

The Science of the Games

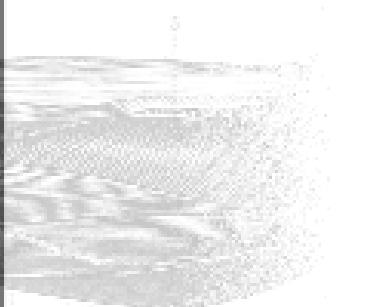
**REACH
FOR THE
RINGS**



**OLYMPIC
EDUCATION**



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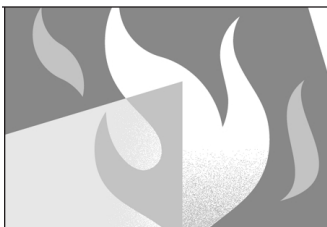
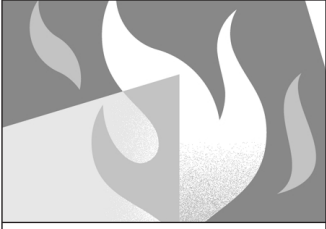


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INTRODUCTION

WHY STUDY SCIENCE AND SPORTS TOGETHER?

Too often, science seems inaccessible to students. They view it as a collection of abstract definitions, charts, tables and mathematical formulas — all of which they must memorize, little of which they see a need to understand. Science careers and scientific discoveries too seem distant possibilities that exist only in remote laboratories.

Sports events, on the other hand, are immediate, exciting and comprehensible. Many students play sports at school and at home after school. Their parents follow college or professional sports teams on a regular basis. Family and friends attend sports events together. In contrast, you can't buy season tickets to a scientific laboratory. And there are few stores in the shopping malls filled with shirts, hats and other paraphernalia dedicated to scientists.

Therefore, it is logical to use sports — a subject students like and understand — as a gateway to teaching about the pervasive and important role science plays in our everyday lives. Sport science shows students how practical it is to understand the physical sciences, life sciences, behavioral sciences, computers and technology.

Newton's third law of physics — that every action has an equal and opposite reaction — seems abstract until you realize that it describes what happens when a swimmer pushes off from a starting block or a volleyball player jumps up to return a serve. Aerodynamics at first seems to relate only to flying airplanes, until you see that cyclists who understand it position themselves on their bicycles in such a way to reduce resistance from the wind. Psychology is not a subject limited to people with mental health problems; athletes use it to help prepare themselves for competitions and maintain a competitive edge throughout an event.

The lessons in “Reach for the Rings: The Science of the Games” introduce students to a number of science topics related to sports. The activities for students enable them to see how those same science topics apply in their own lives.



WHICH SCIENCE FIELDS ARE USED IN SPORTS?

Architecture and engineering: Sport scientists design tennis courts, swimming pools, tracks and stadiums.

Chemistry: Chemists create materials that can be molded into sports and safety equipment, design food products to help improve performance, and work with biochemistry to test athletes' training and fitness levels.

Computer science: Software engineers design programs to measure performance, examine statistics and results of measurements, and analyze databases.

Measurement and timing: Scientists develop technology to help decide the outcome of events, using automated timing systems, electronic equipment to measure speed of balls and positions of landings, and other technology.

Product design: Scientists design sport shoes, weight machines, treadmills, clothes and safety equipment, such as bike helmets, mouth-guards and eyewear. Scientists also design materials for track surfaces, fibers for clothing, bicycle frames, materials to reduce friction and other sports equipment.

Psychology: Psychologists find ways to improve the mental states of athletes, boost their confidence, improve their concentration, overcome fear and reach their highest potential.

Sport medicine: Many branches of medicine include sports-related specialties, such as nutrition, orthopedics, cardiopulmonary medicine (heart and lungs) and neurophysiology (the nervous system).

HOW IS THIS GUIDE ORGANIZED?

This Teacher's Guide is designed to be used as a stand-alone curriculum resource or as a complement to "The Science of the Games" Student Supplement, a 16-page publication that illustrates the application of science to Olympic summer sports. The activities in this guide show students how to connect science topics to real life through newspaper articles and features.

The lessons in the Teacher's Guide parallel the topics in the Student Supplement. Each section in the Teacher's Guide includes:

- A table showing the science topics and applications discussed in that lesson
- A brief introduction to the topic
- Suggestions for introducing the topic to students
- An activity with an accompanying reproducible activity sheet
- An opportunity for students to generate research questions for each topic

These materials from the United States Olympic Committee (USOC) address education standards across the content areas: science, mathematics, social studies, reading and writing. Teachers can use the activities to meet their curriculum objectives in many different subject areas.



SCIENCE AND SPORTS: A WINNING TEAM

Introducing the Lesson

- 1 Have students name the summer Olympic events they like best. List their responses on the board.
- 2 Select one event for discussion. Have students brainstorm all the elements an athlete in that event must include in his or her training (for example, exercise, practice, nutrition).
- 3 Ask students to identify the training elements that could be helped by a certain field of science. Circle the elements and write the appropriate science field next to each.
- 4 Explain to students that people in careers not related to sports can also benefit from science.
- 5 Introduce the activity sheet "The Science Team." Have students share findings.

