

HOVER DISK

BY CREATE IT LAB (CREATEITLAB.ORG)

An easily assembled, fun toy that demonstrates aerodynamic principles.

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



MATERIALS

- ◆ Unwanted CD or DVD
- ◆ Balloon
- ◆ Plastic bottle with an unscrewable nozzle cap
 - ◆ Optimum bottles have caps that snap closed i.e. some dish detergent bottles or some soft drink bottles
 - ◆ Assembly instructions for both snap closure and non-snap closure are provided
- ◆ Saw
- ◆ Glue compatible with plastic
 - ◆ Hot glue is recommended
- ◆ Smooth flat board or other hard surface that can be elevated at one end to create a slide (not shown)
 - ◆ A table top can be used but pushing the Hover Disk will be required



ASSEMBLY

- ◆ Unscrew cap from the bottle
- ◆ Cut neck off from the bottle at the point where the neck flairs
 - ◆ The neck should be long enough for the cap to be completely screwed on
 - ◆ The cut must be at right angles to the neck
- ◆ Place the disk face down on workbench
- ◆ Glue the cut end of the neck onto the disk i.e. with the threads up
- ◆ For bottle with snap closure, insert nozzle into balloon to secure
- ◆ See next page for assembly of bottles without snap closure



ASSEMBLY FOR CAP **WITHOUT** SNAP CLOSURE

- ◆ Cut neck from bottle as described above
- ◆ Invert cap and place nozzle (blue in picture) on a hard surface. Press or tap firmly on cap until nozzle pops out.
- ◆ It is likely that the nozzle opening will be too large, preventing the disk from hovering properly, if at all.
 - ◆ To correct this, cut a piece of a Bic pen such that it equals the narrow length of the nozzle. Press into place.



ASSEMBLY FOR CAP **WITHOUT** SNAP CLOSURE

- ◆ Place the narrow end of the nozzle into the balloon and pull the balloon over to just completely cover the nozzle.
 - ◆ Air must be able to flow through bottom of nozzle.
- ◆ Pull the balloon through the cap.
- ◆ Press nozzle into cap until it snaps in place, securely holding the balloon.
 - ◆ Take care not to rip the balloon.

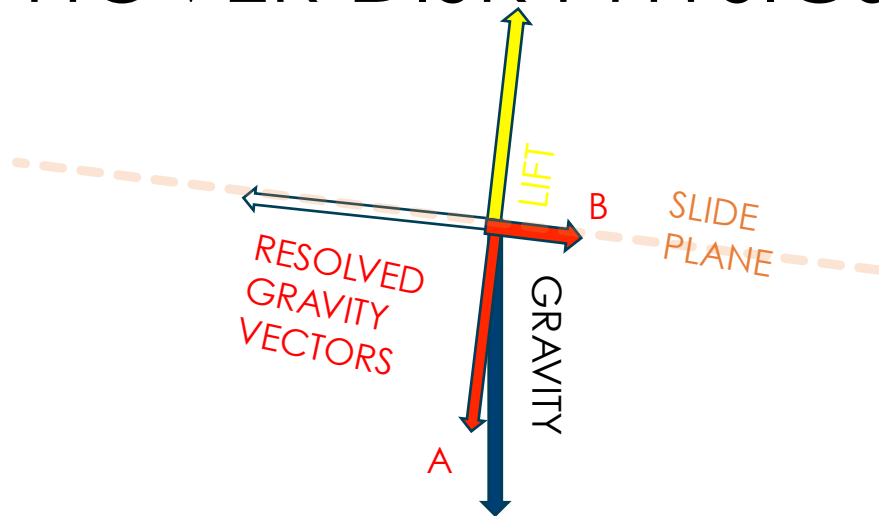


OPERATION

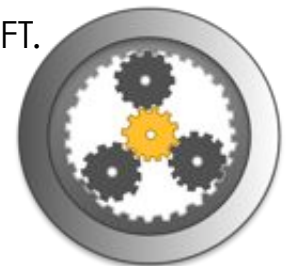
- ◆ Unsnap cover on cap if present
- ◆ Blow into bottom of cap to inflate balloon
- ◆ Snap the cap cover closed to hold in air
 - ◆ If not using a cover with snap closure, pinch the stem of the balloon to retain the air
- ◆ Screw cap onto the neck
- ◆ Place Hover Disk on ramp or table
- ◆ Release air and Hover Disk
 - ◆ Snap open cover or release balloon stem



HOVER DISK PHYSICS

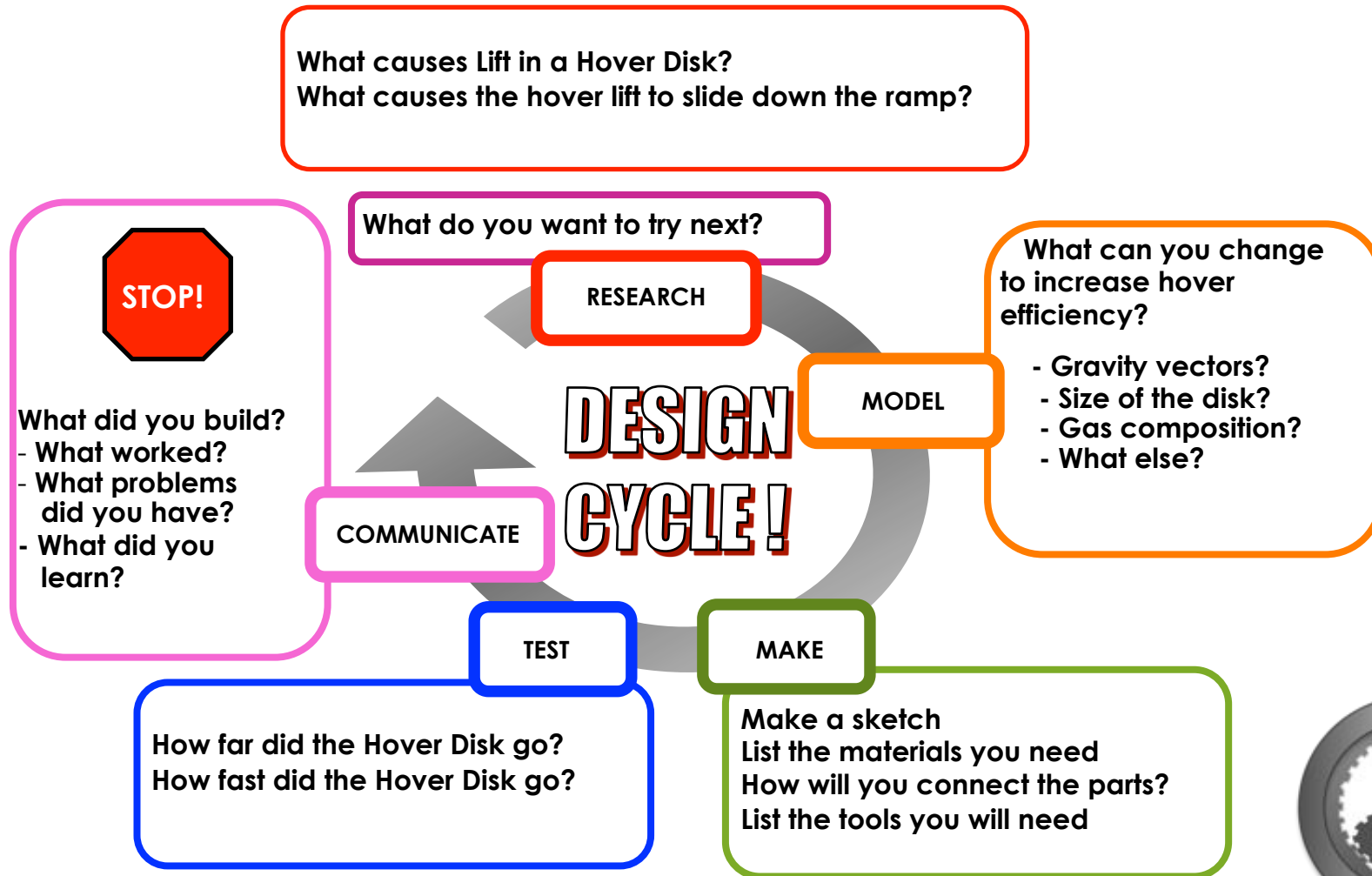


- ◆ GRAVITY PULLS THE HOVER DISK TOWARD THE CENTER OF THE EARTH
 - ◆ GRAVITY CAN BE RESOLVED INTO IT'S COMPONENTS WITH RESPECT TO THE SLIDE PLANE
 - ◆ VECTOR A IS AT RIGHT ANGLES TO THE SLIDE PLANE AND PULLS THE HOVER DISK INTO THE SLIDE
 - ◆ VECTOR B IS IN THE SLIDE PLANE AND TRIES TO PULL THE HOVER DISK DOWN THE SLIDE
- ◆ FRICTION OPPOSES THIS MOVEMENT
 - ◆ IT IS PROPORTIONAL TO THE FORCE OF GRAVITY VECTOR A
- ◆ WHEN THE AIR FLOWS FROM THE BALLON, IT FLOWS UNDER THE DISK & PRODUCES LIFT.
 - ◆ WHEN THE LIFT FORCE IS EQUAL TO OR GREATER THAN GRAVITY VECTOR A,
 - ◆ THE HOVER DISK FLOATS AND FRICTION IS ELIMINATED.
 - ◆ THUS GRAVITY VECTOR B PULLS THE HOVER DISK DOWN THE SLIDE.



HOVER DISK AERODYNAMICS

MAKE A BETTER HOVER DISK! JUST FOLLOW THE **DESIGN CYCLE!**



HOVER DISK EXPERIMENTS

- ◆ What happens if there is more air in the balloon or a bigger balloon is used?
- ◆ What happens if the diameter of the disk is increased?
- ◆ What happens if one end of the disk is weighted?
- ◆ What happens if the air is replaced with Helium?
- ◆ What effect does the slope of the glide plane have?
- ◆ What happens if the slide is angled in two directions, that is, it is tilted or warped?

