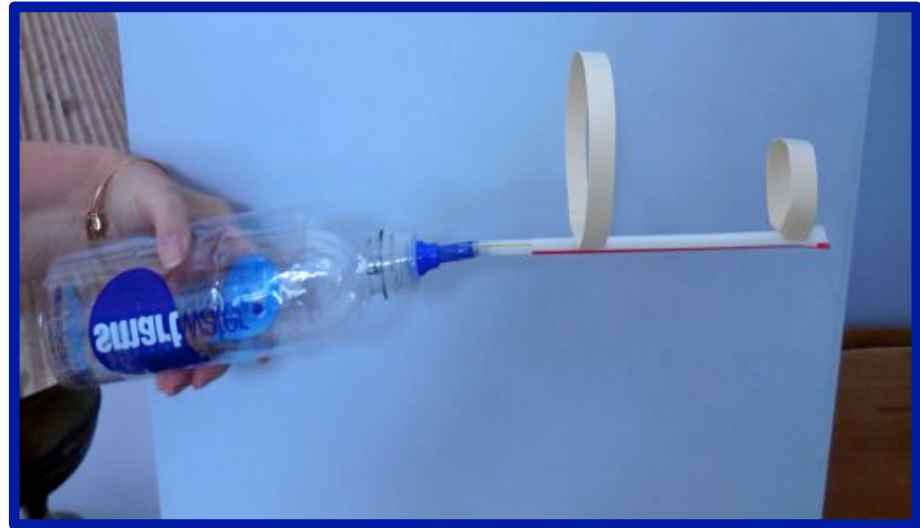


# Rocket Glider

by Create It Lab (CreateItLab.org)



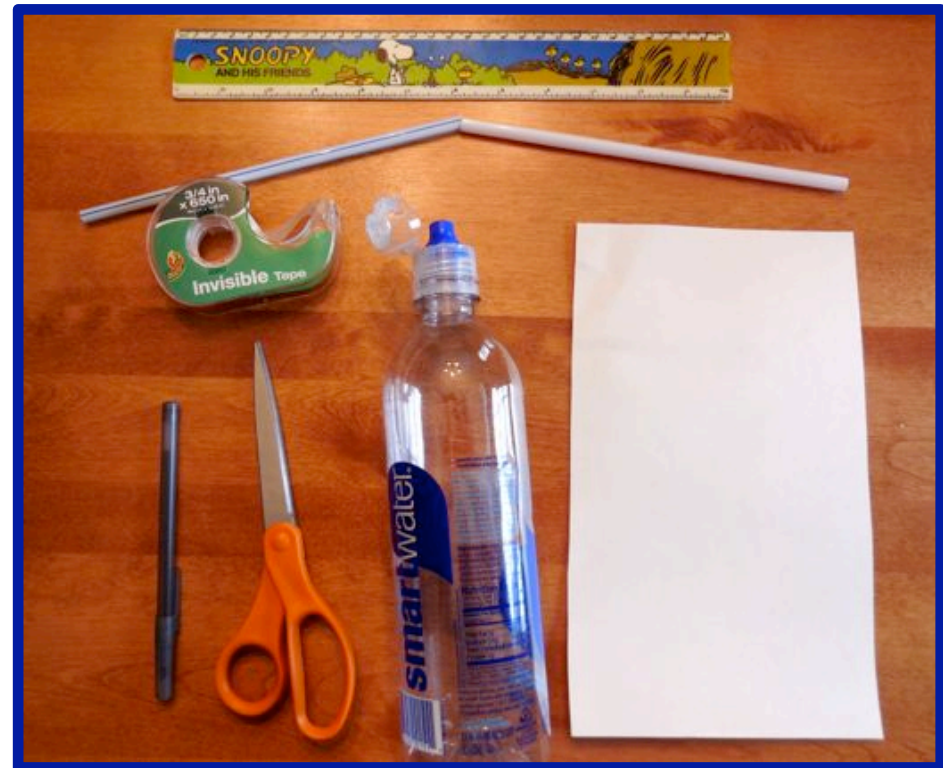
An easily assembled, fun toy that demonstrates both rocketry and aerodynamic principles.

