

## 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/k12/coaster/>
- The official Blue Angels website*  
<http://www.blueangels.navy.mil/flashindex.html>
- Science fun with airplanes*  
<http://www.ag.ohio-state.edu/~flight/homepage.html>

## NATIONAL SCIENCE EDUCATION STANDARDS

5 - 8

### Life Science

Diversity and adaptations of organisms

### Science and Technology

Abilities of Technological Design

9 - 12

### Physical Science

Motions and Forces

### Life Science

The Behavior of organisms

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

## CREDITS

The producers thank Channel 4 Television Corporation/4 Learning for materials used in this program.

### EDUCATOR ADVISORY PANEL

Fred Barch, M.S.  
Rose-Marie Botting, M.S.

Debra A. Murnan, B.A.  
John A. Murnan III, M.S.

### PRODUCTION CREDITS

WRITER/PRODUCER:  
ASSOCIATE PRODUCER:  
EDITOR:  
NARRATOR:

John A. Murnan III, M.S.  
Patricia Norman  
Jon Glassman  
J.J. Wilson

# SCIENCE SCREEN REPORT

*Science Brought To Life In The Classroom*

SCIENCE SCREEN REPORT is a proud participant in the Presidential Awards for Excellence in Mathematics and Science Teaching. For more information visit [www.nsf.gov/pa](http://www.nsf.gov/pa)

1000 Clint Moore Road, Suite 211, Boca Raton, FL 33487  
tel: 1.800.232.2133 email: [info@ssrvideo.com](mailto:info@ssrvideo.com)  
[www.ssrvideo.com](http://www.ssrvideo.com)

COPYRIGHT © 2005 Allegro Productions, Inc. All rights reserved.

# SCIENCE SCREEN REPORT

VOLUME 35 ISSUE 4

## PUSHING THE LIMITS OF THE HUMAN BODY



Accreditation Board  
for Engineering  
and  
Technology



Presidential Awards  
for Excellence in  
Mathematics  
and  
Science Teaching



Junior Engineering  
Technical Society  
[www.jets.org](http://www.jets.org)

## SYNOPSIS

Human technological developments have allowed us to test the limits of our bodies. In this program, we look at some examples of humans pushing the limits. When those limits are exceeded, trained health professionals must be prepared to treat any resulting injuries.

Riding roller coasters is something that almost anyone can do. The perceived danger associated with a coaster ride stimulates an adrenaline rush that produces an elevated mood. Flying in a jet airplane at high speeds can produce very high G forces that can cause the pilot to black out and lose control of the airplane. Divers are subjected to changes in pressure that can cause the lungs to burst if they are not careful.

## CURRICULUM UNITS

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

## RUNNING TIME

16:38

## BACKGROUND

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 (aka 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.

Pilots in a high performance team are highlighted. These 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, the higher the 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 as everything turns black and white. Then his field of view reduces to a tunnel. Eventually, the tunnel 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. Submariners are trained to survive an escape from a submarine. They are taught to exhale as they ascend from different depths. If they hold their breath during ascent, they can suffer from pulmonary barotrauma. 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. Gas that fills a one-liter volume at 10 meters depth will fill a two-liter volume at sea level. 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. This gas lies between the organ and the ribs. A doctor treating a patient with a pneumothorax will have to stick a needle between the ribs and release the air. This is demonstrated on a human simulator.

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 video, 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 Grade 8

- Hormones are chemicals from glands that affect other body parts. They are involved in helping the body respond to danger and in regulating human growth, development, and reproduction.
- Interactions among the senses, nerves, and brain make possible the learning that enables human beings to cope with changes in their environment.

## ADVANCED ORGANIZERS (continued)

### Benchmark 8: The Designed World

#### Section F - Health Technology

Know by Grade 12

- Owing to the large amount of information that computers can process, they are playing an increasingly larger role in medicine. They are used to analyze data and to keep track of diagnostic information about individuals and statistical information on the distribution and spread of various maladies in populations.

### Benchmark 3: Nature of Technology

#### Section C - Issues in technology

Know by Grade 8

- New technologies increase some risks and decrease others. Some of the same technologies that have improved the length and quality of life for many people have also brought new risks.

*\*Benchmarks can be found at [www.project2061.org/tools/benchol/bolintro.htm](http://www.project2061.org/tools/benchol/bolintro.htm)*

## CRITICAL THINKING EXERCISES

1. Design an experiment that exposes an insect to temperature change. Describe adaptations that the insect might have to survive the condition.
2. Design a roller coaster that includes at least one loop. Calculate G forces generated by the coaster moving through the loop at different speeds.
3. Research problems that can result from pulmonary barotrauma. Discuss treatments that doctors can use to help patients recover.
4. Flying higher in the atmosphere or diving lower into the oceans involves changes in pressure on the body. Describe how machines such as airplanes and submersibles are designed to create an artificial environment with near normal atmospheric pressure.
5. Choose a roller coaster at your favorite amusement park. Explain how the coaster helps stimulate the fight or flight response by the body throughout the ride. Include as many senses as possible. Compare experiences on different roller coasters.

## VOCABULARY

Adrenaline

Pneumothorax

Blood Pressure

Pulmonary barotrauma

G force

Trachea

Glucose

## CAREER POSSIBILITIES

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