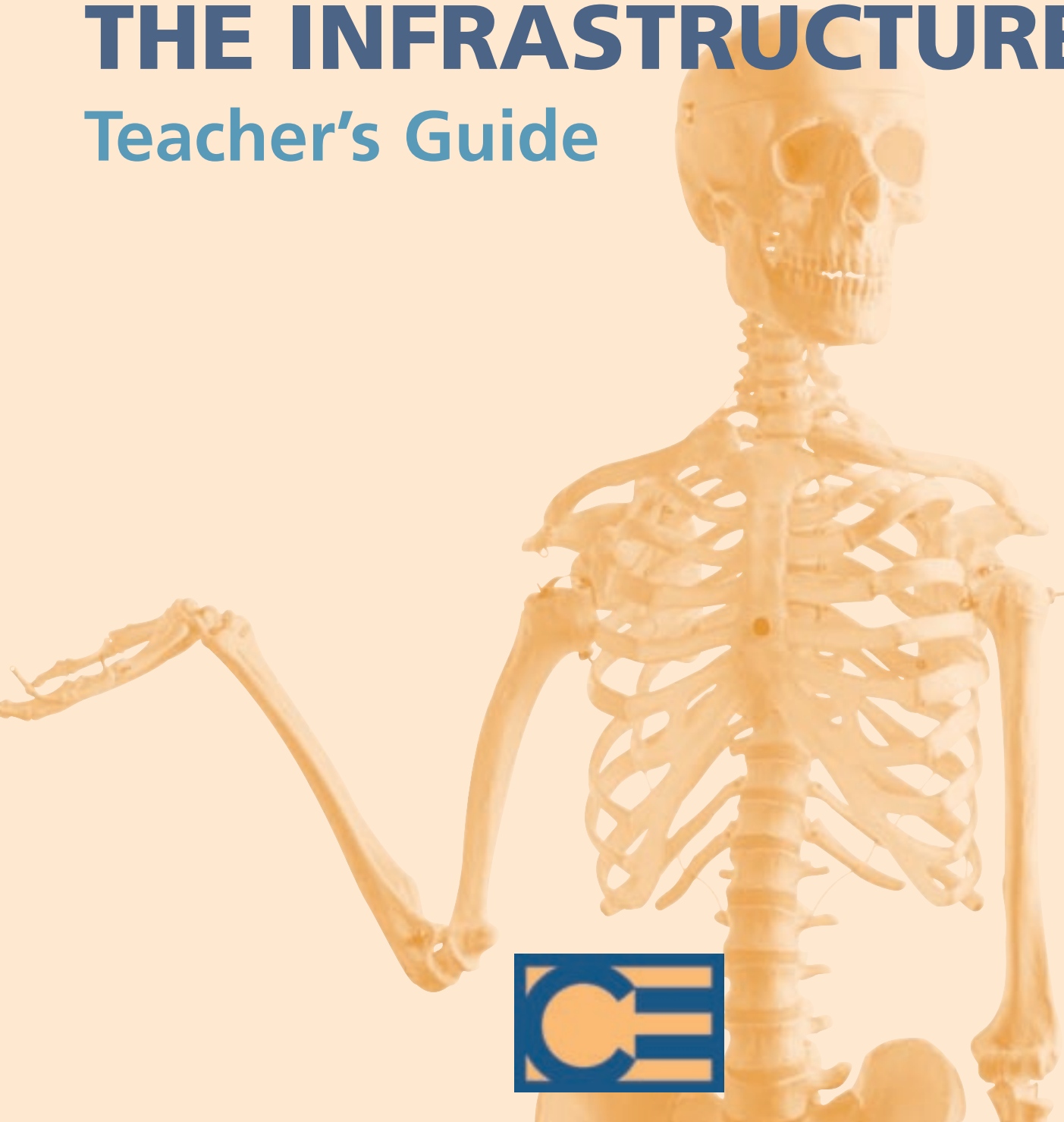


THE HUMAN BODY: SYSTEMS AT WORK

# **SKELETAL SYSTEM: THE INFRASTRUCTURE**

Teacher's Guide



## INTRODUCTION

This Teacher's Guide provides information to help you get the most out of *Skeletal System: The Infrastructure*. The contents in this guide will allow you to prepare your students before using the program and present follow-up activities to reinforce the program's key learning points.

This video provides an introduction to the skeletal system, emphasizing its importance in providing structure and support for the body. A discussion of the major types of joints and bones, and the relationship between them, allows students to gain a solid understanding of why various parts of the body are able to achieve different degrees of motion. Vitamins and minerals required by the skeletal system are also highlighted.

## LEARNING OBJECTIVES

After viewing the program, students will be able to:

- Understand the relationship between joints and bones.
- Discuss the purpose of the musculoskeletal system.
- Name and describe the parts of the musculoskeletal system.
- Name a variety of bones in the skeletal system.
- Name and describe the four major types of joints and the range of movement those joints provide.
- Name and describe the four major types of bones.
- Develop an awareness of the remodeling of our bones' tissue and the necessary vitamins and minerals that aid this process.