This document includes a list of materials required, assembly instructions, and a discussion of the principles involved.



# Materials & Tools

- Scissors
- Ruler
- Stiff paper e.g. file folder or file cards
- Tape
- 2 plastic straws
  - One must fit inside the other and slide
  - MacDonalds uses large diameter straws
- Plastic bottle with a spout-type cap
- Bic pen



# Assembly - 1

## Rocket Glider Wing Assembly

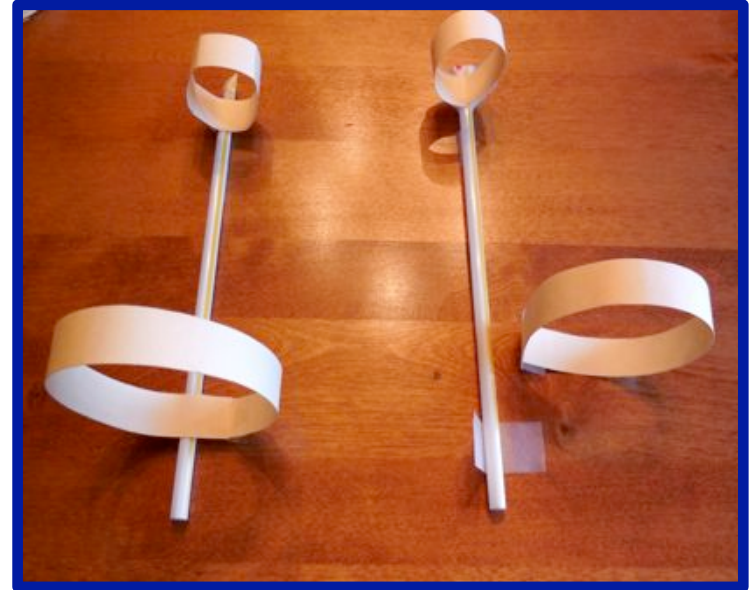
1. Cut stiff paper into three strips 1 inch wide and 5 inches long.
2. Take one strip and curl it into a circle. Tape the ends together to create small loop.
3. Position remaining two strips such that the narrow ends overlap each other.
4. Tape them together producing a long strip.
5. Configure in circle as in step two and tape free ends to create large loop.



# Assembly - 2

## Rocket Glider Final Assembly

1. Select the large diameter straw, fold over one end about  $\frac{1}{4}$  inch and tape to close the end.
2. Place a one inch piece of tape on a table with the sticky side up. Position closed end of the straw onto the center of the tape just before the fold.
3. Position the small loop over the exposed tape and gently wrap tape up onto the loop to secure it to the straw.
4. Using the procedure of steps 2 and 3, attach large loop approximately 1 inch from open end of straw. The loops **must** be lined up with one another.



