Wind Racing

Project Description:

Gear up for an exciting workshop where creativity meets the power of the wind! Students will discover the fascinating concepts of wind power, energy, thrust, and drag in a fun and engaging way. They'll put their engineering hats on to design, build, and test their very own land wind racers. Will their creations speed across the finish line or take an unexpected turn? There's only one way to find out—let the winds of science guide the way!

Time	Suggested Age	Suggested Group Size
Preparation: 15 minutes Activity: 60-90 minutes	☑ Elementary ☑ Middle School ☐ High School ☐ Adult	☑ Individual ☑ 2-5 ☐ 6+

Materials & Preparation:

Tools & Materials	Space Requirements	Supplemental Files
<u>Per vehicle</u>: 1 straight straw 3 hard candies with a center hole Vehicle template Printed instructions Single hole punch Scissors <u>Per person</u>: 1 straight straw (for blowing)	☑ Indoor ☑ Outdoor *Indoor recommended Size Needed: • Workspace with tables and chairs to build vehicles • Open area 10-15 feet long for testing	*The following files are available on the AFS website by searching for the project title: Wind Racing-Elementary.* *Wind Racer Vehicle Instructions (pdf) *Wind Racing Presentation-elementary level (pptx) *Wind Racer Pictures (pdf)

<u>Presentation</u>:
Yard stick or measuring tape
Painters tape or chalk
Sails (Diagrams #1, #2, and #3)
Small blocks of wood
Extra straws

<u>Additional Materials</u>;
Different sized straws
Paper (variety of sizes weights)
Extra hard candies (Wint O Green Lifesavers® work well)
Clear tape and paper clips
Crayons or colored pencils

<u>Preparation</u>:

- Mark the testing zone with a starting line and marked 1 foot increments using painters tape or chalk.
- Fold and label pieces of paper according to Diagrams #1, #2, and #3.
- Prepare a projector and appropriate projection surface if using the Wind Racing Presentation (elementary level) Microsoft PowerPoint® file (pptx).
- If not using the PowerPoint slides, you could gather photos of objects that can be moved by the wind, including a land sail racer. The Wind Racer Pictures (pdf) file has photos you could print out.

Introduction:

Ask: *What kinds of objects are moved by wind?*

List the participants' answers.

Compare the participants' list with the photos (in the PowerPoint, or those you prepared). Note: The last photo should be a land sail racer.

Science Background:

Thrust and Drag

Ask: *How does the wind make things move?*

- Wind is energy (power).
- It's harder to walk against the wind – you have to use more energy to walk forward. It's easier to walk with the wind – you can use some of the wind's energy to help you walk forward.
- Two types of forces affect movement: thrust (forward energy) and drag (resistance to movement)
- To make something move forward, thrust must be stronger than drag.

Demonstration: Show the block of wood sitting on a smooth surface.

Ask: *What would it take for the wind to move this block of wood?*
Demonstrate creating "wind" by blowing through a straw to show the block doesn't move.

Ask: *What would need to change for the wind to move this block of wood?*
Answer: Increase the thrust or reduce the drag.

- Demonstrate how to reduce drag by using rollers (straws) under the block.

Participant Action: Let the participants try to move the block with and without the rollers.

- Which way has less drag and is easier to push?

Suggest further experiments:

- What happens if more than one person blows on the block at the same time?
- What happens if the straws are spaced further apart?
- What happens if the block is set on its side or end?
- How do thrust and drag explain what is happening?

Variations:

If you have limited time, eliminate one of the demonstrations.

If you have additional time, you can include more instruction or experimentation regarding thrust and drag.

Ask: *How could we capture more of the wind energy to move something?*
Answer: Add a sail.

Demonstration: Show the three "sails" lined up on a smooth surface.

Ask: *Which one will move the furthest with one puff of wind?*
Blow through the straw on each piece of paper. Explain:

- Sail #1 has no sail to capture the wind energy (not much thrust) and the most drag (the whole sheet rubs against the floor).
- Sail #2 has a small surface area for the wind to push against (this is a tiny sail, giving a little more thrust) and less drag (a smaller area rubs against the floor).
- Sail #3 has the largest sail (the most thrust) and the least drag.

