

week 12

CD Car

Make a car that will travel the furthest while carrying weight.

Subjects and Skills

- ◆ Circumference, area
- ◆ Velocity, mass, force

Materials

- ◆ Paper
- ◆ Cardboard tubing
- ◆ Straws
- ◆ String, yarn, or twine
- ◆ Four CDs or other disc-shaped objects per team
- ◆ Paper plates
- ◆ Paper bowls
- ◆ Plastic spoons
- ◆ Ramp, slanted board, or nearby hill

Vocabulary

- ◆ Combustion
- ◆ Internal combustion
- ◆ External combustion

Purpose

Engineering and design often require applying principles of a specific design to another purpose. Students will learn how Karl Benz applied the concepts of the bicycle to combustion to invent the first self-powered automobile used for personal travel.

Objectives

Students will learn about and understand:

- ◆ how engineers used the principles of the wheel design to improve transportation's efficiency,
- ◆ the first three-wheeled automobile (optional),
- ◆ how internal and external combustion work to generate usable energy, and
- ◆ how the circumference and area of a circle are applied to solve real-world problems.

Activity Preparation

1. Run off activity sheets.
2. Gather materials and place them in two different areas in the classroom.
3. Bookmark websites to be used in class.
 - a. <http://vimeo.com/26898353>
 - b. <http://www.history.com/shows/modern-marvels/videos/who-invented-the-wheel#who-invented-the-wheel>
 - c. <http://www.howstuffworks.com/engine.htm>
 - d. <http://www.pitara.com/discover/5wh/online.asp?story=28>
 - e. <https://vimeo.com/26894196>

Activity Procedure

1. As a hook for the lesson, show a video (00:48) of the invention of the Dynasphere at Link a.
2. Ask students to think about these questions: Who invented the wheel? When was it invented? How has the wheel changed the way we live?
3. Distribute the activity sheets. Students will read and highlight information and write responses. After students have responded to the first three questions, review and discuss their responses.
4. Discuss ideas from the video “Who Invented the Wheel?” (01:39) at Link b. The wheel was invented around 3,000 B.C. in ancient Mesopotamia. The addition of the wheel to the farmers’ carts allowed for crops to be moved to cities. The discovery of rotary motion occurred around 8,000 B.C. The uses of the wheel were helpful in everyday tasks. Pulleys made lifting heavy stones easier. Water wheels helped to generate power. Rotating gears became essential for a variety of tools.
5. Introduce the term *combustion*. Combustion is the process that takes place when oxygen atoms, heat, and a fuel source react with each other. Combustion is also called burning. For a video (01:38) on combustion, go to Link c. For information on the steam engine, visit Link d.
6. After the students learn about the steam engine, use the video (01:11) at Link e. to introduce Karl Benz’s three-wheeled tricycle.
7. As students finish the independent activity, assign teams and team numbers. Review area and circumference of circles (if necessary) and review the team challenge, answering any questions that students may have.
8. Once 20 minutes have elapsed, direct students to move to a ramp, a slanted board, or a nearby hill with their CD cars for the challenge. Whatever setup you use, you will have to allow enough space for the cars to travel as far as they can, so the area after the incline will have to be cleared.
9. After the challenge, have students complete their activity sheets.
10. If you wish, assign an activity suggested in Extend the Learning With Cars: Activities.

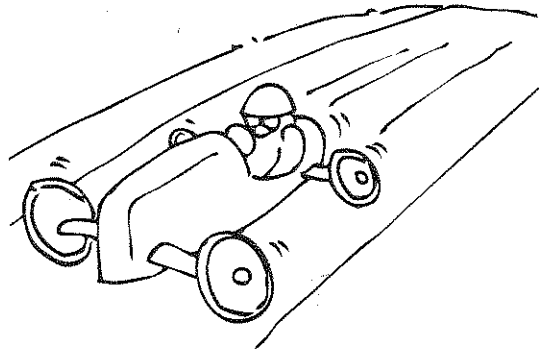
CD Car

GOAL

- Make a car that will travel the furthest while carrying weight.

MATERIALS

- | | |
|--|--------------------------|
| ➤ Paper | ➤ Plastic spoons |
| ➤ Cardboard tubing | ➤ Paper plates |
| ➤ Straws | ➤ Paper bowls |
| ➤ Four CDs or other disc-shaped objects per team | ➤ String, yarn, or twine |



TIME TO CREATE

- 20 minutes

INDIVIDUAL ACTIVITY

Read the following passage, highlighting important information, and then answer the questions.

