

# Hovercraft



Make a vehicle that floats across a table on a cushion of air!

## Get Ready

- Watch the Hovercraft video segment to preview the activity. Then cue the tape to the beginning for the meeting.
- Make a hovercraft before the meeting. Test it and notice what works and what problems arise and how to solve them. (See page 62 for troubleshooting ideas.) Save your hovercraft to show as an example to kids.
- Make sure you have enough clean, smooth surfaces (tables or floor) for kids to work on. Test the surfaces before you start. Grit on the floor may make it difficult for the hovercraft to glide.
- Collect film canisters early. You can ask kids to bring them in from home or ask a photo finishing store if they will donate extras.
- Collect activity materials. For each kid, make copies of the Hovercraft activity sheet and the Stay Tuned message (see end of section).
- Post the new ClubZOOM Board activities (see end of section).

## What You Need

### Design & Build (per team)

- balloon (12" round)
- ballpoint pen
- film canister
- large plastic plate
- poster putty (sold in office supply stores)
- Hovercraft activity sheets

### Redesign (for the group)

- balloons, different sizes and shapes
- paper clips
- plates, different sizes and materials (paper, plastic, and foam)
- scissors
- wooden thread spools
- yarn
- 3/4" round magnets (optional, available at craft stores)
- 12" rulers (optional)
- used CDs (optional)

## Time

1 hour



# Engineering Scoop

## Try This First

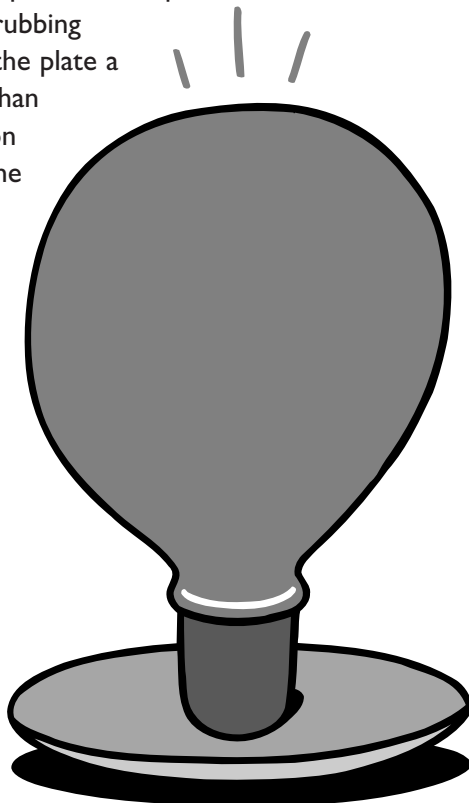
Take a plate, put it on a smooth surface, and gently tap the side to push it forward. How far does it move? Now build a hovercraft by following the directions on the Hovercraft activity sheet. Blow up the balloon, give the plate a small tap, and watch it glide across the table. (If it gets stuck, see the troubleshooting tips on page 62.)

## The Scoop

When you flicked the side of an ordinary plate, it probably didn't move very far. That's because of friction between the bottom of the plate and the top of the table. Friction is a dragging force that happens when objects slide against each other.

So, what helps the hovercraft glide more easily? Air. A hovercraft is a vehicle that rests on a cushion of air. When you let go of the balloon, the air flows out of the balloon and under the plate. (Place your hand under the plate and feel the moving air.)

This layer of air takes up space and keeps the plate and table from rubbing together. When you give the plate a tap, it glides more easily than before because the friction between the bottom of the plate and the layer of air is less than the friction between the plate and the table.



## Find Out More Books

### I Wonder Why Zippers Have Teeth and Other Questions about Inventions

Taylor, Barbara. New York: Kingfisher, 1995.

Turn to page 20 for a picture of a hovercraft. Kids can find answers to their other questions about inventions, such as why nonstick frying pans don't stick or when the ballpoint pen was invented. This book shows how engineering has changed our daily lives.

### Machines

Oxlade, Chris. Milwaukee, WI: Gareth Stevens Publishing, 1998.

Investigate how simple machines work. The hovercraft uses air pressure to create lift, as do the hydraulic and pneumatic systems featured on pages 38 to 39.



## Web Sites

Friction: Slowing Things Down  
[www.darvill.clara.net/enforcemot/friction.htm](http://www.darvill.clara.net/enforcemot/friction.htm)  
Find out what friction is and learn more about fluid friction, a force at work in a hovercraft.

