The NASA SCI Files™

The Case of the Physical Fitness Challenge

Segment 4

As the tree house detectives start to pull all the pieces together, they are beginning to realize that being physically fit involves more than they thought and that they need to make lifestyle changes. For some advice on how to be physically active for life, they visit Mr. Lynn Swann, former NFL football player and ABC Commentator, who also just happens to have been the Chairman for the President's Council on Physical Fitness and Sports. Mr. Swann helps the detectives learn that physical activity should be fun and something you enjoy doing so that you continue to be active. Meanwhile, the kids back in Scotland have been doing some more research of their own, and they head to the RRS *Discovery* to meet astronaut Alvin Drew to learn what NASA is doing to help keep astronauts healthy during long-duration space travel. Finally, the detectives are ready to put all the pieces together to help RJ get in shape, and they meet Dr. D for a wrap-up explanation that a healthy lifestyle includes many things, but especially proper nutrition and daily physical activity.

Objectives

Students will

- demonstrate the importance of stretching activities before and after exercise.
- simulate the effect of a reduced gravity environment on the human body.
- measure the effects of gravity on the spine.
- make a model of a spine.
- demonstrate the importance of flexibility to movement.
- understand the nutritional value of explorers' meals.
- design a nutritionally balanced diet for long-duration space flight.
- learn the benefits of an active lifestyle.

Vocabulary

aerobic endurance – ability to do moderately strenuous activity over a period of time; reflects how well your heart and lungs work together to supply oxygen to the body during exertion

flexibility – ability to move a joint through its full range of motion

healthy body composition – proper balance of fat in your body compared to your bone and muscle

muscle endurance – ability of muscles to hold a particular position for a sustained period or repeat a movement many times

muscle strength – ability of muscles to exert maximum force, such as lifting the heaviest weight you can, one time

Video Component

Implementation Strategy

The NASA SCI Files™ is designed to enhance and enrich existing curriculum. Two to three days of class time are suggested for each segment to fully use video, resources, activities, and web site.

Before Viewing

1. Prior to viewing Segment 4 of *The Case of the Physical Fitness Challenge*, discuss the previous segment to review the problem and what the tree house detectives have learned thus far. Download a copy of the **Problem Board** from the NASA SCI Files™ web site, select **Educators**, and click on the **Tools** section. The **Problem Board** can also be found in the **Problem-Solving Tools** section of the latest online investigation. Have students use it to sort the information learned so far.
2. Review the list of questions and issues that the students created prior to viewing Segment 3 and determine which, if any, were answered in the video or in the students' own research.
3. Revise and correct any misconceptions that may have occurred during Segment 3. Use tools located on the Web, as was previously mentioned in Segment 1.
4. Review the list of ideas and additional questions that were created after viewing Segment 3.
5. Read the overview for Segment 4 and have students add any questions to their lists that will help them better understand the problem.
6. **Focus Questions**—Print the questions from the web site ahead of time for students to copy into their science journals. Encourage students to take notes during the program to answer the questions. An icon will appear when the answer is near.

View Segment 4 of the Video

For optimal educational benefit, view *The Case of the Physical Fitness Challenge*© in 15-minute segments and not in its entirety. If you are viewing a taped copy of the program, you may want to stop the video when the Focus Question icon appears to allow students time to answer the question.

After Viewing

1. At the end of Segment 4, lead students in a discussion of the Focus Questions for Segment 4.
2. Have students discuss and reflect upon the process that the tree house detectives used to determine the importance of nutrition and physical fitness. The following instructional tools located in the **Educators** area of the web site may aid in the discussion: **Experimental Inquiry Process Flowchart** and/or **Scientific Method Flowchart**.
3. Choose activities from the **Educator Guide** and web site to reinforce concepts discussed in the segment. Pinpoint areas in your curriculum that may need to be reinforced and use activities to aid student understanding in those areas.