# Assembly - 3

## Launcher assembly

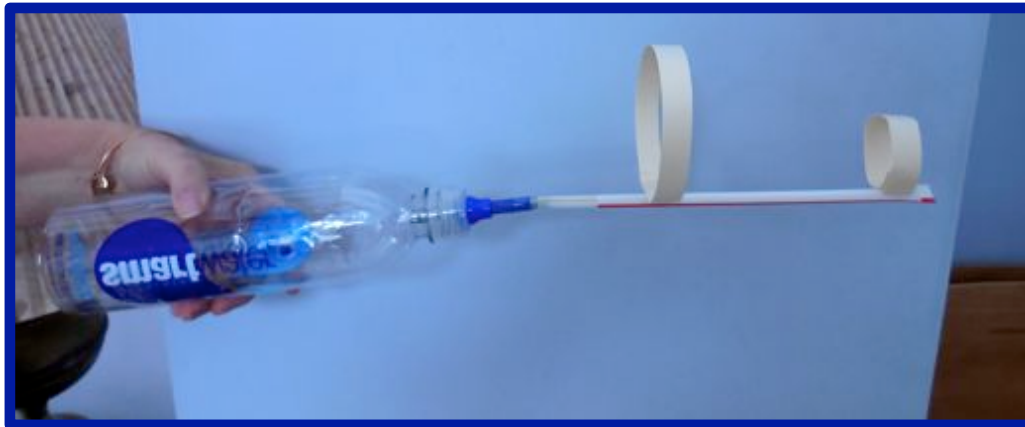
- Remove tip/ink cartridge from pen.
- Cut outer casing 3 inches back from tip of pen.
- Remove insert from tip.
- Remove cap from bottle and cut off protective flap, if present.
- Place tip insert into the top of the cap.
- Secure tip in place by reinserting casing from the inside of cap.
- Tape small diameter straw onto end of tip insert.
- Screw cap onto bottle.



# Operation

- **Preferred mode of operation**

1. Insert small straw of launcher into large straw of glider.
  2. Hold assembly horizontally and squeeze bottle.
- This mode enables discussion of air and air pressure, action/reaction and flight aerodynamics.



- **Alternate mode of operation**

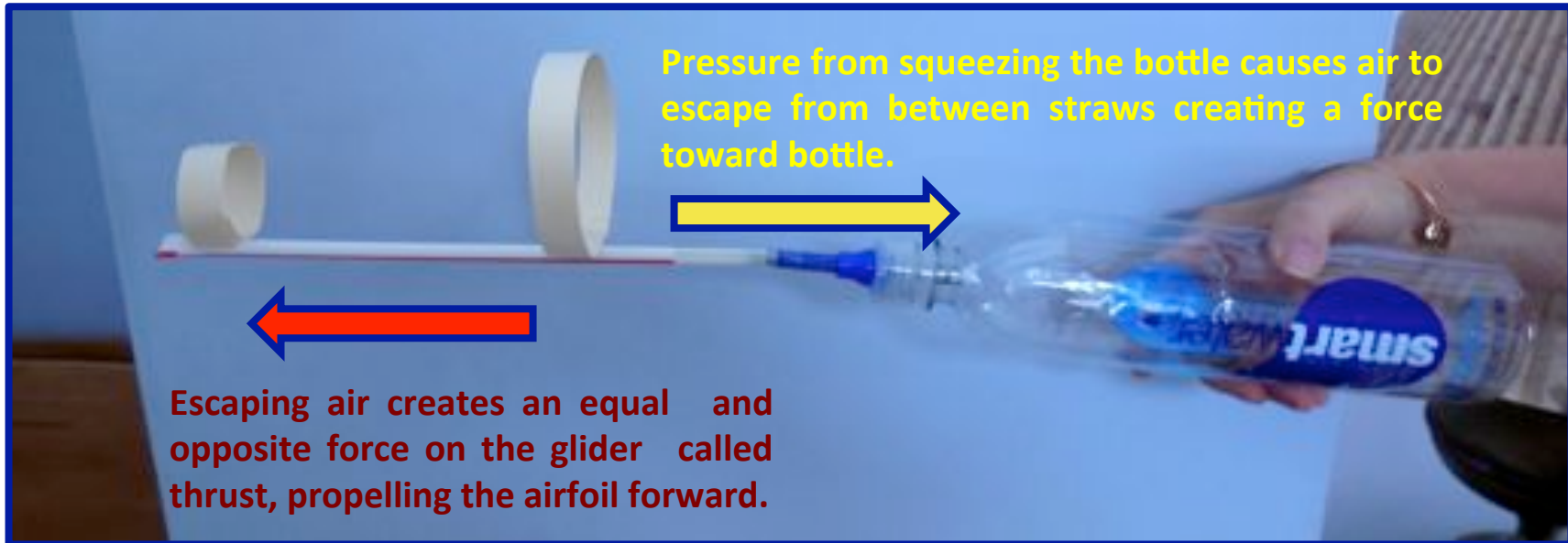
- Do not use bottle assembly, just insert small straw into glider body and blow.
- This mode enables discussion of action/reaction and flight aerodynamics.