The Hovercraft Principle  
[www.neoterichovercraft.com/general\\_info/hovercraft\\_principle/hovercraft\\_principle.htm](http://www.neoterichovercraft.com/general_info/hovercraft_principle/hovercraft_principle.htm)  
Check out this diagram and explanation of how hovercrafts work.

Surfing the Waves  
[membres.lycos.fr/djipibi/aviation/museumpages/AvionsMuseum-4\\_ang.htm](http://membres.lycos.fr/djipibi/aviation/museumpages/AvionsMuseum-4_ang.htm)  
View photos of a hovercraft ferry in Montreal.

# Run the Meeting

## 1 Get Started (10 minutes)

Welcome kids and ask for a volunteer to share the Stay Tuned coded message. (*Answer: I float like a boat and I hover like a bee. What could I be?*) Then read the Challenge Letter together.

Put a plate on a table, and give it a very gentle tap. Ask kids to notice how far the plate moves. Ask: *Why does it slow down and stop instead of traveling forever?* (Friction between the bottom of the plate and the table causes the plate to slow down.)

Then show them the hovercraft you made before the meeting, give it a small tap, and watch it glide across the table. Ask: *Why does the hovercraft glide more easily than a plain plate?* (The air flowing underneath the plate keeps the plate and table from touching. This reduces the amount of friction.)

Tell the kids that the model you're showing them works like a real hovercraft. Hovercrafts are vehicles that move across land or water on a cushion of air. Ask kids if they've ever seen a hovercraft in real life or in a movie, like *Star Wars*. Have them share what they know about how hovercrafts work. Kids may be more familiar with air hockey, which works in a similar way: jets of air push up the hockey puck so that the puck hovers just above the table and glides on top of the air.

Tell kids that they'll first build a basic hovercraft design, and then they'll make changes to try to improve the design.

## 2 Design & Build (10–15 minutes)

Organize teams of 2 to 3 kids and distribute the activity materials. You can show the Hovercraft video segment to introduce the activity directions.



As the kids build, ask:

- *Where do you want the air from the balloon to go?*
- *Does it matter how big the holes are in the plate and the canister?*
- *How can you make sure that the air only moves under the bottom of the plate?*

### Activity Tips

- You can introduce real hovercrafts by showing photos from the book and Web site resources in Find Out More.
- Kids may think that hovercrafts fly in the air and be disappointed by the subtle gliding. Talk about what it means to “hover.”
- Putting the balloon on the film canister can be tricky, so have two people work together. One person can pinch shut the neck of the balloon while the other stretches the opening around the canister.
- Have extra balloons available in case the rubber breaks when it's stretched over the canister or gets “tired” from repeated use.
- Inexpensive balloon pumps, available at party stores, make it easier to inflate balloons.
- Magnets can be used to steer a hovercraft. Use poster putty to attach one magnet to the side of the film canister. Then attach another magnet to the end of a ruler. Hold the ruler so that the opposite poles of each magnet face each other. The magnets will repel, or push away from each other, moving the hovercraft forward.

### 3 Test (5 minutes)

Bring the teams to a “testing” table or floor area and ask them to demonstrate their hovercrafts. Talk about what worked, what problems came up and ways they tried to solve them. If their first designs don’t work exactly as planned, let them know that it’s okay. This “test phase” will help them learn what they want to change to make their hovercrafts work better. Engineers also test designs and make changes to improve their designs. As they test, ask:

- How can you tap with the same amount of force each time?
- Which parts of the hovercraft help it move? Which parts seem to slow it down?
- Which parts could you change to make it glide better?

### 4 Redesign (15 minutes)

Now it’s time to improve the basic hovercraft design! Show kids the new materials you’re providing. Then ask them to think about what they want to improve. For example, how can they redesign the hovercraft to keep the balloon from tipping over? How can they steer it? Or, how can they make a hovercraft that can carry a small load of paper clips?

### 5 Share Results (5–10 minutes)

Ask for volunteers to demonstrate their new designs. Celebrate each design for its special features, such as smoothest ride, most innovative use of materials, most colorful, etc. Talk about the building process by asking:

- What is similar about the hovercraft designs that work best?
- What didn’t work? Knowing what you know now, what changes would you make?
- If you could use one other material, what would it be?
- What might you do to continue improving your design?