4. For related activities from previous programs, download the appropriate **Educator Guide**. On the NASA SCI Files ™ home page, select the fence post that says "**Guides**." Click on the **2002–2003 Season** tab and then click on *The Case of the Biological Biosphere©*. In the green box, click on **Download the Educator Guide**.
   a. In the **Educator Guide** you will find
      a. Segment 3 – *Fitness for Life,* page 46
      b. Segment 4 – *Flexibility is the Key,* page 56

   Click on the **2004–2005 Season** tab and then click on *The Case of the Great Space Exploration©*. In the green box, click on **Download the Educator Guide**.
   b. In the **Educator Guide** you will find
      a. Segment 2 – *Puffy Head, Bird-Leg Syndrome*, page 34

   To locate additional activities and worksheets on the Web, click on **Activities/Worksheets** in the tool bar located at the top of the window. Scroll to the **2002–2003 Season** and click on *The Case of the Galactic Vacation©*. In the **Activities/Worksheet** section, you will find
      b. *Too Short*?
5. Wrap up the featured online PBL investigation. Evaluate the students' or teams' final product, generated to represent the online PBL investigation. Find sample evaluation tools in the Educators area of the web site under the main menu topic **Tools** by clicking on **Instructional Tools**.
6. Have students write in their journals what they have learned about health, nutrition, and physical fitness so that they can share their entry with a partner or the class.

Careers

fitness trainer
pharmacist
physician
professor
science educator
strength and conditioning specialist

Resources *(additional resources located on web site)*

Books

Crelinsten, Jeffrey: *To the Limit.* Harcourt College Publishers, 1992, ISBN: 0152006168.

Frost, Simon: *Flow Motion: Fitness for Young People*. Sterling Publishing Company, 2003, ISBN: 0806993731.

Gaines, Ann: *Female Stars of Physical Fitness*. Mitchell Lane Publishers, Inc., 2000, ISBN: 1584150238.

Jukes, Mavis: *Be Healthy! It's a Girl Thing: Food, Fitness, and Feeling Great*. Crown Books for Young Readers, 2003, ISBN: 0679890297.

Markle, Sandra: *Super Cool Science: South Pole Stations, Past, Present, and Future.* Walker and Company, 1998, ISBN: 0802784704.

Rabe, Tish: *Oh, the Things You Can Do That Are Good for You! All about Staying Healthy.* Random House, 2001, ISBN: 0375810986.

Wells, Rosemary: *Max and Ruby's Midas.* Penguin Group, 2003, ISBN: 0142500666.

Video

NASA Center for Distance Learning: *Destination Tomorrow™: Programs 16 and 17* (two-part series on food in space, looking at what astronauts will eat on future Mars missions)
Grades 9–adult

NASA Center for Distance Learning: *Destination Tomorrow™, Program18: Tech Watch – Challenges of Traveling to Other Worlds*
Grades 9–adult

NASA Center for Distance Learning: *NASA SCI-Files™: The Case of the Galactic Vacation©* (2002)
Grades 3–5

NASA Center for Distance Learning: *NASA SCI-Files™: The Case of the Great Space Exploration©* (2004)
Grades 3–5

Discovery School: *Body in Motion* (2004)
Grades K–5

Discovery School: *Eating for Your Future* (2005)
Grades 5–12

IMAX: *To the Limit* (1989)
Grades 3–adult

Web Sites

NASA KSNN™ (Kids' Science News Network™)
Find the answers to questions like, "Do astronauts need calcium in space?" or "How would your body change in space?" This site includes 60-second animations, activities, and resource links.
http://ksnn.larc.nasa.gov/exploration.html

Space Food
Visit this kid friendly NASA web site to learn about the kinds of foods astronauts eat in space and how they eat them.
http://www.nasa.gov/audience/forkids/home/F_Space_Food.html

Living in Space
On this NASA web site, learn about the foods astronauts eat, view video about space food, copy recipes to make actual space food, and learn what life in space is like.
http://spaceflight.nasa.gov/living/index.html

