Discovery Lesson

TEACHER ENRICHMENT RESOURCE PACKET

Wheels to Wings

September 13 - January 9, 2011

Planes, trains, and automobiles! From the wheel to the jet engine, humans have created many ways to move around. Examine the different forms of transportation in use around the world. Learn about bike and car safety and how our transportation choices today can affect our environment and our future.

Learning Objectives:

Learning objectives provide a broad overall guide to what students will begin to experience and understand through this TERP and through participation in Explorit's "Wheels to Wings" *Discovery Lesson*. During this *Discovery Lesson*, students will be exposed to the following ideas:

- Machines are used to apply pushes and pulls (forces) to make things move.
- Machines and living things convert stored energy to motion and heat.
- Many different modes of transportation have been available to people throughout the ages.
- Safety precautions are important to consider when choosing and using different modes of transportation.
- Some forms of transportation use more natural resources and cause more pollution that others.
- The many forms of transportation have environmental, economic and social impacts.

Think it.
Try it.
Explorit.

Contents:

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Welcome to Explorit Science Center

Thank you for choosing Explorit Science Center's *Discovery Lesson* program to supplement your ongoing science curriculum. Whether you use the program to kick off a new unit, wrap up a nearly completed unit, or purely to excite and interest your students in the wonderful world of science, advance preparation and follow up with your students are critical to achieving the greatest educational benefit from this unique science experience.

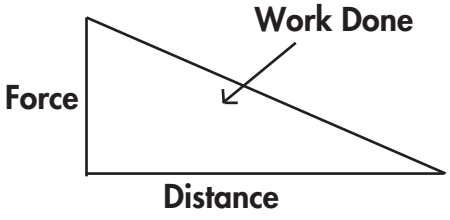
Explorit provides two resources to help prepare you and your students for the *Discovery Lesson*. First, simple logistics of the program are detailed in the confirmation letter. Second, this Teacher Enrichment Resource Packet outlines appropriate science content and processes to help you:

- successfully prepare your students prior to visiting Explorit;
- participate fully in the *Discovery Lesson* yourself; and
- follow-up with your students back in the classroom.

"Wheels to Wings" Background Information

Science and History of Transportation

Transportation involves moving people or cargo from place to place. In other words, the many forms of transportation help us do work. In physics, work is when a force moves an object a certain distance. A force is a push or a pull. If a force does not cause an object to move, no work is done. Simply put, the formula for work is:



WORK = FORCE X DISTANCE

Machines make work easier for us by providing some trade-off between the force applied and the distance. In most cases, they decrease the force needed to move something by increasing the distance over which that force is applied.

Elevators use pulleys to lift. Cars, trains and trucks have wheels. The wheel and axle and the pulley are two types of simple machines. There are 6 kinds of simple machines that help us in different ways. They are: levers, wheels and axles, pulleys, inclined planes (ramps), screws and wedges. If two or more simple machines work together as one, they form a compound machine. A wheelbarrow is a good example of a compound machine because it acts as a lever, but it also uses a wheel and axle. Even the most complicated machines are often combinations of these basic simple machines.

etc.usf.edu/.../45175/45175_cartier_ship.htm

One of the earliest forms of transportation was the boat. Due to buoyancy, travel by water allowed people to move heavier goods than they could on land. Buoyancy is the upward force on an object (like a boat) that comes from the fluid it is surrounded by. This force is caused by a difference in pressure of the fluid at the top and bottom of the object. The buoyant force on an object is equal to the weight of the fluid displaced by the object.

An object's density also affects how it floats. Density is the ratio of an object's mass (or weight) to its volume (how much space it takes up). Pure

etc.usf.edu/.../24100/24135/battleship_24135.htm

water has a density of 1 g/ml. Anything with a greater density will sink, while objects with a lower density will float. So why does a steel ship float if steel is more dense than water? It has to do with the shape of the ship. The ship has a large surface area, meaning the steel is spread out to form a thin outer hull, while most of the inside is air. Together the ship and the air inside are less dense than the water the ship is floating on. While the ship is being forced down by gravity, the water is exerting a greater buoyant (upward) force on the bottom of the boat. If a ship has too much weight, the force of gravity overcomes the buoyant force and the ship sinks. Salt water is more dense than fresh water, so the same ship will float higher in salt water than in fresh water.