Connect the activity to engineering by talking about different ways hovercrafts can be used. You can use the “Engineering the Future” bulletin board posting to launch discussion.

### 6 Wrap Up (5 minutes)

Hand out club card stickers and the Stay Tuned coded message for the next meeting.

### Troubleshooting

- Line up the balloon with the holes in the film canister and the plate so the air flows smoothly and under the plate.
- Adjust the airflow by changing the size of the holes in the canister and plate.
- To make a big hole smaller, cover the hole with poster putty and poke a new hole through the putty.
- Keep the bottom of the hovercraft plate smooth to reduce friction.
- Tap the side of the plate gently and with consistent force.

### ZOOM Links



Try these related activities on the ZOOM Web site.

#### Air Lift

[pbskids.org/zoom/sci/airlift.html](https://pbskids.org/zoom/sci/airlift.html)

Lift a heavy object with a bag of air.

#### Balloon Car

[pbskids.org/zoom/sci/ballooncar.html](https://pbskids.org/zoom/sci/ballooncar.html)

Build a balloon-powered car.

#### Puff Mobile

[pbskids.org/zoom/sci/puffmobile.html](https://pbskids.org/zoom/sci/puffmobile.html)

Make a vehicle that moves when you blow on it.



# Challenge

Dear ClubZOOM Engineers,

Good afternoon! My name is Jack N. Box, president of the Fun Times toy store. I'm writing to you with a desperate plea.

I'm about to introduce a new toy called a hovercraft. It travels across the floor on a cushion of air. Pretty cool, huh?

My hovercraft toy designer mysteriously disappeared last month. I've hired detectives to find her, but I can't afford to wait any longer.

Here's where I need your help. I'd like you to build a toy hovercraft. You can start with my toy designer's model. Then improve it. I want it to work so well that I will sell millions and get rich and famous!

Good luck to you!

**JACK**

Jack N. Box  
President  
Fun Times



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# Hovercraft

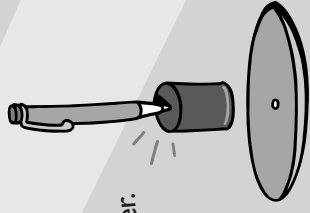
## What You Need

- ballpoint pen
- large plastic plate
- film canister
- 12" round balloon
- poster putty (sold in office supply stores)

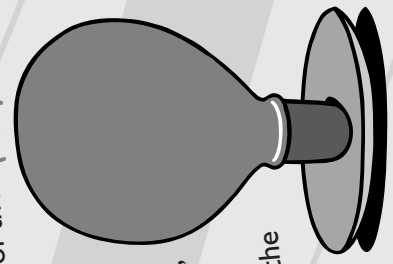


## Engineering Scoop

Put a **plain plate** on a table and **gently tap** the side of the plate. It doesn't move very far, does it? That's because of **friction** between the bottom of the plate and the table. Friction is a **dragging force** that happens when objects slide against each other. Why does your hovercraft **glide** more easily? Because it's **resting** on a cushion of air! When you let go of the balloon, the **air flows** under the plate. The **layer of air** under the plate **takes up space** and keeps the plate and table from rubbing together. When a plate slides on top of air, there is **less friction** than when it slides on the table.



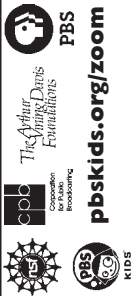
- 1 Use the **point** of the pen to **poke** a small **hole** in the center of the plate.
- 2 **Poke** another hole in the **bottom** of the film canister.
- 3 **Put** some poster putty around the **bottom** of the film canister. Make sure you **don't cover** the hole.
- 4 **Stick** the film canister to the **middle** of the plate. Try to **line up** the **holes** in the plate and the film canister.
- 5 **Blow** up the balloon. **Twist** the end and **pinch** it shut.
- 6 Work with your teammate to **put** the balloon on the film canister. One person can **hold** the neck of the balloon so no air escapes. The other person can **stretch** the end of the balloon over the film canister.
- 7 **Place** your hovercraft on a smooth surface, like a table or the floor.
- 8 **Let go** of the balloon. Then **gently tap** the side of the plate. **What happens?**



### Redesign It!

**Change** the design of your hovercraft. How can you make the hovercraft travel a **long distance** in one tap? How can you make one that **lasts a long time** before the air runs out? Can you think of a way to **steer** your hovercraft? Choose **one thing** to change, like the size of the plate or the hole in the film canister. Then **test it** and **send** your results to ZOOM.

