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Bruce Museum @ Home
STEAM Activities for Children

Lesson # 4: *Speed Demon – Making a Rubber Band Motor*
Week of April 13, 2020

During the Bruce Museum's closure to the public to help combat the spread of coronavirus in our community and beyond, Museum educators from the Audience Engagement Department are creating weekly STEAM activities for families with children to do at home.

Below, Corinne Flax, Manager of School and Community Partnerships, continues the series with a new activity for children to learn more about displacement, buoyancy, and how we can use engineering principals to harness energy for movement.

Speed Demon- – Make a Boat Motor

This week's STEAM activity builds on concepts covered in the last three weeks' lessons. Last week, your learners created sailboats that took advantage of the energy created by a fan. This week, learners will create a sturdy boat that can support the unbridled energy of a rubber-band powered motor. Your learner will need to use their science journals once again this week; if they haven't made one yet, go back to Week 1 for instructions on how to make a journal.

In order of appearance, this lesson contains: a materials list for Speed Demon and an associated art activity, general instructions for Speed Demon, ways to add-on to the activity and open-ended question ideas, a brief art activity, and NGSS Performance Expectations.

Absolutely necessary materials: pencils, paper, water containers, science journal, rubber bands, scissors, ruler or another straight edge.

Materials to choose, depending on availability (most of which are in your recycling bin): cardboard, soda bottles, Popsicle sticks, electrical tape, duct tape, Styrofoam trays.

Art project materials: paper egg cups, primary color paints, paint brush, unsharpened pencil, scissors, playdough, tape or glue.

Instructions for making your boat: This week, learners will make rubber-band motor boats. These will be tricky, as the boats will need to have a rigid construction to support the

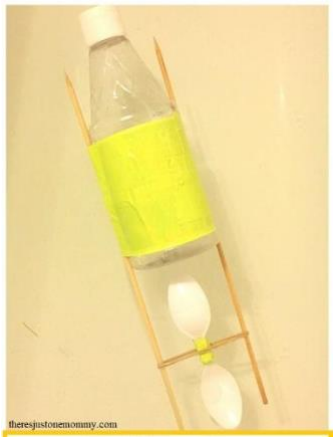
movement of the motor. Cutting out the boats, making the motors, and creating the rigid construction necessary to support the motors as they work is complicated. This project may need more oversight from an adult than the previous three lessons.

The steps that your learner will take to create their motor boat are dependent on whether or not you're making your rubber-band motor from Popsicle sticks or from cardboard. Your learner should use their science journal to sketch out their plans for their motor. They should also list questions they have for what, why, and how the motor will work, any challenges they think they may face, and anything they want to try.

Note: Watch out for flying rubber bands. If you feel more comfortable having your learner wear protective gear, sunglasses are a good substitute for protective goggles. If you have the time, it can be helpful to have pre-built a boat with a motor when presenting the lesson, as it helps students visualize what they will be working on.

Popsicle Stick Rubber-Band Motor

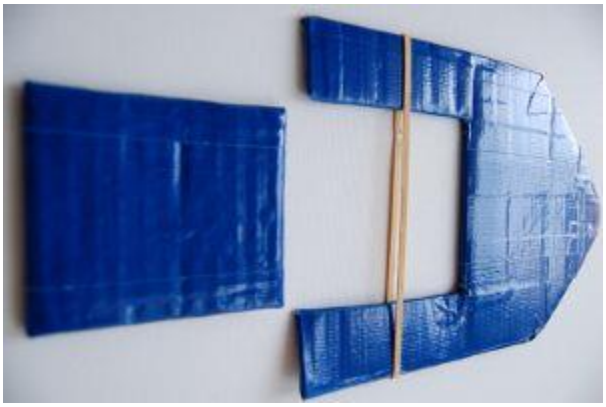
On the right is a Popsicle stick motor, it was made by gluing three Popsicle sticks together into a U shape. On the open end of the U, stretch a rubber band. Once this structure is dry and stable, slot a fourth Popsicle stick through the rubber band so that it makes a T or cross with the rubber band. Spin the Popsicle stick around, until the band is wound tight. The tightness, and subsequent release, of the rubber band is the transfer of your own energy into the rubber band. When you release the fourth Popsicle stick, that energy will express itself by causing the Popsicle stick to spin around quickly; this is what will power the boat. Once this motor is built, it can be attached to a boat made of almost anything, from plastic soda bottles to Styrofoam plates, making these materials into a mini power boat. The only limit to the boat making is the materials you have on hand.