- **Second alternate mode**

- Hand launch glider
- This enables discussion of flight aerodynamics.



# Rocket Glider Propulsion 1



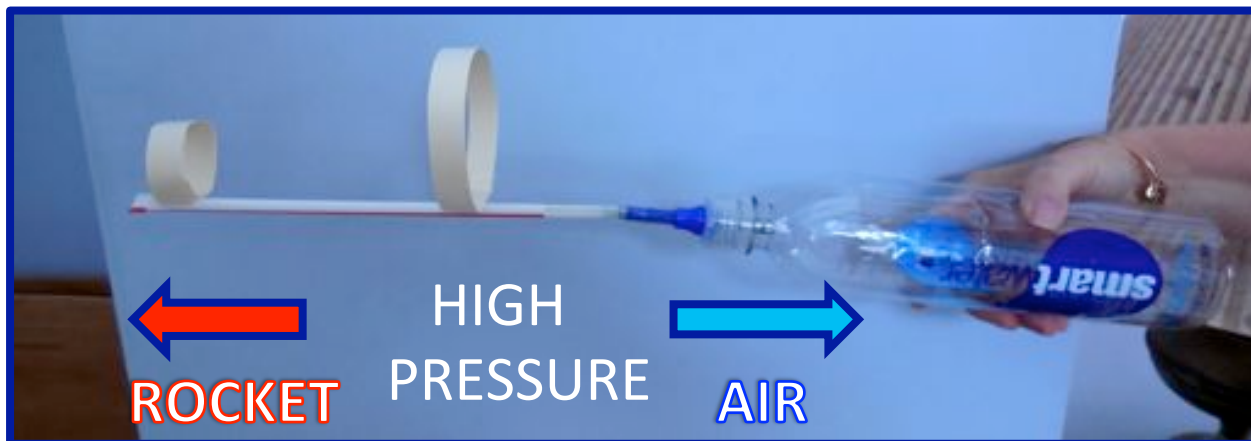
- Because the airfoils are flat, little lift is created.
  - Any lift generated is due to angle of attack, that is, any angular deviation of the airfoil from horizontal.
- The system is dynamic because the thrust is not constant.