Sent in by Dene D. of Woodbridge, VA



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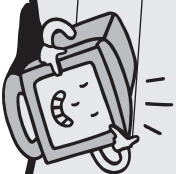
# Hovercraft

Engineer's Notebook

**Here's my hovercraft design.**

(Draw your design and label the parts.)

To improve it, I might ...



**Send It to ZOOM™!**  
Tell us about your hovercraft at  
[pbskids.org/zoom/sendit](http://pbskids.org/zoom/sendit)



[pbskids.org/zoom](http://pbskids.org/zoom)  
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## Meet an Engineer



# Susan Knack

Where does an engineer work? At a desk? In front of a computer? That's where you might find Susan Knack ... or you might find her rappelling down the side of a building! Rappelling is the way rock climbers move up and down steep mountains. Susan rappels to look for leaks and other problems in buildings. As a civil engineer, it's her job to figure out how to repair buildings. Susan enjoys her work because it's a perfect way to combine her love of problem solving with her sense of adventure.



[pbskids.org/zoom](http://pbskids.org/zoom)

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## Engineering the Future

Tired of taking the bus to school? In the future, you may be able to ride your own personal hovercraft. Kevin Inkster invented a small hovercraft called an **Airboard**. You ride it like a skateboard, but it works like a hovercraft. Do you have ideas for other ways to use hovercrafts? Become an engineer and make **your ideas** come to life!



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# Pundle

Sent in by Grace P. of Sunrise, FL

Figure out the word or phrase that each picture stands for.

**1** stand  
i

**2** sailing  
ccccccc

**3** s a  
d n

**4** cycle  
cycle  
cycle

Hint: The first one is "I understand."  
Get it? The word "I" is under the word "stand."

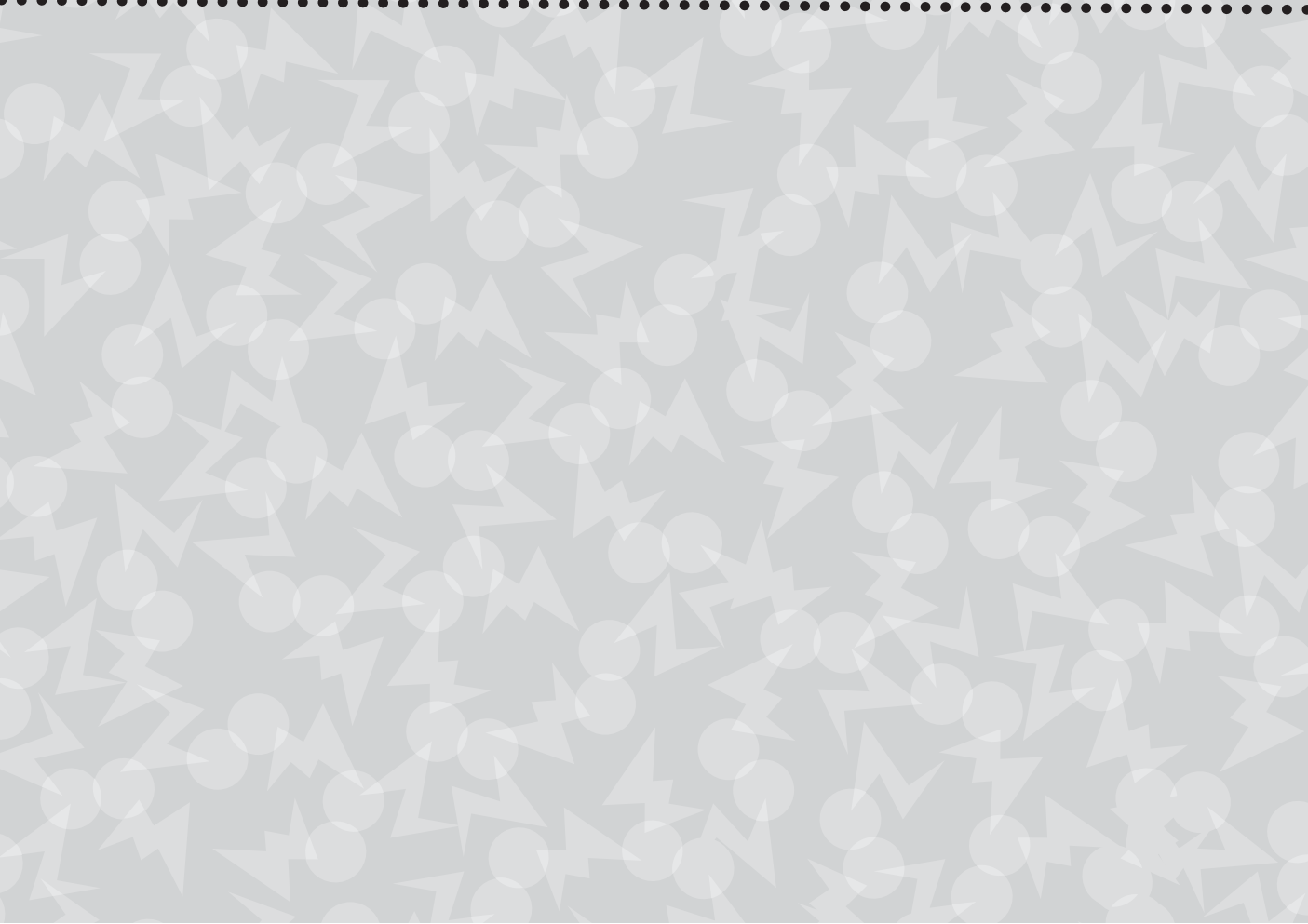
Ready to check  
your answer?  
Look inside!



