SYNOPSIS:

Why do things fall down and not up? If gravity is the reason, how do birds, flying insects, hot air balloons, and airplanes overcome this silent, invisible force and escape earth's boundaries? When astronauts are in space, they become weightless. Does that mean that they have escaped the earth's gravitational force?

The answers to these and other interesting questions are provided in Understanding Gravity. In this program, we are introduced to Sir Isaac Newton's three laws of motion and gravity. We learn how the application of Archimedes' and Bernoulli's principles allows us to float and fly. And we see striking comparisons between modern aircraft and their counterparts in the natural world.

CURRICULUM UNITS:

Aeronautical Science	Engineering	Physical Science
Biology	Entomology	Physics
Botany	Life Science	Space Science
Earth Science	Ornithology	

CAREER OPPORTUNITIES:

Aeronautical Designer/Engineer	Engineer
Aerospace Designer/Engineer	Naturalist
Aircraft Mechanic	Ornithologist
Astronaut	Pilot
Biologist	Physicist

PROGRAM OVERVIEW:

Long ago, Sir Isaac Newton formulated the laws of motion and explanations of how gravity affects motion. This program demonstrates the motion of everything in our world is governed by these laws, and provides fascinating visual comparisons of nature and human invention—flying, floating, hovering, parachuting, soaring, gliding, and dive-bombing—to show the often very similar ways they overcome or use the force of gravity.

Gravity can be thought of as a downward force, and thus objects acted upon by this force obey Newton's law of motion. But how can we explain a hot air balloon rising, the ability to lift another person almost effortlessly while in a pool, or a spider on a silken thread floating away from the wind? In the time of ancient Greece, Archimedes observes that a body will seem to lose an amount of weight equal to the weight of the fluid it displaces. The observation became known as Archimedes' principle. Think now of water and air—a liquid and a mixture of gases—both fluids. When we float in a pool, the water we displace creates buoyancy, which seems to cancel the downward pull of gravity. Likewise, a hot air balloon rises upward because the heated air within it is less dense than the air outside. The outside air is displaced, canceling the downward pull of gravity. Additional examples shown are astronauts experiencing the feeling of weightlessness in an underwater simulator; sea lions, awkward on land, swimming gracefully in the water; and a blimp.

Bernoulli's principle explains just how lift occurs, whether the flyer is a plane, a bird, or another living creature. As a wing moves forward through the air, the air moves faster over its curved leading edge and upper surface than it moves under its lower surface. Now think again of air as a fluid. The faster the molecules within a fluid move, the less the air pressure within the fluid. The molecules of air move faster over the wing, lessening the pressure above the wing. The pressure below the wing "lifts" the wing upward. Propellers on planes and helicopters are really double wings.

The program ends with a look to the future, when aerospace planes should make space travel as common as getting on an airplane today.

ISSUES AND CRITICAL THINKING:

After showing the DVD ask the following:
What holds our atmosphere close to the earth? (Gravity)
What is gravity? (A force, something like magnetism, which is always around us)
Why is the moon's force of gravity less than the earth's? (Because the earth is much larger than the moon, and the greater the mass of an object, the stronger its gravitational force.)
You weigh 100 pounds on earth. You visit a planet where the force of gravity is half as strong as on earth. How much do you weigh on that planet? You stop at another planet where the force of gravity is ten times as strong as on earth. What do you weigh there?
Why do astronauts in an orbiting spacecraft seem to become weightless? (Because earth's gravitational pull is not as strong outside of our atmosphere.)

Lead the class in a discussion about Newton's three laws of gravity and motion. Ask a student for examples of how these laws apply to things in nature or machines.
Recall the DVD clip of the astronauts hopping across the moon's surface. Conduct a class discussion about what life on earth would be like if the force of gravity was much less and/or much greater than what it is. Have each of the students draw a picture or write a paragraph about some aspects of life in one of the conditions. (Ex- they might have to wear weighted shoes to keep them from bouncing to high off the ground if gravity were much less, or it might be difficult to stand up if gravity were much stronger.)
Discuss Archimedes' principle and how it explains the effects of apparent weight loss in fluids. Perform single experiments to demonstrate Archimedes' principle and test students' ability to estimate. Using paper clips as weights, test the "lifting power" of helium-filled balloons and the buoyancy of aluminum foil boats. Compare the number of paper clips lifted and floated. Ask students to account the difference in balloon size versus boat size required for the same number of paper clips.
Discuss Bernoulli's principle and ask students to recreate

the same experiment shown in the DVD (with strip of paper). Using a funnel and a ping-pong ball, try o "float" the ball by gently blowing in the funnel.

In order to better understand (and remember) the four forces acting upon a plane in flight, ask students to sketch a plane and label correctly. Provide students with an assortment of pictures (jets, helicopters, sailboats, propeller planes, various flying insects, birds, "flying" mammals, wing designs). Ask students to comment on shape as related to the four forces.

Some in expensive binoculars for up-close bird watching, video or film clips showing birds in flight, or a visit to an aviary can provide background for research, on wing a feather type and design. Ask students to compare how bird wings and feathers are mimicked by ailerons, flaps, rudders, and spoilers on aircraft.

And last but not least, conduct a paper airplane design contest. Aw a rd prizes for highest, longest, best directionally controlled flights, or best boomerang-style flight.

GLOSSARY:

ACCELERATION- For the purpose of simplification in this program, increasing speed. However the scientifically correct definition is the rate of change in velocity with respect to time (ex- g=9.8m/sec).

AERODYNAMIC- Pertaining to forces acting upon any solid or liquid moving in a gas (air).

ARCHIMEDES' PRINCIPLE- A body immersed in a fluid undergoes an apparent loss in weight equal to the weight of fluid it displaces.

ATMOSPHERE- The envelopes of gases surrounding the earth.

BERNOULLI'S PRINCIPLE- As the speed of a stream of fluid increases, its pressure decreases.

BUOYANCY- The vertical force exerted by a fluid on a body floating or submerged in the fluid.

DRAG- The horizontal force opposing thrust

FLAPS- Typically, an extension of a wing's trailing edge used to increase wing surface area resulting in an increase of lift.

FORCE- An influence on a body that causes it to accelerate.

GRAVITY- The gravitational attraction of a body of greater mass for a body of lesser mass.

LIFT- The upward vertical component of the four forces acting on a wing or entire plane.

MASS- For the purpose of simplification, the amount of matter making up an object. The scientific definition is a quantity equal to an object's resistance to being accelerated.

ORBIT- A closed path followed by an object under the influence of gravity.

PENDULUM CLOCK- A clock using a swinging pendulum to produce a regularly occurring action.

SPOILERS- Plates which can be made to project upward from an airfoil (wing) to disrupt the smooth flow of air and thereby increase drag and "spoil" lift.

THRUST- The forward horizontal component of the four forces acting on a wing/entire plane.

WEIGHTLESS- Being in a condition described as zero gravity, in which no acceleration, gravity, or any other force can be detected.

TMW MEDIA GROUP
2321 Abbot Kinney Blvd., Venice, CA 90291
(310) 577-8581 Fax (310) 574-0886
Email- sale@tmwmedia.com
Web- www.tmwmedia.com

Producers & Distributors of Quality Educational Media

The Wonders of Physics & Chemistry

Show Me Science

K4417DVD

UNDERSTANDING GRAVITY