With the invention of the wheel—which occurred, according to archeologists, in about 6000 B.C. by the Sumerians—the concept of a more efficient mode of transportation took hold. For thousands of years, our fascination with transportation has led us through water, land, air, and space. In the late 15th century, Leonardo da Vinci introduced sketches of a self-powered vehicle. At that time, a self-powered vehicle was a rather farfetched concept.

It didn't come to pass until 1705, when Thomas Newcomen invented the first engine powered by combustion (a chemical process of burning fuel that occurs when a fuel substance reacts with oxygen in the air to give off heat). Newcomen's engine was known as the steam engine, as it was an external combustion engine that converted steam into energy. The steam engine's fuel burned outside of the engine to create steam, which created motion inside of the engine. The steam engine powered all early locomotives, steamboats, and factories.

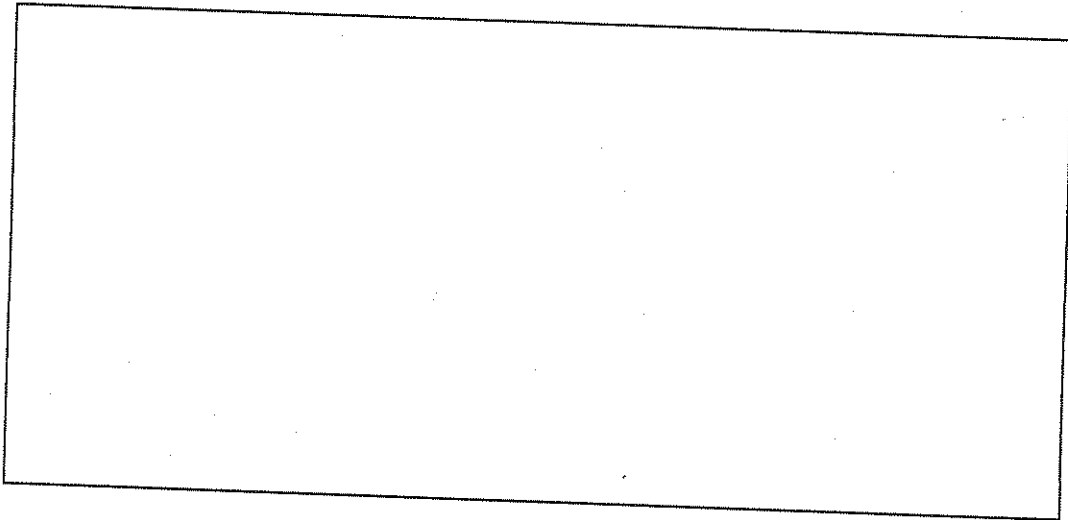
The first steam-driven tractor, introduced in the 1760s, was built as a means of transporting a cannon. The tractor was a large, three-wheeled vehicle capable of traveling at speeds of approximately 3 miles per hour, which isn't much faster than the pace at which a person walks.

Internal combustion is smaller and more efficient than external combustion, and it takes less fuel per mile. In 1885, German inventor Karl Benz produced the first three-wheeled vehicle powered by an internal combustion engine.

1. Who most likely invented the wheel? _____
2. List some ways we use wheels today. _____

3. Over the past couple of centuries, what sources have been utilized to enable vehicles to move? _____
4. About how fast can an automobile travel today? _____
5. If wheeled vehicles had not been invented, how might students go to and from school each day? _____

6. Leonardo da Vinci saw ways that machines could save people time and effort, and he used his creativity and his understanding of machinery to design and sketch his inventions. You are going to design a vehicle of your own. Draw a sketch of what your CD car might look like, labeling specific parts.