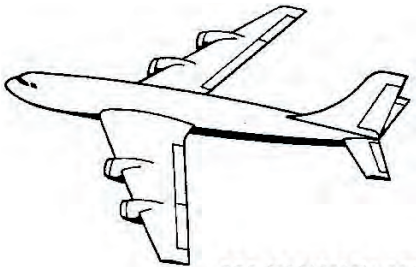
Besides using boats, early civilizations traveled by foot and moved goods using sledges, log rollers, and eventually domesticated animals. But sometime around 4000-3500 BC, the first wheels took shape in either Mesopotamia or Asia. With the invention of the wheel came a myriad of vehicles, from the earliest two-wheeled chariots to the many choices available to us today. With bicycles, trains, cars, trucks, skateboards and wheelchairs, it is hard to imagine life without the wheel. Wheels have provided us our main forms of transportation over land for centuries, but eventually we looked to the skies.

etc.usf.edu/.../51391/51391_wright_aerop.htm

The invention of the airplane by the Wright brothers in 1903 was a milestone in the history of travel. As air travel became safer and more practical as a popular means of transportation, the world became a much smaller place. People could travel to distant countries in just a few hours rather than several days or weeks. But how are heavy metal aircraft able to stay up in the air? The answer is rather complicated, involving difficult mathematical equations and seemingly conflicting theories.

Airplanes have four forces acting on them when they fly. Their weight is a downward force caused by gravity. To overcome that force, they must produce lift in order to fly. To move forward, the engines provide thrust while friction with the air creates drag, or air resistance, that pulls the plane backwards.

Exactly how airplanes produce lift is not fully understood, but many theories have been argued. The basic shape of an airplane wing is called an airfoil. As it moves through the air, a pressure difference is created, with low pressure on the top of the wing and higher pressure along the bottom. The higher air pressure under the wing lifts the plane up.



www.lucytravels.com/airplane-coloring-pages.html

Lift also depends on the angle at which the wing approaches the airstream. This angle of attack determines how much air gets deflected off the wing. If the angle is not great enough, no lift will be produced. If the angle is too great, there will be too much turbulence and the plane will stall.

Eventually our human curiosity led to the desire to explore beyond our atmosphere. American physicist Robert Goddard, known as "the father of modern rocketry," was one of the first to experiment with the idea of spaceflight. So how do rockets fly? Imagine what happens when you inflate a balloon and then release it. The balloon doesn't stay in one place as the

German v-2 Rocket
avoca.ndirect.co.uk/enigma/enigma12.htm

air rushes out - it flies around the room. Rockets, from the tiny to the very large, work the same way. When fuel is pushed out the back of a rocket it forces the rocket to move in the opposite direction. This is an example of Sir Isaac Newton's third law which states that for every action there is an equal and opposite reaction. In this case the action is the fuel moving out the back of the rocket and the reaction is the rocket moving forward. Fins on the side of the rocket help stabilize it and keep it moving forward.

The first rocket to reach space was the German V-2 Rocket in June 1944. In October 1957 Russia launched Sputnik 1, which was the first artificial satellite to orbit Earth. The furthest distance a manned spacecraft has traveled is to the moon during the United States' Apollo missions in the late 1960s and 70s.

Along with our ability to travel around our planet and beyond comes a responsibility to safety and the environment. Following all of the laws and safety recommendations when walking, biking, and driving can prevent accidents from happening. Devices such as bicycle helmets, seat belts, and car seats keep people safer when accidents do occur.

When a car is stopped suddenly, like in an auto accident, objects in the car will continue to move in the same direction. A person without a seat belt on may hit the windshield or be ejected from the car. A seat belt or car seat stops the person from flying forward and keeps them in their seat. In most cases, this is safer than being thrown from the car, which can result in head injuries. The National Highway Safety Administration and AAA recommend that children stay in a booster seat until they are 4'9" tall and 8 years old. Children under 13 should always sit in the back seat where it is safer.

A bike helmet is a hard covering used to protect your head in a fall. In a crash, the plastic shell of the helmet spreads the force of the crash over a large area of your head while the foam lining cushions and absorbs shock. This protects your skull and brain. Bike helmets come in many styles and sizes. No matter what helmet you choose, it is important that it fit you properly. It should never be too loose.

As we look to the future of travel, we must reflect on the impact our inventions and choices have had on our planet. Air pollution, water pollution and noise pollution are just some of the problems associated with some forms of transportation used in the past and present. Our dependence on fossil fuels to run many of our vehicles has led to environmental and social changes and challenges. Efforts are underway to develop new energy sources and new types of vehicles that will have less of an impact on the planet. In the mean time, we as individuals can think about our daily transportation choices and their affect on the environment.

