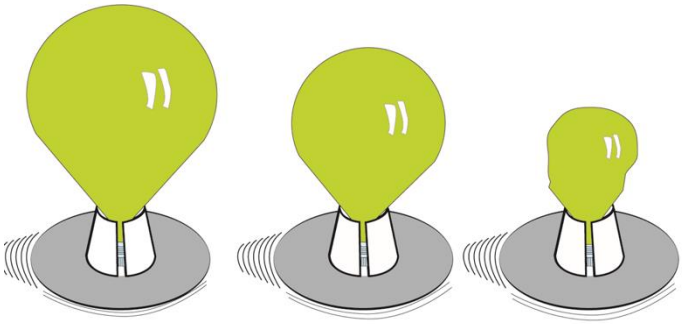
HOVERCRAFT

Get a big lift from a little air pressure!



Explore how a hovercraft can glide smoothly along by constructing this quick-to-assemble four-piece model. Once the hovercraft is built, test it on any smooth, flat surface!

Curriculum topics:

- Friction
- Air Pressure
- Motion
- Inertia

Subject:
Physical Science

Grade range: 4 – 12

Who we are:

Resource Area for Teaching (RAFT) helps educators transform the learning experience by inspiring joy through hands-on learning.

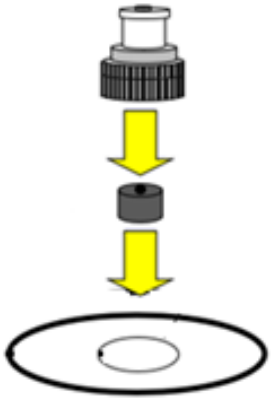
For more ideas visit
https://raft.net

Materials required per hovercraft

- CD with smooth label side (x1)
- Sports bottle cap with push/pull closure (x1)
- Index card, 3” x 5” (x1)
- Balloon, 6” – 12” (x1)
- Double-sided adhesive foam cylinder w/ center hole

WARNINGS: Children under 8 years can choke or suffocate on uninflated or broken balloons. Adult supervision required. Balloons contain Natural Rubber Latex which may cause allergic reactions.

Set-Up



1. Place the CD **smoother label side downward**. Remove the release paper from one side of the foam cylinder, center over CD hole, adhesive side downward, and press down.
2. Remove the release paper from the top of the adhesive foam. Center cap over foam, bottom downward, and press down.
3. Make a collar by folding the 3” x 5” index card in thirds. A collar will prevent the balloon from tipping and dragging on the table.

To do and notice

1. Place hovercraft on a smooth and clean counter, desktop, or horizontal whiteboard. Make sure the push/pull part of the sports cap is in the “down” position (closed).
2. Inflate the balloon, twist the neck to seal in the air, and place the balloon’s neck over the sports cap. The neck of the balloon should seal tightly to cap.
3. Place the collar around the balloon as shown on title page and untwist the balloon neck so that air flows through the cap.
4. Give the hovercraft a light push or spin, blow on the balloon, or fan the balloon to make the hovercraft move. The hovercraft should glide smoothly. If not, follow the tips below:

Troubleshooting tips

- Make sure the bottom of the hovercraft and the gliding surface are both smooth and clean. Even small grains of material or rough spots or will stop the hovercraft.
- Use a pushpin as a tool to poke 2-3 holes in the cap (Note that more holes will allow the hovercraft to move over higher surface irregularities, but the balloon will deflate faster).
- If the balloon tips over, be sure the collar is in position.

Content Standards:

NGSS

Kinetic and Potential Energy:
4-PS3-1
MS-PS3-2
MS-PS3-5

Forces and Motion:
3-PS2-1
MS-PS2-2
HS-PS2-1

Gravity:
5-PS2-1
MS-PS2-4

Compare Multiple Solutions; Testing Variable (Engineering):
3-5-ETS1-2
3-5-ETS1-3
MS-ETS1-2
MS-ETS1-4

The content behind the activity

The air in the inflated balloon is compressed (**pressurized**) by the stretched surface of the balloon. When the compressed air escapes through the small holes in the top of the cap, it is pushed out of the hole in the center of the CD. After exiting the CD's center hole, the air pushes its way between the flat bottom of the CD and the smooth flat surface underneath. A thin cushion of moving air forms under the CD. When the force from the cushion of air is greater than the force of gravity pushing down on the hovercraft, the hovercraft will lift off the surface a tiny amount. The pressurized air continues to flow outwardly until it reaches the edge of the CD, where it goes back into the atmosphere. If it is replaced by new air coming from the balloon, the cushion of air is maintained. In commercial hovercrafts, a flexible curtain surrounds the edges of the vehicle to help trap the pressurized air so the hovercraft can rise higher and thus move over rougher terrain.

Smaller (or fewer) holes slow down the release of the air from the balloon and allow a longer "flight time." But the reduced air flow can only lift the CD up a tiny amount. Larger (or more) holes lift the CD higher but shorten the flight time (see Troubleshooting Tips, page 2).

Unless they are operating in a vacuum, all moving objects rub against something else while moving along. The resistance to that movement (**friction**) is what keeps us from slipping as we walk. Friction also slows down a rolling ball. With the hovercraft, the thin cushion of air has reduced the friction between the flat surface below and the bottom of the CD. The hovercraft is sliding over a layer of air resulting in much less friction than for a CD sliding directly against a surface. The friction is reduced so much that the slowing down due to frictional energy losses is negligible, giving the illusion that the hovercraft could glide on forever. The CD's weight and size help keep the CD parallel to the table so that the CD does not tilt and drag on the table. The CD also distributes the weight of the hovercraft over a wide area. The larger "footprint" means the hovercraft needs less upward force, per unit of area, to lift the CD up off the surface.

Learn more

- Students can calculate the air pressure needed to lift the hovercraft off the table. The air pressure must be greater than the weight of the hovercraft divided by the surface area of the CD.
- Work in teams to maneuver a fleet of hovercrafts around an obstacle course or racetrack.
- Use stickers or markers to personalize the hovercrafts

Visit https://raft.net to view the following related activities!

Air – A Pressing Matter
Air Pressure – Feel It!
Balloon in a Bottle
Car on a Roll

Resources

- YouTube video (6:45), Hovercraft History - https://bit.ly/358Kk4R
- Hovercraft images - https://bit.ly/3eVSoKM