NASA Human Space Flight
Explore this NASA web site to learn more about the Space Shuttle and the International Space Station (ISS), go behind the scenes of human space flight, and get the latest space news.
http://spaceflight.nasa.gov/home/index.html

The President's Challenge – Physical Activity and Fitness Award Program
The President's Challenge is a program that encourages all Americans to make being active part of their everyday lives. The President's Challenge can help motivate people of any physical activity and fitness level.
http://www.presidentschallenge.org/

The President's Council on Physical Fitness and Sports
This web site is the health, physical activity, fitness, and sports information web site of the President's Council on Physical Fitness and Sports. Find out about the Council and its work, view its publications, and link to the resources of other government agencies as well as to health and fitness organizations.
http://www.fitness.gov/

Fit4Life
The United States Department of Health and Human Services Centers for Disease Control and Prevention's web site for kids has some quick tips for looking and feeling good—both inside and out. Check out Fit4Life for hints on eating healthy and getting active to keep your body and mind working for you!
http://www.bam.gov/fit4life/index.htm

Kidnetic.com
Find out why physical activity is important to your body and its systems.
http://www.kidnetic.com/home/bright_papers/bp_cat2_30.html

Science News for Kids
Discover why stretching is an important part of any physical activity and helps keep your body safe.
http://www.sciencenewsforkids.org/articles/20040505/Feature1.asp

Special Olympics
Learn more about the Special Olympics, which provides year-round sports training and athletic competition to more than 1.7 million people with disabilities in more than 150 countries.
http://www.specialolympics.org/Special+Olympics+Public+Website/default.htm

Space Grocery List
This site contains a list of astronauts' favorite foods you can find at a grocery store.
http://www.spacehab.com/space_grocery_list.pdf

Defying Gravity Online
Want to learn more about bones? This web site contains excellent lessons, hands-on experiments, and visuals to help you understand bone growth and the effects of calcium loss.
http://defyinggravity.net/bone.htm

HealthierUS.gov
Learn more about ways to stay healthy by being more physically fit, eating a nutritious diet, getting preventive health screenings, and avoiding risky behaviors. There are also links to other health-related web sites.
http://healthierus.gov/

Activities and Worksheets

In the Guide

Stretch It Out
Practice some daily stretching moves before and after exercise to help improve your flexibility. 84

Taking a Midnight Stretch
Investigate the effect gravity has on your spine by taking a few simple measurements before you go to bed each night and rechecking your data first thing in the morning. 86

A Spindly Spine
Build a macaroni model of your spine to see just how important flexibility is to physical movement. 88

Have Food Will Travel
Are you tired of eating the same old food every day? Plan a special menu for the astronauts on a long-duration space flight that is both exciting and nutritionally balanced. 90

Finding Physical Fitness
Understanding the words in this puzzle will be your first step towards physical fitness. 92

Stretch and Tone Crossword Puzzle
Get active and use some of the new terms you learned in this program to create your own crossword puzzle. 93

Answer Key
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On the Web

The President's Challenge: Physical Activity and Fitness Awards Program
Learn more about the benefits of an active lifestyle and sign up to participate in the President's Challenge!

Stretch It Out

Segment 4

Purpose

To demonstrate the importance of stretching activities before and after exercise

Materials

masking tape
cm measuring stick
science journal

Background

To move the body, muscles and tendons must be flexible—able to bend and stretch. Some people's muscles and tendons are more flexible than others. With practice, everyone can increase flexibility. Heavy physical activity can cause muscle soreness and tendon damage as the muscles contract. Daily stretching and stretching before and after exercise warms the muscles and connective tissue and increases the flow of oxygen and nutrients to the muscles. Stretching keeps muscles healthy, increases flexibility, and decreases the chances of muscle injury during physical activity.

