains electrons will have a net negative (-). The item that loses electrons will have a net positive (+). Note that electrons are moved, not created, in this process! Charges will "stay put" unless the item is a conductor, like the Mylar used in this activity, that lets electrons move about easily.

Opposite (unlike) charges (+/-) are attracted to each other. Same (like) charges (+/+ or -/-) are repelled by each other. The forces of attraction and repulsion become greater when the distance between the charged items becomes smaller.

When a Mylar® strip moves near enough to a charged item, some electrons can bump over the gap. Some electrons will move toward the Mylar® from a negatively charged item or from the Mylar® toward a positively charged item. Either way, the Mylar® will end up with the same charge (+ or -) as the nearby charged item. A Mylar® strip, which can rotate, will be repelled from the charged item. The strip is now strongly attracted to the oppositely charged second item. When a charged strip moves near enough to the second item, some electrons are again transferred. The Mylar® strip now acquires the same type of charge as the second item. The strip is now repelled from this second item but will be attracted to the first charged item. The Mylar® strip continues rotating due to momentum. When a Mylar® strip rotates near the first charged item, the process repeats. The attractive force changes to a repelling force and the Mylar® strip rotates away, repeating the cycle.

Learn more

- Have students first build and explore a motor with only 1 vane.
- Explore other materials that can be rubbed together to generate a charge imbalance.
- Use extra vanes to create new versions of the rotor.
- Instead of placing both the fabric and balloon/container near the motor, substitute a finger for one item. What happens differently?

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. 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 such as missing, broken, or poorly fitting parts as well as improvements or other suggestions.

Resources

- Benjamin Franklin's electric motor - https://bit.ly/3bRGek8
- Background info on static electricity - https://bit.ly/2Ymv5DT