THE SCIENCE TOPICS RELATED TO SPORT SCIENCE ARE:

Science topic Application

Sport science

- Sport science is a field that applies the methods of science to help athletes optimize performance and stabilize competitive excellence.
- Sport scientists evaluate athletes on endurance capacity, muscular strength, power, flexibility and body composition.
- Sport science fields include sport medicine, product design, measurement and timing, architecture and engineering, computers, chemistry and psychology.

Scientific method

- Sport science uses the same process all scientists go through to try to answer a question:
 - Choose a question.
 - Observe and record data.
 - Examine what's already known.
 - Make a guess (create a model).
 - Test the guess.
 - Observe what happens.
 - Return to examine what is already known.

How scientists and athletes are alike

- Scientists and athletes have common characteristics:
 - They learn to take risks.
 - They learn not to give up.
 - They learn to work as a team.
 - They learn respect for others.
 - They learn to lose.
 - They learn to compete.

EVERYDAY SCIENCE

Often, the student who is good at science and the student who is good on the playing field seem worlds apart. One student is recognized for intellectual ability while the other is recognized for athletic agility. In sport science, the two elements come together. The skills and processes that help scientists — taking risks, sticking to goals, working in teams — also benefit the athlete. The scientist's knowledge of physiology, biomechanics, psychology and physics helps the athlete train more efficiently, prevent injuries and refine performance. These same skills, processes and knowledge help all of us in everyday life as well.



THE SCIENCE TEAM

THINK SCIENCE!

Science is not restricted to laboratories and computer centers. You will find science on the volleyball court, the archery range, the swimming pool and the track. Scientists from many different fields work with Olympic athletes to prevent injury, maximize training and refine performance. Science is also used in everything from road construction to computer programs to cosmetics.

Find a story in the newspaper that illustrates how knowledge of science affects everyday life. Choose an article that is not related to sports. Describe the story and explain how science plays a part in the events reported.

Headline of the story: _____

Science field	Application
Biomechanics How the body moves to accomplish tasks	
Nutrition How food fuels the body	
Physics/chemistry How the design of tools and materials improves performance	
Physiology How the body works	
Psychology How attitude and determination help us achieve goals	

DO SCIENCE!

Write a research question that explores the need for science in a career you might follow.



FITNESS COUNTS

Introducing the Lesson

- 1 List the following words as column heads on the board: endurance, energy, fitness, plyometrics, power, strength, tapering, VO₂max.
- 2 Discuss the definitions of the words.
- 3 Have students suggest Olympic events that fit under each topic — for example, which events use a lot of energy, which require great strength, and so on.
- 4 Ask students to discuss different professions that would fit under the various categories.
- 5 Introduce the activity sheet “Training for Life.” Have students share their findings.

THE SCIENCE TOPICS RELATED TO FITNESS ARE:

Science topic	Application
Endurance	<ul style="list-style-type: none"> • Endurance refers to the ability to maintain a fixed level of power output for a sustained period of time. • Athletes in events that cover long distances (running, cycling, swimming) must be able to continually supply energy to their muscles.
Energy	<ul style="list-style-type: none"> • Energy in this case refers to the body's ability for action. Fuel is stored in muscles. Scientists can measure an athlete's fuel efficiency — how well they perform with the fuel stores in their muscles. • <i>Anaerobic</i> energy is energy used for short, intense events like sprints. • <i>Aerobic</i> energy is energy used for prolonged activities and involves the metabolism of carbohydrates and fat together with oxygen.
Fitness	<ul style="list-style-type: none"> • Fitness experts develop individualized programs to meet the needs of athletes. The programs help athletes maximize their time in the fitness center. • Fitness experts provide cross-training exercises, in which athletes work on muscle groups beyond those most directly involved in their sport.
Plyometrics	<ul style="list-style-type: none"> • Plyometrics is a ballistic type of training that uses body weight to teach muscles to stretch and react very quickly. • Plyometric exercises include broad jumps on a mat. Athletes must be able to press one and one-half times their own body weight before they are allowed to participate in plyometric training.
Power	<ul style="list-style-type: none"> • Power is defined as strength times speed. Athletes in some events must be able to move weight (equipment, their own bodies) quickly.
Strength	<ul style="list-style-type: none"> • Strength is defined as the maximum force exerted in a single effort. • Olympians involved in events that feature lifting, carrying and throwing are concerned with improving their strength.
Tapering	<ul style="list-style-type: none"> • Tapering refers to the practice of reducing the amount of training one or two weeks before a competition. During this time, athletes adhere to core training. • Tapering gives the body time to recover before a major event.
VO₂max	<ul style="list-style-type: none"> • VO₂max refers to the amount of oxygen that is consumed in one minute at sea level. In practical terms, it is a measure of cardiovascular health.

EVERYDAY SCIENCE

Olympic athletes work hard to develop strength, endurance and agility. Marathoners have cardiovascular systems that operate at high levels for many miles. Weight lifters lift and press twice their body weight in a movement that takes only seconds. Gymnasts combine strength, balance and flexibility as they challenge different sets of muscles in a variety of events. But fitness and nutrition are important to more than elite athletes; they are important to all of us. Food servers may be on their feet for eight hours a day. Furniture movers maneuver heavy appliances on and off trucks, around corners and up and down stairs. Even an office worker needs stamina and endurance to handle phone calls, computer work and interpersonal contacts day after day. Scientists give us the knowledge we need to prepare our bodies for the tasks we want to do efficiently and effectively.