Procedure

1. Put a strip of masking tape on the floor.
2. Sit on the floor with your legs straight out in front of you.
3. Make sure your back is lined up with the strip of tape on the floor.
4. Place your hands on your thighs, keeping your arms straight.
5. As you slowly exhale, bend at the waist, sliding your hands along your legs toward your feet.
6. Ask a partner to mark the place where your fingertips comfortably reach.
7. Measure the distance between this mark and the tape strip on the floor.
8. Record the length in your science journal.
9. Now do some simple stretches.

   a. Lie on the floor. Lift one leg and grasp the lower leg with both hands. Pull the leg gently toward your nose, keeping the leg straight. Stretch out to the side. Raise the other leg and repeat.

   b. Lie on your stomach. Raise your upper body off the floor, arching your spine. Then raise both feet. Try to touch your head with your toes.

   c. Kneel and sit on your heels. Bend down until your forehead touches the floor. Stretch your arms in front of you. Inhale, then exhale and stretch your arms out a little farther.

   d. Stand with both feet flat on the floor. Bend both knees as far as you can without lifting your heels from the floor. Repeat three or four times.

   e. Lie on the floor. Lift one leg and bend the knee so the lower leg is parallel to the floor. Point the toes forward. Put the toes back and stretch toward the shin. Switch legs.
10. Sit on the floor again, with your back lined up with the strip of tape.
11. Now try reaching towards your toes again.
12. Ask your partner to mark the place where your fingertips reach this time.
13. Measure the distance between this mark and the tape strip.
14. Record the distance in your science journal and calculate any difference in distance.
15. Repeat the activity each day for one week.
16. Record your findings and discuss them.

Stretch It Out

Segment 4

Discussion

1. How did the distance you could comfortably reach change after the stretching exercises?
2. What effect did stretching each day for one week have on your results?
3. Why is stretching before and after exercise important?

Extension

Try bending over and touching your toes. After you complete a few stretching activities, bend over and touch your toes again. Did you notice any difference?

Taking a Midnight Stretch

Segment 4

Purpose

To measure the effects of gravity on the spine

To simulate the effect of a reduced gravity environment on the human body

Materials

cm measuring tape
hardback book
pencil
height data sheet

Background

The force of gravity on Earth pulls down on the body all day, creating resistance that keeps bones and muscles strong. This force also compresses or pushes down on the cartilage discs in the back. These cartilage discs are like flexible sponges that act as shock absorbers as our bodies move. Just like sponges, the cartilage absorbs water, which can be squeezed out when a force pushes on it. During a night of rest, without gravity pressing them down, the cartilage discs expand, creating a temporary height increase.

Space travel has many effects on the human body. One effect is that an astronaut's height increases while he or she is in space. The increase in height happens because there is less gravity to compress the cartilage discs between the vertebrae in the spine. However, the astronauts do not continue to "grow" in space. Once the cartilage has expanded, it will not get any larger, but this phenomenon can cause an astronaut's height to increase by up to five centimeters. When the astronaut returns to Earth, his/her height also returns to normal. The effects on cartilage do not appear to cause any harm to astronauts, but space suits must be designed to compensate for this temporary change in height.

Procedure

1. Remove your shoes.
2. Stand straight with your back against the wall and your heels against the base of the wall.
3. Place a book, spine up, on top of your head. Make sure the edge of the book is against the wall above your head. See diagram 1.
4. Gently move your head back and forth until it feels like the bottom of the book is flat against the top of your head.
5. Hold the book tightly in position against the wall and carefully lower your head away from the wall.
6. Turn around and lightly mark with a pencil where the bottom edge of the book meets the wall.
7. Measure from this mark on the wall to the floor in centimeters.
8. Record the measurement as your "End of Day Height."
9. As soon as you get up in the morning, repeat steps 1–7.
10. Record the new measurement as your "Beginning of the Day Height."
11. Calculate the difference between the two marks. This difference is your "Overnight Height Change."
12. After walking around for 15 minutes, repeat steps 1–7.
13. Continue to walk for 30–45 minutes and repeat steps 1–7 again.
14. Record your findings.
15. Repeat the experiment each day for at least three days.
16. Be sure to keep notes about your sleep habits for each day, including the number of hours you slept each night and whether you got up during the night.
17. Compare your results with friends and family who are conducting the same experiment.