Supplemental Resources

PICTURE BOOKS

I Love Trucks - Philemon Sturges and Shari Halpern
Two Little Trains - Margaret Wise Brown and Leo And Diane Dillon
Cars - Anne Rockwell
Planes - Anne Rockwell
Trains - Anne Rockwell
Boats - Anne Rockwell
Taxi Dog - Debra Barracca, Sal Barracca, and Mark Buehner
Scuffy The Tugboat - Gertrude Crampton and Tibor Gergely
The Little Red Caboose - Marian Potter
Lisa's Airplane Trip - Anne Gutman and Georg Hallensleben
Tonka If I Could Drive A Grader - Michael Teitelbaum and Isidre Mones
Tonka If I Could Drive A Car Hauler - Michael Teitelbaum and Isidre Mones
Train Song - Harriet Ziefert and Saaf
Freight Train - Donald Crews
Truck - Donald Crews
Inside Freight Train - Donald Crews
Busy Boats (Amazing Machines) - Tony Mitton and Ant Parker
Tremendous Tractor - Tony Mitton and Ant Parker
Chugga, Chugga Choo Choo - Kevin Lewis and Daniel Kirk
My Truck is Stuck - Kevin Lewis and Daniel Kirk
Drive A Tractor - DK Publishing
Cars and Trains, Ships and Planes - Catherine Hernandez

WEB SITES

America on the Move
http://americanhistory.si.edu/onthemove/
Timeline - The History of Transportation
http://inventors.about.com/library/inventors/bl_history_of_transportation.htm
Transit People
http://www.transitpeople.org/lesson/trancovr.htm
The History of Transportation
http://www.essortment.com/all/transportationh_rgly.htm

Classroom Activity #1

Leonardo's parachute design
© Biblioteca Ambrosiana, Milan.
Codex Atlanticus, f.1058v.

ACTIVITY #1 - Falling Paper

Mankind has always strived for achieving the impossible. Moving from wheels to wings was only one of man's successes in transportation. The first parachutes were designed by Leonardo da Vinci. He was able to make use of air resistance to hover above the earth. His chute consisted of linen cloth held open by a pyramid of wooden poles. In his journal he remarked that with such a device anyone can jump from any height without injury.

In the late 18th century, a foldable silk parachute with a hole near the top of the canopy to stabilize it, was developed. Then in the late 19th century, the harness and the concept of packing the parachute in a container was introduced. However, it was not until 1920 that the modern fold-up parachute with a ripcord was patented.

Objective:

In this activity students will have the opportunity to explore and experiment with different materials and ideas to find out how things move through the air.

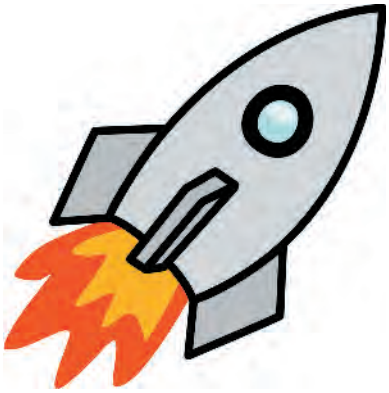
Materials:

2 pieces of the same size paper
Plastic grocery bag
4 pieces of string 12" long
Paper Clip
Tape
Scissors

Procedure:

1. Crumple one piece of paper and keep the other uncrumpled.
2. Hold them both up at arm's length and drop them.
3. *What happens? What seems to keep the flat sheet from falling quickly?*
4. The flat sheet has a greater surface for air to push against. (The spread out wings of a plane give it that same lift.)
5. Cut the plastic grocery bag into a 12" x 12" square.
6. Attach a 12" length of string to each corner with clear tape.
7. Gather all the strings together at the bottom.
8. Hang a small paper clip there as a weight.
9. Open the chute and let it fall from a high place.
10. *How does its flight compare to the flat and crumpled paper?*
11. Use scissors to cut 2 small slits into the center of the chute.
12. Let it go again.
13. Experiment with different-sized chutes, holes, and weights.

Classroom Activity #2



ACTIVITY #2 - Rocket Propulsion

Propulsion systems are governed by Newton's 3rd Law of Motion which says that "for every action there is an equal and opposite reaction." A balloon provides a simple example of how this works. The air trapped inside the balloon pushes out the open end, causing the balloon to move forward. The force of the air escaping is the "action" mentioned in Newton's 3rd Law. The movement of the balloon forward is the "reaction" predicted the same Law.