Project:

Ask: *What kinds of vehicles are moved by wind?*
Show pictures of vehicles used earlier (balloon, sail boat, land sail racer). Explain: Land sailing and sailboat racing both use wind to power the racers and are competitive sports. Engineers understand how to harness the wind and reduce drag to get the most energy (thrust) out of the wind power.

Today you will be an engineer that builds a land racer. You need to build a racer that moves across the track using only wind as the source of power. You will get to test your vehicle to see how successfully it races.

Participant Action: Provide each individual or group with materials to build their racers (1 straw, scissors, 1 template, hole punch, 3 candies). Demonstrate how to build the racer and assist as needed.

Variations:

Use crayons or pencils to decorate the racers.

Experiment with different sizes or shapes of sails to see which one is most effective.

Experiment with other supplies (tape, extra wheels, extra straws, paper clips, etc.) to see what makes the racer most effective.

Experiment with how and where to blow on the sail to maximize thrust.

Testing: Participant Action: As each individual or group finishes their racer, they can move to the testing zone.

- Test the racers by setting them at the starting line and blowing on the sail through a straw.
- Measure the total distance the racer moves.

Variations:

Hold races to test which vehicle goes the furthest or fastest.

Experiment with other sources of thrust such as a fan, canned air, etc.

Wrapping Up: Ask: *Did you get the outcome you were looking for?*

- *What could have changed the outcome?*
- *What did you learn about thrust and drag?*
- *Do you have follow up questions?*

More Resources:

- Landsailing Oregon's Alvord Desert by Oregon Field Guide
  https://www.youtube.com/watch?v=OcoCIJ-1X7Q
- Let's Go Land Sailing! by Outdoor Nevada S2 Ep 1 Clip
  https://www.youtube.com/watch?v=lx2TN35RWxg
- The Physics of Land Sailing by Shirley Robertson (CNN)
  https://www.cnn.com/videos/sports/2014/08/14/spc-mainsail-land-sailing-c.cnn
- Speedy Sails by Edinburgh Science Festival
  https://www.youtube.com/watch?v=F-iDqJMz4CY
- Young Engineers: Wind-Powered Sail Car - Easy DIY STEM Activity for Kids by STEM Inventions
  https://www.youtube.com/watch?v=mvTV1irGk6M
- Land Sailing: Experiments and Background Information by Julian's Science Experiments
  https://www.juliantrubin.com/encyclopedia/aviation/land_sailing.html

#1 - FLAT

FOLD

#2 - SHORT SAIL

FOLD

#3 - TALL SAIL

How to Make a Wind Racer

Introduction:

Making a Wind Racer is wholesome fun that takes only a few minutes to do, but can be entertaining for hours. It can be an activity you do on your own or even with a group of friends. There are many ways to make a Wind Racer, and the instructions below show just one of those ways. Follow the steps carefully to build your own simple, fun, quality Wind Racer!

Materials Needed:

Printed Wind Racer template
Scissors
Ruler
Hole punch
Hard candy with a hole (Wint O Green Lifesavers® work well).
Straw*

*If you use a bendy (flex) straw, you will need 2 of them.

Warnings:

Be aware of sharp edges and paper cuts.
Remember not to run with scissors.

Steps:

Figure 1

1. Cut a 2 inch piece off the straw (see Figure 1). Set aside the two pieces of the straw for steps 6 and 8.

Note: If you are using a bendy straw, you will also need to cut a 6 inch piece off the second straw.

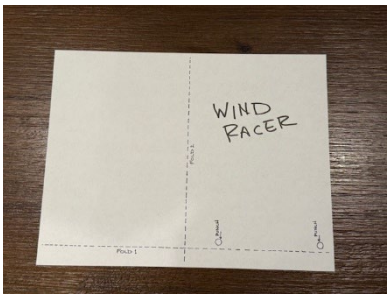

Figure 2

Note: It is ok to turn the paper to make folding easer.