Diagram 1

Taking a Midnight Stretch

Segment 4

Discussion

1. What happened to your height each morning? Why?
2. How did this experiment simulate the effects of space on astronauts?
3. If an astronaut stays in space for an extended period of time, will he/she continue to grow?
4. What design changes would you make to ensure that a space suit fits an astronaut during flight?

Extension

1. Visit the web site: www.defyinggravity.net and click on the Bon-e Voyage link. In the visuals section, you will find a graph that shows data for how an astronauts' height changes while in space. Create a graph that shows what happened to your height each night. Compare your data to the astronauts' data and discuss any similarities or differences.
2. Watch an informative NASA video about the effects of space on the human body by visiting: *http://quest.nasa.gov/space/teachers/liftoff/system.html* Make a list of the effects of space flight on each of the body systems.

Height Data Sheet

	End of Day Height	**Beginning of Day Height**	**Overnight Height Change**	**Time Asleep**	**Notes About Sleep**
Day 1					
Day 2					
Day 3					

Record the time at which height returns to End of Day Height

Time Elapsed (minutes)	**15**	**30**	**45**
Height (cm)			

A Spindly Spine

Segment 4

Purpose

To make a spine model

Materials

small foam plate
foam cup
2 chenille sticks
24 wagon wheel macaroni noodles
hole-punch
scissors

Background

The body is made up of 206 bones that vary in shape and structure. Each bone is designed for a special purpose. The skull, for example, is made up of over 20 flat bones that are joined together and do not move at all. These bones provide the helmet-like protection needed for the brain. Other bones, such as the backbone or spine, are designed to make movement easier. The backbone is made up of thirty-three bones called vertebrae. These small ring-shaped bones protect the spinal cord and allow a wide range of motion that includes bending, lifting, pushing, and twisting.

Procedure

1. Punch two holes next to each other in the rim of a small foam plate.
2. Thread a chenille stick through the holes and twist the end so it is attached to the plate. The plate represents your skull, and the chenille stick represents the spinal cord. See diagram 1.
3. Thread seven wagon wheel macaroni noodles onto the chenille stick. They represent the seven cervical vertebrae or neck bones.
4. Fold another chenille stick in half and twist it around the spinal cord below the noodles to represent your shoulder bones or clavicles. See diagram 2.
5. Thread 12 more noodles on the spinal cord chenille stick. These 12 noodles represent the thoracic vertebrae, or upper backbones.
6. Add five more noodles onto the spinal cord chenille stick to represent the lumbar vertebrae, or lower backbones. See diagram 3 on page 89.
7. Using scissors, carefully cut the rim off a foam drinking cup. With the hole-punch, punch a hole in the back of the cup's rim and attach the bottom end of the spinal cord chenille stick to the rim through the hole. The rim of the cup will represent the pelvis, or hipbones. See diagram 4 page 89.
8. Holding your model carefully, try moving your model in different directions.
9. Observe its movement and record your observations in your science journal.

