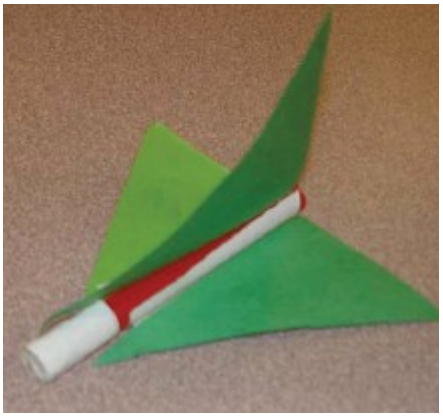
Name: _____

Pneumatically-Powered Toys Lab Activity
SPH4C

Part 1: The Straw Dart

Materials: large straw, small straw, masking tape, sturdy paper, scissors

Directions:



1. Cut the large straw to the desired length and cover one end of it with tape.

2. Cut out three triangular-shaped fins and use the tape to attach them to the dart as shown. (The long end of the find should be near the open end of the dart.)

3. Insert the smaller straw into the dart and blow through the small straw to propel the dart. (Do not launch the dart at anyone.)

   When you have a functional dart, please demonstrate it to your teacher and ask your teacher to initial this space:

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Calculations:

You can estimate the initial speed v of the dart by determining the horizontal distance Δd it travels when launched horizontally from a given height h (and remember $g = 9.8 \frac{m}{s^2}$):

$$v = \Delta d \times \sqrt{\frac{g}{2h}} \quad =$$

The force on the dart of mass m and length L was therefore:

$$F = \frac{m v^2}{2L} \quad =$$

The pressure on the dart of radius r was therefore:

$$p = \frac{F}{\pi r^2} \quad =$$

Part 2: The Wind Turbine

Materials: small prescription bottle or film canister, straw, wooden dowel, cardboard, masking tape, scissors, awl

Directions:

1. Cut the straw in half.

2. Using the awl, carefully poke a hole in the lid of the bottle or canister and insert the straw. The straw should not be loose.

3. Insert the dowel rod into the straw. It should poke out at least 4 cm above the straw. (Trim the straw if necessary.) The dowel rod should be loose in the straw.

4. Use the scissors to cut from the cardboard two circles about 5 cm in diameter. Using the awl, carefully poke a small hole in the centre of the circles.

5. Place the cardboard disks on the dowel rod, about 2.5 cm apart.

6. Take two pieces of masking tape, each about 3 cm long, and attach them to the cardboard disks as shown in the photo at right. The pieces of tape should bow out in opposite directions.

7. Blow between the pieces of tape to turn the turbine.

   When you have a functional turbine, please demonstrate it to your teacher and ask your teacher to initial this space:

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Calculations:

You can determine the speed of the turbine of radius r by counting the number of rotations N it makes in a time Δt :

$$v = \frac{2\pi r \times N}{\Delta t} \quad =$$

Would you estimate that the pressure on the turbine is more than, less than, or the same as the pressure on the dart from Part 1? Explain why.

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Part 3: The Hovercraft

Materials: CD, bottle with push up cap, box cutter, duct tape, balloon

Directions:

1. Using the box cutter, cut off the top part of the bottle.
2. Place the bottle top over the CD as shown in the photo at right and secure it with duct tape to make an air-tight seal.
3. Push the bottle cap down so that it is closed.
4. Inflate the balloon and twist it closed but do not tie it.
5. Pull the end of the balloon over the bottle cap and let the balloon untwist.
6. Pull up the bottle cap and release.

When you have a functional hovercraft, please demonstrate it to your teacher and ask your teacher to initial this space:

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Calculations:

You can calculate the volume of air in the balloon at maximum inflation by measuring the radius r of the balloon:

$$V = \frac{4}{3}\pi r^3 \quad =$$

If the balloon takes a time Δt to deflate, the volume flow rate is therefore:

$$q_V = \frac{V}{\Delta t} \quad =$$

What part of the hovercraft controls this volume flow rate? _____

If you increased the volume flow rate, would it improve the performance of the hovercraft? Explain why or why not.

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