To keep teasing your brain, visit ZOOMzingers at pbskids.org/zoom/zingers

I understand	sailing over seven seas	sandbox	tricycle
stand !	sailing cccccc	s a p n	cycle cycle cycle
1	2	3	4

ANSWER



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How can you  
**wakeboard**  
without a  
**speedboat?**

- a. Use a kite.
- b. Tow the wakeboarder  
with a canoe.
- c. Use a jet pack.



A wakeboard is like a surfboard, except the rider is towed by a speedboat.

**Mind Blaster**  
...brought to you by



**Ready to check  
your answer?  
Look inside!**

**DragonflyTV** is a show about real kids doing real science. Visit the DragonflyTV Web site at [pbskids.org/dragonflytv](http://pbskids.org/dragonflytv) to find out when the show is on in your area and explore more science.



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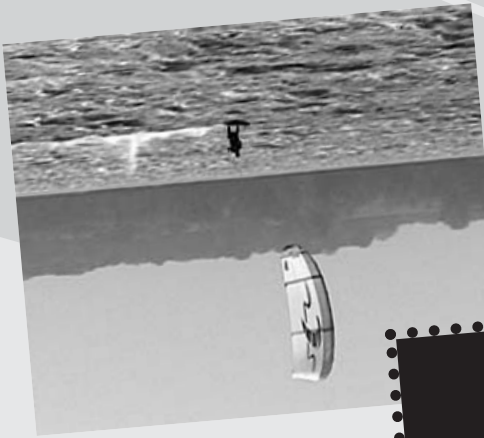
[pbskids.org/zoom](http://pbskids.org/zoom)   TM/©2003 WGBH Educational Foundation

# ANSWER

A canoe won't move you as fast as a speedboat, and jetpacks haven't been invented yet.

**So the answer is A—you use a kite!** You can capture the power of the wind with a giant kite. (Now that you're

instead of wakeboarding.) The force of the wind on the kite pulls you across the water, just like a boat does. The kite also provides lift so you can do some incredible stunts. And the action doesn't stop on the water . . . you can also kiteboard on the snow! Kiteboarding is an extreme sport, so if you want to try it, make sure to get an expert's help.





# Stay Tuned

**Wondering what you'll be doing next time in ClubZOOM?  
Solve the secret message, and you'll get a clue!**

To read the message, you need to learn the **Box Code**. Here's how it works. Write the secret message below in the grid. Start with box 1 and keep going until you get to box 16. Then read across to get the clue. (The letter "X" stands for a space.)

1	5	9	13
2	6	10	14
3	7	11	15
4	8	12	16



## Secret Message

FMTL ROOU OOXE MXGX

\_\_\_\_\_



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