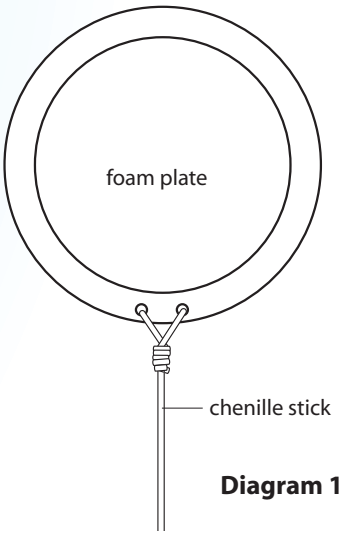

Diagram 1

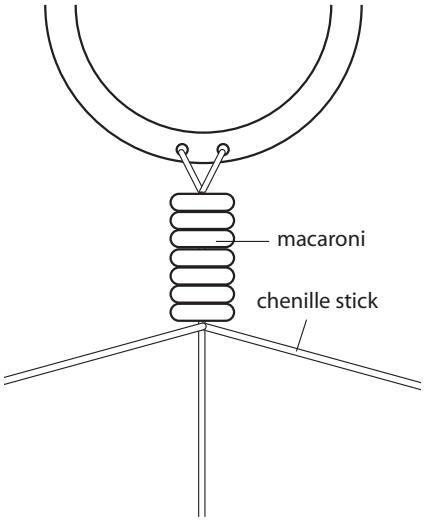

Diagram 2

A Spindly Spine

Segment 4

Discussion

1. How flexible is the model?
2. What would happen if the backbones were fused or stuck together?
3. Why is flexibility important to physical movement?

Extension

1. Put your hands on your back, just above the waist. Feel the muscles contract as you move from side to side or bend over. In your science journal, illustrate what you think your spine looks like and describe how it works with your muscles to move your body.

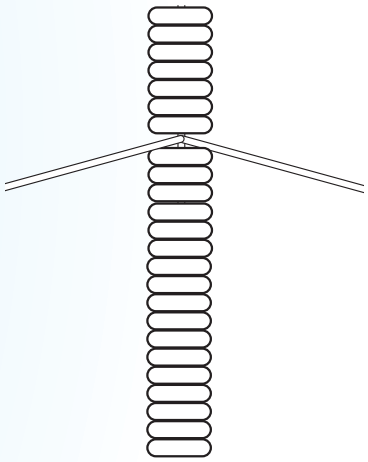

Diagram 3

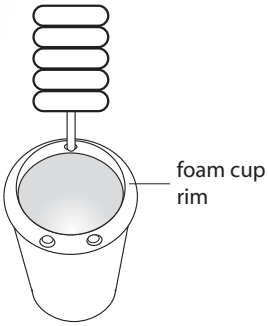

Diagram 4

Have Food Will Travel

Segment 4

Purpose

To understand the nutritional value of explorers' meals

To design a nutritionally balanced diet for long-duration space flight

Materials

computer with internet access
pencil

Background

When Captain Robert F. Scott and the crew of the RRS *Discovery* left England in 1901 to explore Antarctica, they took a variety of foods to meet their nutritional needs. When the explorers were stranded, the demands on them increased and they probably used more energy than they consumed. Although the average person uses about 2,000 calories each day, the explorers in Antarctica may have burned as many as 7,000–10,000 calories per day. By the end of their journey, they had basically no carbohydrates left to eat, existing on mainly seal, penguin, and seaweed. At this point, the explorers neither consumed enough calories to meet their level of activity nor had the variety of foods (especially carbohydrates and vitamins) in their diet necessary to fulfill basic nutritional needs. As a result, the explorers suffered from fatigue syndrome, a condition that made physical labor almost impossible.

Astronauts are also concerned about consuming a healthy diet, especially on long-duration space flights. Astronauts use about 3,500 calories per day, but the effects of space on their bodies sometimes make it difficult for astronauts to get the proper nutrition. For example, fluids in the body shift, leaving crewmembers congested, so food doesn't have much taste. To compensate for reduced taste sensations, astronauts often season their food with hot sauce or ketchup. Astronauts also report just not feeling hungry or being too busy to think about eating.

To be sure the astronauts are getting enough food and the correct amounts of each food type to meet their nutritional needs, nutritionists work with the astronauts and carefully plan their menus for space. To help monitor general food intake, astronauts keep a food frequency journal that records how many items they eat each day. Even beverages and water intake are recorded. As missions to the Moon, Mars, and beyond proceed, space nutrition will change even more. For example, astronauts may need to grow some of their foods. Technology and science will continue to help the astronauts live healthy lives even while they're away from Earth.