2. Fold the template (paper) on the FOLD 1 line (see Figures 2 and 3).

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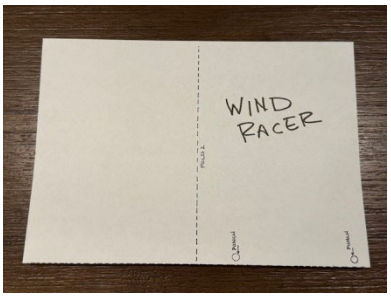


Figure 3

Note: The paper should look like Figure 3 after you finished Step 2.

Figure 4

3. Fold the template (paper) on the FOLD 2 line (see Figure 4).

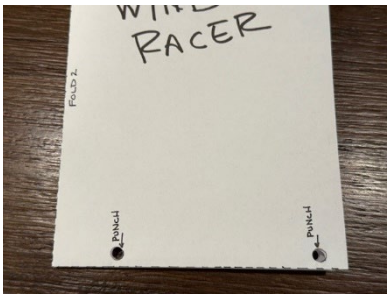


Figure 5

4. With a hole punch, punch out the 2 holes marked "PUNCH" on the template (see Figure 5).

Figure 6

5. Open the template (paper) card style (see Figure 6).

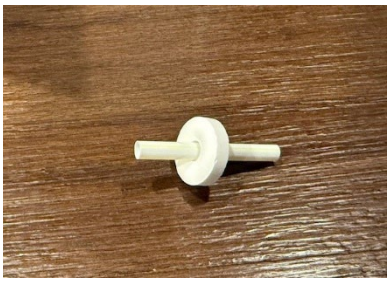


Figure 7

Note: You will now add the wheels to the Wind Racer.

6. Place 1 hard candy on the 2 inch (short) straw (see Figure 7).

Note: this will be the front axle of the Wind Racer.

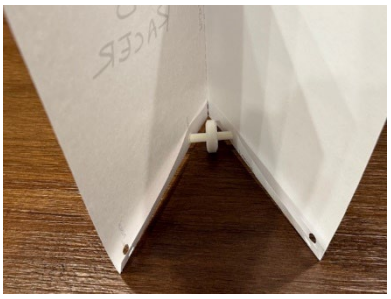


Figure 8

7. Insert the 2 inch straw into the two holes closest to the card center (see Figure 8).

Note: The hard candy should be between the holes in the template.

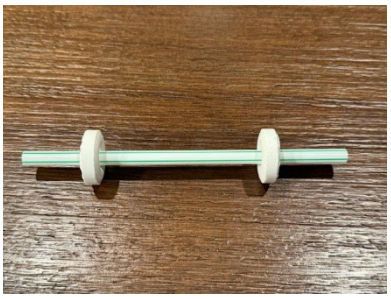


Figure 9

8. Place 2 hard candies on the 6 inch (long) straw (see Figure 9).

Note: this will be the back axle of the Wind Racer.

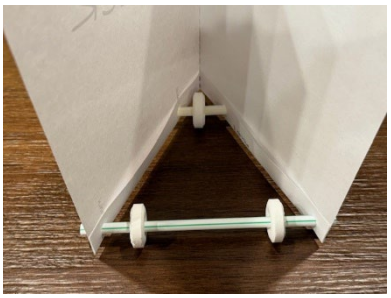


Figure 10

9. Insert the 6 inch straw into the two holes furthest from the card center (see Figure 10).

Note: The 2 hard candies should be between the holes in the template.

10. Slide the 2 hard candies away from each other along the straw to balance the Wind Racer (see Figure 9).

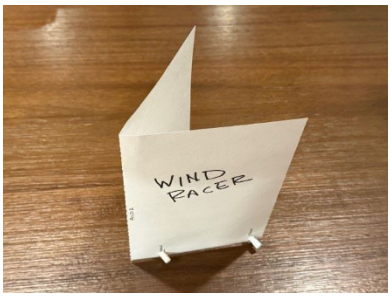


Figure 11

11. Set the Wind Racer on an open, flat surface with the wheels (hard candies) down so they can roll freely (see Figure 11).