# Rocket Glider Propulsion 2

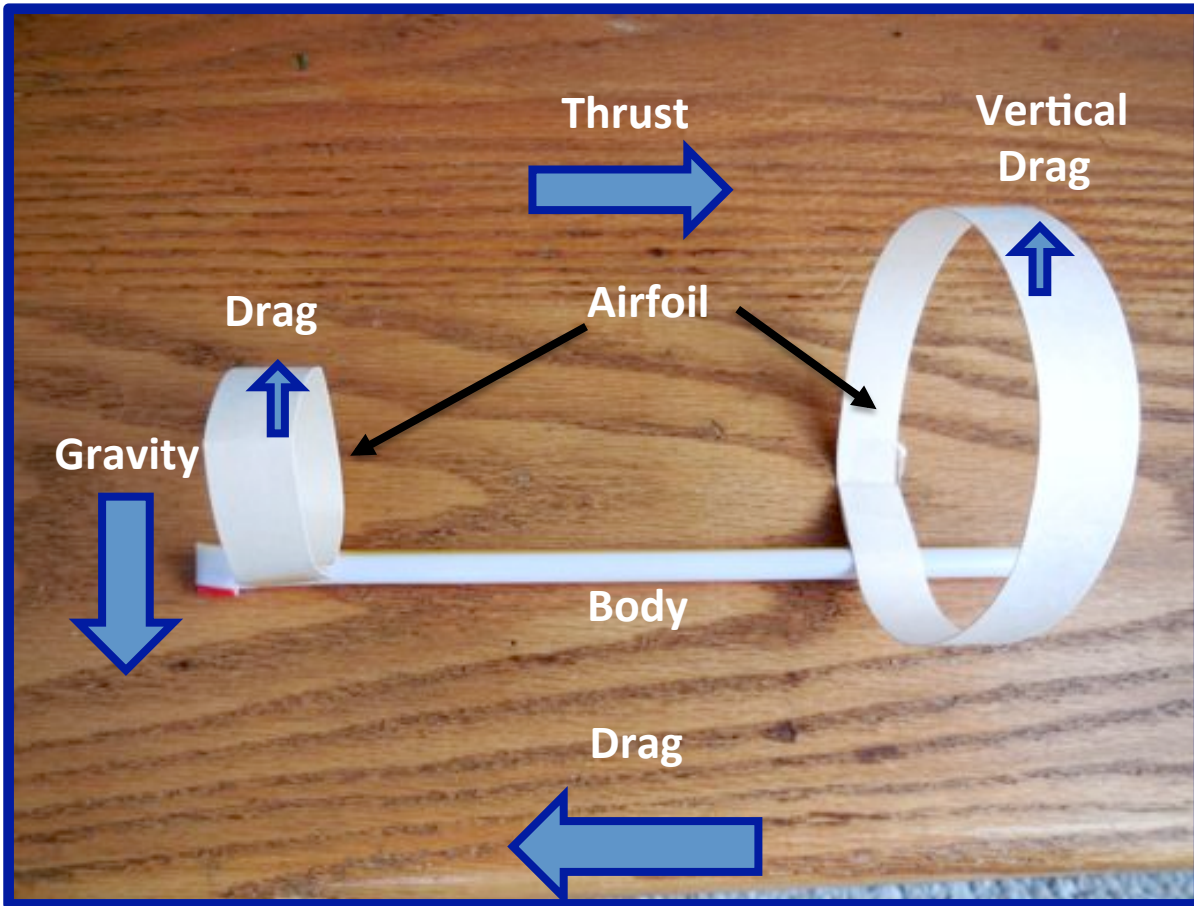
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- Squeezing the bottle creates an increase in air pressure inside the launch straw.
- The increased pressure is reduced by pushing the rocket forward on the launch straw; thus increasing the volume of the system.
- For large sudden increases in air pressure, the volume increase must also be large and sudden.
- Thus the rocket is rapidly pushed forward on the launch straw, gaining momentum until pushed off the launch straw.
- After the rocket leaves the tube, the pressure is released and the launching thrust becomes zero