Procedure

1. Visit www.mypyramid.gov and click on "My Pyramid Plan."
2. Put in your age, gender, and the amount of physical activity you do each day.
3. Click "submit" and find your average needs for each food group.
4. On the right side of the page, click on the "Meal Tracking Worksheet."
5. Download and print a copy.
6. Use this sheet to keep track of everything you eat in a day.
7. Compare your food intake to the recommended amounts of each food group.
8. In your science journal, write an evaluation of your food choices.
9. Do some research to find out about which foods travel well in space.
10. Plan a 10-day rotating menu for a long-duration space flight. (Remember that astronauts need about 3,500 calories per day and that they will eat these same meals 18 times on a 180-day mission.)

Have Food Will Travel

Activity Sheet

Discussion

1. Why is a nutritionally balanced diet important?
2. What special problems do astronauts face when planning a diet?
3. Why do people have different nutritional needs?

Extension

1. To learn more about the RRS *Discovery* and Captain Robert F. Scott, visit the RRS *Discovery* Museum web site *http://www.rrsdiscovery.com/*
2. Visit the NOVA web site to learn more about the Shackleton expedition to Antarctica: *http://www.pbs.org/wgbh/nova/shackletonexped/1914/*
3. Complete the online adventure to learn more about endurance diets. *http://www.pbs.org/wgbh/nova/shackletonexped/classroom/w4meal.html*. Calculate the number of calories consumed by the Antarctic explorers and evaluate their diets' nutritional quality.
4. Conduct research to learn more about other historic expeditions.
5. When man explored the Moon for the first time in July 1969, we knew more about the Moon than Captain Scott knew about Antarctica when he began his expedition. Research and explain why.

Finding Physical Fitness

Segment 4

Understanding the words in this puzzle will be your first step to better physical fitness, so get hopping and find these words!

aerobic	bone marrow	metabolism	osteoporosis
exercise	calories	musculoskeletal system	flexibility
joint	carbohydrates	nutrients	endurance
muscles	ligaments	Basal Metabolic Rate	strength
stress	macronutrients	proteins	resistive exercise

M C E A N C A M P R Y Y T I L I B I X E L F
U E M O M G A S S E D I T E J O I N T I I I
S M T A M O R P M E T S Y A H E R A E L B G
C O A A E P E R I A K M C I C R I P A O A N
U N M C B I O M B N G K M S T M N T R T S E
L H E E R O S T E O P O R O S I S T E H A O
O I A I N O L K S E I R O L A C E E S Y L U
S J G L Z D N I M D C C L T U O S R I D M F
K L P A E T U U S C T O F L P I S M S R E I
E A I E E E W R T M Z N S O M N E O T S T L
L S M W R T I A A R T V R U E E R H I T A A
E X E R C I S E V N I O R M R I T A V R B M
T N L D S A I N D E C E E M S A S L E E O E
A G E A R S Z A I E S E N O I E P I E N L N
L I G A M E N T S G P T W T B R A N X G I T
S S P A C E S T T T I O O T S O C E E T C H
Y E N S I T Y C N R R E R T E B E I R H R S
S E N E I G P S E E E S R O E I A C C E A N
T E R T C E F F I S I L A I R C C T I C T I
E K A T I I T G R D T B M R B I L L S A E E
M U S C L E S I T D R I E I O Y T I E F R T
G A E M O H S O U I T E N A T I V E N R U O
P E R M E A B L N C S N O K K I N Y N U P R
M F A S E T A R D Y H O B R A C O T S S R P

Stretch and Tone Crossword Puzzle

Segment

Use the words below to create your own crossword puzzle

cardiac muscles	carbohydrates	metabolism	muscles
stress	ligament	nutrients	endurance
bone marrow	macronutrients	proteins	
calories	exercise	flexibility	

Across

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Down

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Answer Key

Segment 4

Stretch It Out

1. Answers will vary, but students should see an increase in the distance they were able to reach after stretching.
2. Students should be able to reach slightly farther at the start of each trial after stretching for a week.
3. Stretching before and after exercise helps the body warm up and cool down, increases flexibility, keeps muscles healthy, and decreases the chance of muscle injury.