7. Look at what materials will be available to you during this challenge. Write into your sketch what materials you will use for each part.
8. Wheels are circular. Write the formulas for finding the area and circumference of a circle.
 Area: _____
 Circumference: _____
9. Find the area and circumference, rounded to the nearest hundredth, of a wheel with a 5-inch radius: A = _____ C = _____

TEAM CHALLENGE

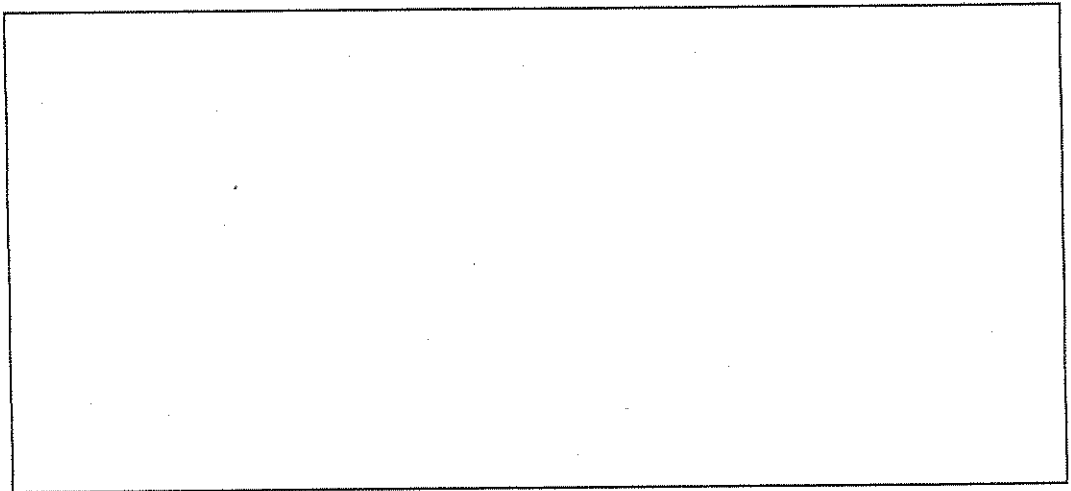
Participants will work together in teams of two or three for 20 minutes to design and build a car that will travel the furthest distance while carrying weight. Each team can incorporate elements of each team member's individual designs, if desired.

When the teacher starts the time, your group will have exactly 20 minutes to gather your materials and build your car. Once the teacher signals that time is up, stop working immediately and proceed with your car to the challenge site. Any team that continues working after the time is up may be disqualified.

Start Time ____:____ + 20 Minutes = ____:____ End Time

After the team challenge has been completed, answer the following questions.

1. Sketch and label your team's car.



2. Record the distance, time, and weight of five different cars. Evaluate the results and write a brief analysis of each car's performance specific to the strengths and weaknesses.

Team #	Distance in Inches	Time in Seconds	Weight	Analysis

3. Which car was able to travel the furthest with the most weight? _____
4. What do you think contributed to the success of the car that was able to carry a load the furthest? _____

5. If you were going to build a car capable of transporting a person, what materials would you use? _____

6. How would the car move? _____

7. How might cars change over the next 25–50 years? _____

EXTEND THE LEARNING WITH CARS: ACTIVITIES

1. **Explore cars' effects on the environment.** With soaring gas prices and concerns for air quality, it has become necessary to investigate alternative fuels for our cars. CNN has dedicated coverage to enlightening Americans on the impact of our oil consumption. Research a variety of articles and videos by visiting <http://www.cnn.com/SPECIALS/2008/fueling.america>, and complete a report on alternative fuels. Select a topic to report on from the information, and then act as a video journalist to create a news report. Your analysis should include comparisons of miles per gallon for various cars. Your purpose is to educate others to use public transportation and/or alternative fuels as a resource.
2. **Make a persuasive speech or report about alternative fuels.** Conduct research and then summarize what you have learned about what must be done to make a positive change. For compelling facts, review the U.S. Department of Energy's statistics on alternative fuels at <http://www.afdc.energy.gov/afdc/fuels>. You can also visit the following websites to gather information:
 - ◆ http://www.pbs.org/newshour/indepth_coverage/science/alt_fuels/
 - ◆ <http://www.energyquest.ca.gov/transportation/biodiesel.html>
3. **Design the car of the future.** Visit <http://www.pbs.org/wgbh/nova/tech/car-of-the-future.html>, a powerful NOVA presentation (53:12) about two brothers' journey to make a car of the future. Continue to the Model of Efficiency at <http://www.pbs.org/wgbh/nova/car/efficiency.html>. Learn about the changes in car design, materials, safety, weight, software, functionality, aerodynamics, air drag, style, tires, speed, accessories propulsion, fuels, internal combustion, biodiesel, and concept cars from real-life car companies (e.g., Toyota, Nissan, Mazda). Design your own car of the future, and write a page about the elements of your car that make it an improvement over current vehicles.