WIND RACERS
Duration: 5-30 minutes
Institution: Science Museum of Minnesota
Skill level/Age Level: K- Grey
Group size: 1-6 depending on how many sail carts you have available

INTRODUCTION
Wind racers is a fun activity that helps visitors play with moving air and transform it into doing work. Using sails and small-wheeled carts, they explore how wind can be used to move a boat or in this case a cart or a wind racer. Visitors construct a wind racer using paper for sails, dowels, and small-wheeled carts. There is a smooth raceway path with a fan blowing from one end of it on which the visitors will race their creations or see how far they can make it.
KEY CONCEPTS AND/OR SUBJECT AREA (STYLE: HEADING 1)

Air is something we interact with, and although it is not usually visible, it has force. Sails are things we make that use the wind to capture a force to move a boat or other vehicle. Sails are normally built from a flexible material to allow the sail to work from either side with the wind.

The mainsail is a larger sail that captures the bulk of the wind power necessary to move the sailboat. Its vertical side is attached to the mast, a long upright pole, and its horizontal side can be connected to the boom, a long pole parallel to the deck.

Air pressure is a force that is created around the sail when it meets the wind. When a sail is angled into the wind it curves. Some of the air in the wind moves along the inside of the sail (the windward side) and some air moves along the curved outside of the sail (the leeward side). The air traveling along the leeward side has a longer way to go than the air on the windward side, so it has to go faster and that means the air pressure is higher on the leeward side. The sail “lifts,” or moves, toward the lower-pressure side causing the boat to move.
MATERIALS AND TOOLS (STYLE: HEADING 1)

Essential Materials:
• 6-8 Wind carts with holes drilled on top to fit the dowels (masts) for sails
• ¼” Dowels in a range of lengths to be used as masts
• Assorted brightly colored paper cut from 8 ½ “ x 11” sheets (5 ½ x 8 ½ “, 4 ½ “ x 5 ½ “)
• Aluminum foil sheets 4” x4” to 6”x6”
• Thick, brightly colored yarn pieces 4-6” (for tying sails)
• ½ “to ¾” binder clips (these help to clip on yarn or aluminum foil)
• Child scissors and hole punchers
• Information binder with supplemental sail documents
• Fan

Optional Materials:
• Raceway (folded in sections) Textured plastic sheeting provides a non slip smooth surface for carts rolling
• Wind Racers tabletop sign
• Red gaffers tape – only to be used to tape raceway down (not a construction material)

SET UP
• Set up paper, scissors, hole punchers, sticks, cars and sign on the table

• Layout raceway a few feet in front of the table where the fan can reach it if it is plugged in. Make sure there is room around either side of the raceway between the building area and the raceway and that the raceway is secured with red tape
• Plug in the fan and place it on one end of the raceway. Set the fan to speed 2 and make and test a wind racer

Note: table setup should not be super neat and tidy, a little messiness and a lot of materials on the table will be more inviting and interesting to guests who come and play.

HOW TO OR STEP-BY-STEP (STYLE: HEADING 1)

Many guests will be excited to begin building as they come up to the table. The best method with this activity is to let the guests build a wind racer and try it out. From there you can ask questions as to how their wind racer moved or performed and then encourage them to continue experimenting by making adjustments to the wind racer – adding more sails, adjusting them or even making a new one.

STAGE ONE: BUILDING THE WIND RACER

1. Gather your materials. Get a cart and then think about how many sails you want. Get enough dowels and paper to construct them.
2. Make sails. You can modify sails with scissors or hole punchers. You can also pick sails that have already been made.

3. Insert dowels into the car wherever you think will be the best position

4. Fasten sails onto the dowels, or masts, by using the hole punch to create holes that the mast can go through and be used to attach the sail to it

5. Once all of your sails are attached, it’s ready to race

6. Talk with the guest and ask why they made certain choices while building their racer and how they think those components would help it travel a long distance

**STAGE TWO: RACING**

1. Place the wind racer at the end of the raceway closest to the fan
2. Let go! and see how the wind affects its motion and direction

**FACILITATION TIPS**

Observe and record how far the wind racer makes it down the raceway. If the guest is interested in beating their previous distance you can mark their distance with tape so they can beat it the next time.

Discuss with the guest what made their racer go as far as it did noting their creativity for how they built it. Encourage them to try again and make the racer go further down the track.

1. Can you build a wind racer that can get to the end of the track?
2. How do you think the size or number of sails affects your racer?
3. What would happen if you filled all the sails?
4. Have you ever been on a sailboat or seen one?
5. Have you ever wondered how the sails work?

**MATERIALS SOURCES**

The wind racers are built from 2”x4” cut to 10”, shaped and sanded with four ¼ “ holes drilled using a drill press for 90 degree holes (so that all the holes are parallel) for wheel axles. The wooden wheels and peg axles were bought at a craft store. Metal and nylon washers are used between each wheel and the body of the cart. The top is drilled with a large number of holes using a drill press with a 1/4 “ bit to accommodate ¼ “ dowels for the masts.
MORE INFORMATION

**Online resources:**
How Does A Sailboat Actually Work? - YouTube

*A great video on youtube with interviews and discussions about how sailboats move*

How a sail (and wing) works: A wing deflects air down. As the air is pushed down, the wing is pushed up. The force that pushes the air down is the same force that pushes the wing up. Compare to: When you are standing on the floor there is a force supporting you, and a force pushing the floor down. This is the same force. http://www.sailtheory.com/sail.html

**Museum Resources:**
At the Science Museum of Minnesota visit the *Experiment Gallery* to find wind related activities such as “Streamline & Turbulent Flow” and “Aerodynamics Lab

**Community Resources:**

**Activity to do at home:**
You can figure out how a sail works by putting your hand outside the window of a moving car. When you hold your palm open and flat to the wind, your hand will be forced back. (That’s how a sailboat moves forward when the wind is directly behind the boat and the sail is fully let out.) Now turn the side of your hand toward the front of the car and cup your fingers. As you try out different angles of approach to the wind, you will feel more or less pressure on the palm and the back of your hand. That's how changes in the fullness of a sail can change the degree of forward motion created.