Taking a Midnight Stretch

1. Your height increases slightly each morning. During the night, the cartilage discs between the vertebrae in the spine expand, creating a temporary height increase.
2. Because there is little gravity in space, the cartilage discs in an astronaut's spine expand, holding water in them, and thus giving the astronaut added height while he or she is in space.
3. No, the astronaut will not continue to grow. Once the cartilage has expanded, it will not get any larger. Astronauts will also return to their normal height when they return to Earth's gravity.
4. Answers will vary, but students should understand that the astronaut suit must be a closed system, and yet it must be flexible enough to accommodate the change in height.

Have Food Will Travel

1. A nutritionally balanced diet helps ensure that you get enough vitamins, minerals, and calories to meet your activity level.
2. Astronauts are often congested in space, so food doesn't taste good. They also report not feeling hungry and/or being too busy to eat. In addition, astronauts on long-duration flights must eat the same kinds of food several times during the trip.
3. People have different nutritional needs based on their age, size, gender, overall health, and level of physical activity.

A Spindly Spine

1. The model is very flexible, allowing movement in several different directions.
2. If the backbones were fused together, bending would not be possible and other movements would be severely limited.
3. Flexibility is one component of physical fitness. We need flexibility in daily life to do tasks as simple as fastening a button or as complex as playing soccer. Flexibility can increase our range of motion, relieve muscle soreness, and reduce injury risk.

Finding Physical Fitness

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M C E A N C A M P R Y Y T I L I B I X E L F
U E M O M G A S S E D I T E J O I N T I I I
S M T A M O R P M E T S Y A H E R A E L B G
C O A A E P E R I A K M C I C R I P A O A N
U N M C B I O M B N G K M S T M N T R T S E
L H E E R O S T E O P O R O S I S T E H A O
O I A I N O L K S E I R O L A C E E S Y L U
S J G L Z D N I M D C C L T U O S R I D M F
K L P A E T U U S C T O F L P I S M S R E I
E A I E E E W R T M Z N S O M N E O T S T L
L S M W R T I A A R T V R U E E R H I T A A
E X E R C I S E V N I O R M R I T A V R B M
T N L D S A I N D E C E E M S A S L E E O E
A G E A R S Z A I E S E N O I E P I E N L N
L I G A M E N T S G P T W T B R A N X G I T
S S P A C E S T T T I O O T S O C E E T C H
Y E N S I T Y C N R R E R T E B E I R H R S
S E N E I G P S E E E S R O E I A C C E A N
T E R T C E F F I S I L A I R C C T I C T I
E K A T I I T G R D T B M R B I L L S A E E
M U S C L E S I T D R I E I O Y T I E F R T
G A E M O H S O U I T E N A T I V E N R U O
P E R M E A B L N C S N O K K I N Y N U P R
M F A S E T A R D Y H O B R A C O T S S R P
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On the Web

The President's Challenge

Physical Activity and Fitness Awards Program

1. The Active Lifestyle and Presidential Champions programs are for individuals who want to earn awards while becoming healthier.
2. Staying active helps improve heart health, builds strong bones, creates a sense of well being, develops a social life, and improves physical appearance.
3. The web site encourages you to

   a. enter your activities on the activity log

   b. review your progress

   c. earn awards
4. Answers will vary.
5. Answers will vary, but may include any of the activities listed on the Challenge list: take your dog out for a walk; play tag with kids in your neighborhood; help your parents do yard work; see how many jumping jacks you can do, and so on.