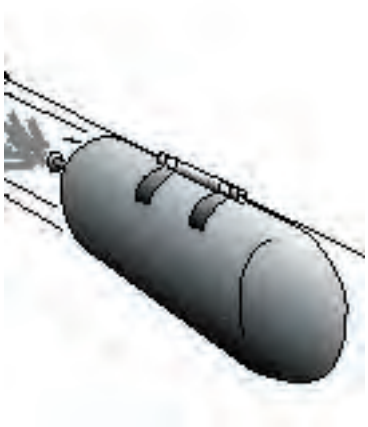
The distance that a balloon will travel when restricted to a straight line is related to the amount of air trapped inside the balloon when it is released. Similarly, the distance a rocket will travel is related to the amount of fuel trapped inside the rocket engine and the properties of that fuel.

Objective:

This experiment will allow students to investigate how filling balloons with different amounts of air affect how far they will travel along a straight path.

Materials:

2 Chairs
Long length of string (~10-20 ft.)
Tape
Drinking Straw
Long Balloon



Procedure:

1. Split the class into groups of two or three and give each group a length of string, tape, a drinking straw, and a balloon.
2. Ask each group to tie their string to a chair and blow up the balloon as much as possible.
3. While a student holds the balloon shut, have another student tape a straw to the top of the balloon and thread the string through the straw.
4. The other end of the string gets tied to another chair.
5. Have the students let go of the balloon and observe the balloon's propulsion. (If the balloon doesn't move properly, adjust the location of the straw.)
5. The force of the air leaving it propels the balloon forward.
6. After the first run, each group should fill their balloon with a different amount of air and record which amount propels it forward the most and least, using a ruler to measure how far they go.

Classroom Activity #3

Japanese Map Symbol for Museum

Activity #3 - Transportation Museum

A museum is a place where people can go to look at and learn about different things. There are different kinds of museums, such as art museums, computer museums, science museums like Explorit Science Center, and history museums.

Objective:

Children will learn about different vehicles by creating their own transportation museum. By organizing the displays in their museum, they will also develop a better understanding of the educational value of museums.

Materials:

Index cards
Construction paper
Donor Chart (included)

Procedure:

1. Ask children if they know what a museum is. Encourage those children who have visited a museum to talk about their experience. What did they see? What did they learn? Were there things for them to touch? What did they like most about the museum?
2. Explain to children that they are going to create their own transportation museum in the classroom. Brainstorm a list of different vehicles. Encourage children to think of all modes of transportation, including vehicles for land, air, sea, and space. Record their suggestions on a piece of chart paper. Some children may have toy cars, trains, planes, boats, or spaceships at home. Ask them to bring in one or two of these vehicles to display (temporarily) in the museum. You may want to use the Donor Chart to keep track of who brought in which vehicle. If some children don't have any vehicles that they can bring in for the museum, have them choose a vehicle to draw. Explain that their pictures can also be displayed in the museum.
3. When you have assembled all the vehicles and drawings of vehicles, display them on a large table. Then discuss with children how they want to organize their museum. Do they want to group all land vehicles together, all air vehicles together, all sea vehicles together? Do they want to separate trains from cars and trucks? Do they want to group together vehicles that are made to carry people? Do they want to place them on a timeline of when they were invented?
4. When children have decided how to organize the exhibits in their museum, help them set it up. Depending on how many items you have to display, you may want to use a table near a bulletin board or several flat surfaces around the classroom. Then pass out index cards to have children label their donations with the name of the item and their own name.
5. When the museum is finished, invite children from other classes to view it. Have volunteers show the visitors around the museum and answer any questions they may have.

Transportation Museum

Donor Chart

Item	Donor

Science Standards for Wheels to Wings

CA STANDARDS

Kindergarten: 4a,b,c,d
Grade 1: 4a,b,c,d
Grade 2: 1d,f 4a
Grade 3: 1c 5a,c,d,e
Grade 4: 1d,f,g 6c,d,f
Grade 5: 6a,b,f,h
Grade 6: 3a,b 7b,e

Explorit Programs for Schools and Groups

At Explorit's Sites

Discovery Lessons & Inquiry Labs Visit one or more of the Changing Exhibitions throughout the year
Nature Safaris Fall and Spring visits to Explorit's outdoor spaces at Mace Ranch Park

Explorit in Your Classroom

Classroom Adventures Science Investigations for Grades K-6
Young Scientist Series Science investigations through multiple visits

For the Whole School

Health in Your World Learn about keeping your body and the world healthy and safe
Science in Your World The ultimate family science night
Science Assembly A multi-media presentation for the whole school

Reservations required.

For information please call
530.756.0191

HOW TO CONTACT US

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