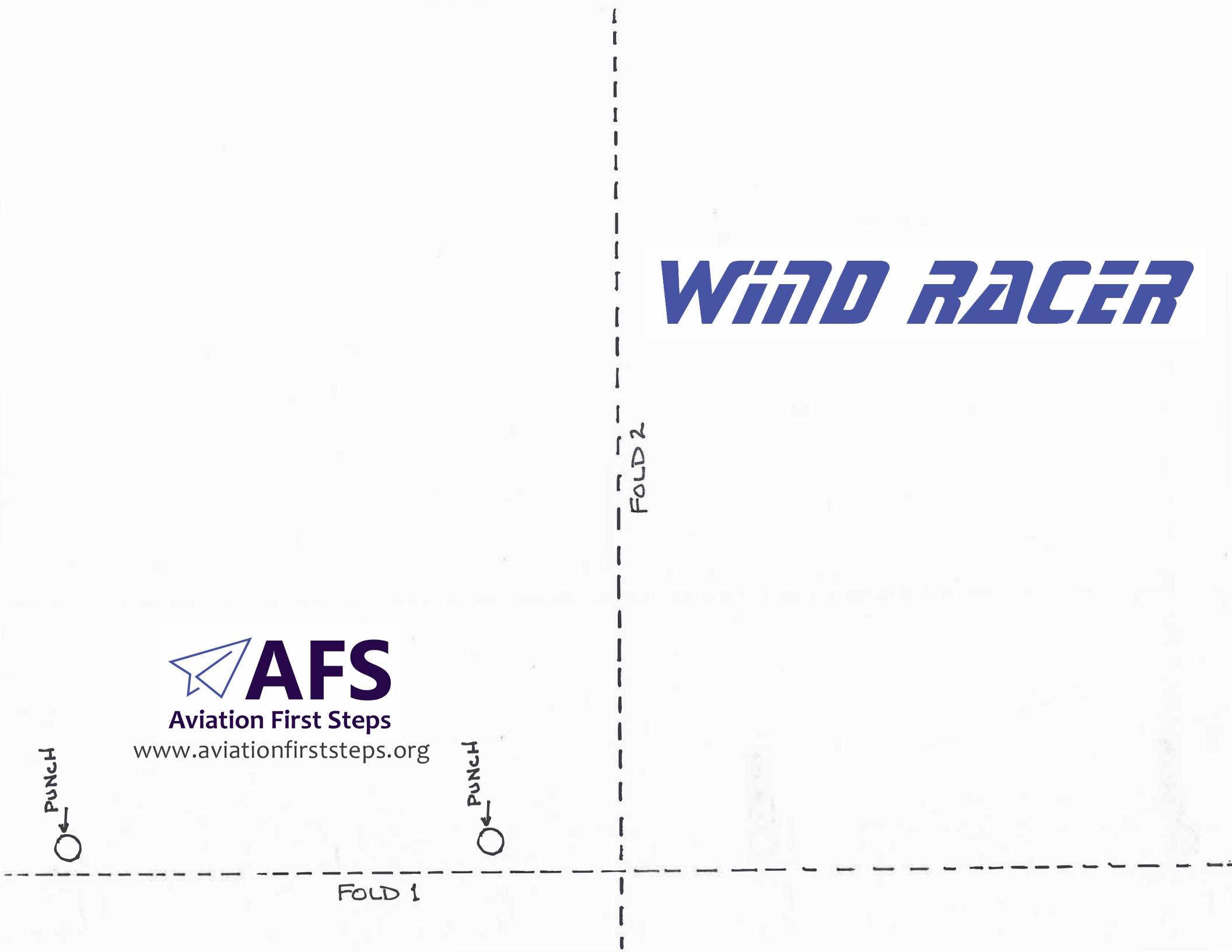
12. Blow into the paper sail and watch how it goes. Have fun!

Have a contest with your friends to see whose Wind Racer will go the farthest.

⚠**Warning** – Rapid exhaling may cause dizziness.

♻Please Recycle

WIND RACER


FOLD 2
AFS
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PUNCH
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