Whatever your learner uses to make their boat will have to support the tension created by the engine, while also staying

afloat in water. There is no one way to design; the end result is what's important. This is when the science journal will come in handy, as notes from previous boats and from throughout this project will help your learner create a working motor boat.

Cardboard Rubber-Band Motor



Not everyone has Popsicle sticks at home, so even without Popsicle sticks a rubber band motor is still within reach. In this design, the motor and boat are essentially the same thing. Find a large piece of cardboard and, using a ruler or straight edge, draw a rectangle on one end, leaving extra space on either side. On the other end, draw a shape like the front of a boat; see photo on right. Cut out the rectangle and set that piece aside; this is what will eventually become the propeller, or motor, of your boat. Cut around the boat-shaped lines and set this piece aside. Take the rectangle that you cut out earlier and trim it so that it will have room to move freely when it is placed back into the space you cut it. The rectangle should have space on either side of it as it sits between the 'legs' you cut out. Slip the rubber band onto the legs of your boat shape, so that it stretches across either side of the empty space you cut out. Place the propeller (the rectangle you cut out and trimmed,) into the rubber band, wind it up, and let it go. Does it move freely? You might find that you need to trim it a bit more if your propeller does not spin freely.

Once you've slotted in your cardboard rectangle and it can move easily, your boat is ready to take to the water.

Note: To waterproof your cardboard, cover it in duct tape or electrical tape. This won't work forever, but it will give your boat a longer life in the water.

If you have all the materials for both the Popsicle stick and cardboard rubber-band motors, challenge your learner to make two and compare the process of making each. They may also want to experiment with their own design concepts for creating a motor, which is highly encouraged.

Inquiry questions to help your learner add to the activity:

- What was the most complicated part of the design?
    - What did you learn that might make it easier in the future?
- What worked the best for you?
    - Why do you think this was?

- What worked the worst?
    - How might you change this in the future to make it work better?
- How do you think these boats are similar to real motorboats?
- How do you think these boats are different from real motorboats?
- Try timing your boat – how long does it take to get from one side of the water container to the other?
    - Can you make it go faster?
    - Can you make it go slower?

Craft Project: Red Light, Yellow Light, Green Light, GO!

Now that your learner has a rip-raring speed boat, they need a stoplight to tell them when it's time to get going. This simple paint project will provide your learner with that light.

- Cut out three stacked egg carton cups.
- Glue or tape them onto a popsicle stick or pencil
- Have your learner paint the inside of the cups red, yellow, and green.
    - If you don't have green paint, it can be mixed easily from yellow and blue.
    - If you don't have paint you can use scrap paper from magazines or circulars and collage in the color.
- Stick the base of your stick or pencil into a small piece of playdough or use another cup from the egg carton to make a base.

NGSS Performance Expectations

K-PS2-1 Motion and Stability: Forces and Interactions
Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

K-PS2-2 Motion and Stability: Forces and Interactions
Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

2-PS-2 Matter and It Interactions

Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

3-PS2-1 Motion and Stability: Forces and Interactions

Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

K-2-ETS1-2 Engineering Design

Develop a simple sketch, drawing or physical model to illustrate how the shape of an object helps its function as needed to solve a given problem.

K-2-ETS1-3 Engineering Design

Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

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