# Rocket Glider Aerodynamics

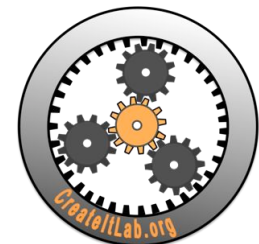
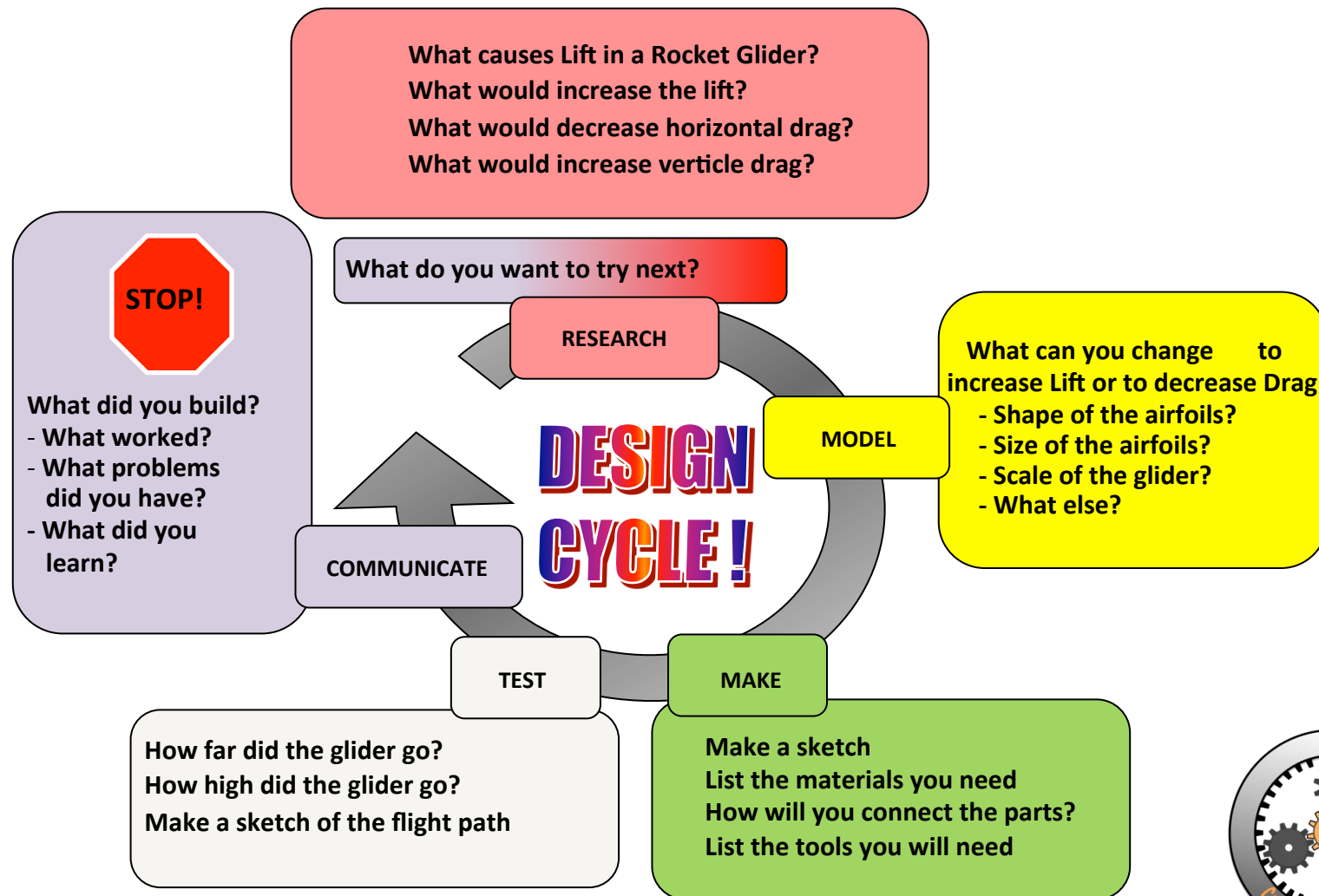


Airfoils slow the fall of the glider by increasing surface area which increases the vertical drag i.e., air resistance.



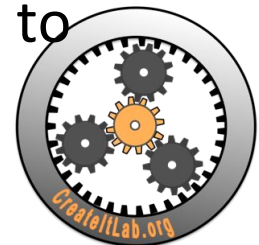
# ROCKET GLIDER AERODYNAMICS

MAKE A BETTER ROCKET GLIDER ! JUST FOLLOW THE **DESIGN CYCLE!**



# Rocket Glider Experiments

- What happens if the width of the airfoils is made larger?
- What happens if the diameter of the airfoil is increased?
- What happens if the tip is weighted down, i.e. a paper clip is attached?
- What happens if the tail is weighted down?
- Does the launch velocity affect the fall time?
- Compare the time in the air of a glider that is dropped to an identical glider that is launched.



# Rocket Glider Questions

- Observation: the glider does not stay aloft.
  - Why?
  - Does this mean that the system is stable or dynamic?
  - What would be required to keep the glider in the air?
- What would happen if the rocket glider were released in outer space?

