NSF GK-12 Graduate Fellows Program
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University of North Carolina at Wilmington

The Physics of Skateboarding

Activity Instructions

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Skateboard Project:
What would Isaac Newton think if he were to ride a skateboard?

Background:

www.exploratorium.org/skateboarding (This website leads you and the students through a lesson on motion and forces and how they relate to skateboarding. It covers anything from the way the board is constructed to the tricks performed.)

Objectives covered:

4.01—Analyze gravity as a universal force.
4.04—Determine how the force of friction retards motion.
4.06—Apply Newton's Laws of Motion to the way the world works.
**Can be expanded to an explanation of 4.05 (Describe and measure quantities that characterize moving objects and their interactions within a system.

Materials:

Internet connection *
Tony Hawk Video *
Skateboards
Powerpoint

* Optional

Procedure:

This is a great illustration of motion and forces that the kids will relate to. Use the website if you need something to take you through step by step, or have the kids do this individually.

Use either the website, video, or real people skateboarding. The kids can watch how the rider moves the skateboard and what forces are involved in each movement.

Applications:

1. Apply Newton's Laws to skateboarding.
2. Illustrate how friction retards motion and how that can be partially overcome.
3. Illustrate how gravity affects motion.
4. Illustrate how an object's motion is always judged relative to some other object or point.
5. Help describe and measure quantities that characterize moving objects and their interactions within a system.

Skateboard exploratorium SCIENCE

Activity

Mid-Air Maneuver

To understand how skaters turn in midair, try this little experiment. You can do it on your own, but an assistant to help you will make your results all the more convincing.

1. Find a clear area and stand there, facing your assistant.

2. Jump into the air. Just as you become airborne, your assistant should point either to your left or right. Now, while you're still in the air, quickly turn your body 90 degrees in the direction that your assistant pointed. (If you have no assistant, just decide in midair which way you will turn and then turn that way.)

3. This isn't easy, so give it a few tries. You'll find it's much easier on a trampoline or diving board, both of which give you more time to respond.

What's going on?

If you managed to pull this off, then guess what: You've just turned in midair while keeping your angular momentum constant at zero. The arbitrary choice of your assistant guarantees that you didn't get your rotation by pushing off from the ground. So where did you get it? Your upper body.

As you rotate your legs 90 degrees beneath you, your arms and torso rotate in the opposite direction. You probably found yourself naturally sticking your arms out as you turned—this increases the of your upper body. The upshot is that a large rotation of your legs is exactly cancelled by a small rotation of your outspread arms. Since the two rotations cancel, angular momentum stays constant at zero, and the law of conservation of angular momentum is satisfied. (Whew.)

In much the same way, skateboarders turn in midair by twisting their arms and legs in opposite directions. Upon landing, a skater can use the friction between his or her feet and the skateboard to twist the upper body back into alignment.

Believe it or not, this is exactly how a cat always manages to land on its feet. By extending and retracting its front and rear legs, the cat changes its rotational inertia. While falling, the cat extends its rear legs and twists the front half of its body toward the ground. The rear half rotates in the opposite direction, but not as far. Then the cat extends its front legs and twists its tucked rear legs toward the floor. By repeating these motions, the cat gains sufficient net rotation to guarantee that its feet point downward when it strikes the ground.

From: www.exploratorium.com

Skateboard Worksheet

Name:_____

1. Draw a diagram of a skateboard and name all the parts. On that same diagram, label the forces that act on the system (skateboarder and board) while he/she is NOT moving.

2. How do the wheels help overcome friction? What is another object that we use in daily life that also utilizes this strategy for overcoming friction?

3. Draw a small diagram of a skateboarder doing an ollie (stick figure are fine) OR describe how it is done in words.

Skateboard Worksheet

Name:_____

Directions: Explain how Newton's Laws pertain to the physics of skateboarding. Use examples or pictures if you need to.

Newton's First Law:

An object at rest or moving at a constant speed in a straight path continues to do so until a net force acts on it.

Newton's Second Law:

An object acted upon by a net force will accelerate in the direction of this force.

Newton's Third Law:

Forces always act in equal but opposite pairs.

Skateboarding and Physics Vocabulary

Name:_____

Directions: Define these terms in your own words as they relate to skateboarding.

1. Friction:

2. Inertia:

3. Forward Momentum:

4. Center of Gravity:

5. Acceleration:

6. Action/Reaction:

7. Gravity:

8. Weight: