

SUGGESTED REFERENCES

- Joiner, James T.
NOAA Diving Manual: Diving for Science and Technology, Fourth Edition
- *Amusement Park Physics*
<http://www.learner.org/exhibits/parkphysics/>
- *Designing your own roller coaster*
<http://www.funderstanding.com/kas/coaster/>
- *The official Blue Angels website*
<http://www.blueangels.navy.mil/>
- *Science fun with airplanes*
<http://www.ag.ohiostate.edu/~flight/homepage.html>

NATIONAL SCIENCE EDUCATION STANDARDS

Grades K - 4

Physical Science

Position and motion of objects

Life Science

Characteristics of organisms

Grades 5 - 8

Life Science

Diversity and adaptations of organisms

Science and Technology

Abilities of Technological Design

*Source: *National Science Education Standards, 1996, National Academy Press*

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SCIENCE SCREEN REPORT

FOR KIDS

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PUSHING THE LIMITS OF THE HUMAN BODY



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SYNOPSIS

Thrill seekers, extreme sports, and even dangerous professions all push our bodies to their limits. The question is, how much can the human body handle? With the help of science, we are able to create products to assist our bodies in these situations. With newer technology, doctors are able to simulate events on models and monitors - giving insight into what would happen in a real life situation.

In this program, we will explore various activities where people are pushing their bodies to the limit and what happens if they go too far. What creates the thrill inside us that makes us want to ride such a ride? And does participating in a ride like this have any affect on our bodies? Much of our survival depends on medical technologies and doctor's knowledge of how our bodies react to these different kinds of pressure.

CURRICULUM UNITS

- ANATOMY AND PHYSIOLOGY
- BIOLOGY
- HEALTH PHYSICS
- PHYSICAL SCIENCE

RUNNING TIME

17:22

BACKGROUND

Pushing the limits sometimes takes our bodies beyond what's natural for them. We didn't evolve in order to ride roller coasters, fly jet planes, or escape from submarines, yet we can survive these extreme activities. Much of our survival depends on medical technologies and doctor's knowledge of how our bodies react to these different kinds of pressure.

Humans have developed many different technologies. Our understanding of the natural world has allowed us to manipulate it in ways that are not possible by any other species. As a result, we can fly into space, explore the depths of the sea, and travel to almost any place on land. Although these feats are possible, they often put a strain on our bodies, which have not evolved to fly at 800 kilometers per hour or dive down 30 meters into the ocean. These stresses can cause harm that must be treated by a doctor.

How do we react to riding on a roller coaster? Roller coasters are extremely safe, but they are designed to produce a fear response by the body known as the "fight or flight" response. As the brain receives information from the senses about imminent danger, it responds by stimulating the release of a hormone known as epinephrine or adrenaline. The body's systems begin to speed up to be ready to respond to the danger. Evidence of this is shown with a human simulator in a teaching hospital. A dose of epinephrine is administered to the simulator. Immediately, the heart rate rises and blood pressure increases. These responses last until after the danger ends. Once it ends, another effect of epinephrine is mood elevation. This is demonstrated as interviewed subjects all show signs of satisfaction after leaving the roller coaster.

High performance pilots perform aerial stunts flying in close formation at very high speeds. The turns in these stunts produce high G forces. The faster the plane is moving and the tighter the turn means a greater force of gravity on the body of the pilot. High G forces push blood from the top of the body towards the bottom. Without blood to service the brain, the pilot will eventually lose consciousness. A pilot can tell when he is going to "black out" because his vision changes. First, he loses his color vision and everything turns to black and white. Then he gets tunnel vision which soon disappears and the pilot loses consciousness. To counteract the force of gravity, the pilot wears "G force" pants. As gravity increases, the pants inflate pushing blood back up into the top of the body, keeping the pilot from losing consciousness.

The most dramatic segment of the program shows what happens when divers ascend after making a dive. In addition, submariners are trained to survive an escape from a submerged submarine. They are taught to exhale as they ascend from different depths. If they hold their breath during ascent, they can suffer from pulmonary barotraumas. This injury results because of the changes in pressures that occur as the diver ascends. The gas in the lungs is easily expanded by decreases in pressure. If the gas in the lungs is not exhaled, it pushes against the tissue and can cause a rupture in the lungs called a pneumothorax.

With people flying in space or exploring the depths of the oceans, even greater challenges will be placed on the human body. Between new developments in technology and better training of medical personnel, we can ensure that humans pushing the limits will survive.

ADVANCED ORGANIZERS

Prior to showing this program students should have some understanding of the following Benchmarks for Science Literacy, Oxford University Press, which are excerpted and, in some cases, abbreviated below. Refer to the Benchmarks for more information.

Benchmark 6: The Human Organism

Section C - Basic Functions

Know by the end of Grade 2

- The brain enables human beings to think and send messages to various body parts to help them work properly.

Benchmark 3: Nature of Technology

Section C - Issues in Technology

Know by the end of Grade 2

- People are always inventing new ways to solve problems and to get work done. The tools and ways of doing things that people have invented affect all aspects of life.

Know by the end of Grade 5

- Technology has been part of life on the earth since the advent of the human species...it is an intrinsic part of human culture, and it both shapes society and is shaped by it.

*Benchmarks can be found at www.project2061.org/tools/bencho/bolintro.htm

CRITICAL THINKING EXERCISES

1. Brainstorm different activities that students find exciting. How do these activities make students feel? What do students notice about their bodies and state of mind when doing these things? Discuss in class why some students find these feelings exciting while others do not. What do they attribute to the difference?
2. Imagine being on your favorite ride, like a roller coaster. Explain how the ride helps stimulate the flight or fight response by the body throughout the ride. Include as many senses as possible.
3. Why do you think people don't fall out of a rollercoaster when they go upside down and through a loop? In cooperative groups have students discuss and come up with ideas as to why this occurs.
4. Next, conduct an experiment on the concept of G forces and gravity. Fill buckets up with different things - water, crayons, dirt - and swing it around. Do so at different speeds. What happens when you do it slowly, faster? Explain your findings.
5. Research problems that can result from pulmonary barotraumas or pneumothorax. Discuss treatments that doctors can use to help patients recover.

VOCABULARY

Adrenaline	A hormone secreted by the adrenal medulla that is released into the bloodstream in response to physical or mental stress, as from fear or injury. It initiates many bodily responses, including the stimulation of heart action and an increase in blood pressure, metabolic rate, and blood glucose concentration.
Atmosphere	The gaseous mass or envelope surrounding a celestial body, especially the one surrounding the earth, and retained by the celestial body's gravitational field.
Blood pressure	The pressure of the circulating blood against the walls of the blood vessels.
G Force	A unit of inertial force on a body that is subjected to rapid acceleration or gravity.
Gravity	The natural force of attraction exerted by a celestial body, such as Earth, upon objects at or near its surface, tending to draw them toward the center of the body.
Glucose	It is the principal circulating sugar in the blood and the major energy source of the body.
Pulse	The rhythmical throbbing of arteries produced by the regular contractions of the heart, especially as palpated at the wrist or in the neck.

CAREER POSSIBILITIES

- ENGINEER
- EXERCISE PHYSIOLOGIST
- MEDICAL TECHNOLOGIST
- NURSE
- PHYSICIAN
- PILOT
- DIVER