## EDUCATIONAL STANDARDS

### National Standards

This program correlates with the National Science Education Standards from the National Academy of Sciences, Project 2061 Benchmarks for Science Literacy by the American Association for the Advancement of Science, and the National Health Education Standards: Achieving Health Literacy by the Joint Committee on National Health Education Standards. The content has been aligned with the following educational standards and benchmarks from these organizations.

- Comprehend concepts related to health promotion and disease prevention.
- Understand personal and community health.
- Understand form and function.
- Understand systems, order, and organization.
- Understand matter, energy, and organization in living systems.
- Understand that in many physical, biological, and social systems, changes in one direction tend to produce opposing (but somewhat delayed) influences, leading to repetitive cycles of behavior.
- Understand that a system usually has some properties that are different from those of its parts, but appear because of the interaction of those parts.
- Understand that a system can include processes as well as things.
- Understand that thinking about things as systems means looking for how every part relates to others. The output from one part of a system (which can include material, energy, or information) can become the input to other parts. Such feedback can serve to control what goes on in the system as a whole.
- Understand how things work and designing solutions to problems of almost any kind can be facilitated by systems analysis. In defining a system, it is important to specify its boundaries and subsystems, indicate its relation to other systems, and identify what its input and its output are expected to be.

- Understand that any system is usually connected to other systems, both internally and externally. Thus a system may be thought of as containing subsystems and as being a subsystem of a larger system.
- Understand that organs and organ systems are composed of cells and help to provide all cells with basic needs.
- Understand that the amount of food energy (calories) a person requires varies with body weight, age, sex, activity level, and natural body efficiency. Regular exercise is important to maintain a healthy heart/lung system, good muscle tone, and bone strength.

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*This represents the work of the Joint Committee on National Health Education Standards. Copies of National Health Education Standards: Achieving Health Literacy can be obtained through the American School Health Association, Association for the Advancement of Health Education or the American Cancer Society. Reprinted with permission.*

## **English Language Arts Standards**

The activities in this Teacher's Guide were created in compliance with the following National Standards for the English Language Arts from the National Council of Teachers of English.

- Use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).
- Use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.
- Conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and nonprint texts, artifacts, people) to communicate their discoveries.
- Adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.

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## **Technology Standards**

The activities in this Teacher's Guide were created in compliance with the following National Education Technology Standards from the National Education Technology Standards Project.

- Demonstrate a sound understanding of the nature and operation of technology systems.
- Use a variety of media and formats to communicate information and ideas effectively to multiple audiences.
- Use technology to locate, evaluate, and collect information from a variety of sources.
- Employ technology in the development of strategies for solving problems in the real world.

- Evaluate and select new information resources and technological innovations based on the appropriateness for specific tasks.

*The National Education Technology Standards reprinted with permission from the International Society of Technology Education.*

## PROGRAM OVERVIEW

This program discusses the musculoskeletal system. Various subjects include the relationship between joints and bones, range of motion, bone injury and disease, and the nutrients necessary to ensure healthy bones.

## MAIN TOPICS

### Topic 1: What is the Musculoskeletal System?

This section discusses the basic purpose of the skeletal system and how our musculoskeletal system acts as the infrastructure of our body by providing the support we need. Also mentioned are the components of the system, the interdependence of these components, and the five functions of the system.

### Topic 2: Bones

In this section, the four types of bones are identified. Several major bones of the body are named and described. The purpose of a cast in healing a broken bone is also illustrated.

### Topic 3: Joints

This section describes the purpose of joints and how joints work with bones to produce movement. The structure and function of various joints are introduced.

### Topic 4: Bone Growth and Replacement

The last section describes the concept of remodeling. The minerals, vitamins, and hormones essential to proper bone growth and replacement are reviewed.

## FAST FACTS

- The most important job of the musculoskeletal system is to provide movement or locomotion for the body.
- A joint is composed of bones that act like levers. The joints provide movement for the body.
- The skeletal system depends on two types of connective tissues: cartilage and bones.
- Spaces between the hard components of bones provide channels for blood vessels, which provide the bone with nutrients.
- The spaces in the bones make the bones lighter. The distribution of the spaces determines whether the bones are compact or spongy.
- The bones serve as storage areas for mineral salts, calcium, phosphorus, and fats.
- Two vital functions of the skeletal system are to support the soft tissues of the body so the body can maintain its form and posture, and to protect the delicate structures like the brain, spinal chord, heart, lungs, and major blood vessels in the thoracic cavity.
- Blood cell production occurs in the red bone marrow.
- The facial and cranial bones are the two sets of bones in the skull.
- There are 206 bones in the adult human body.
- The bones of the leg are the most commonly broken.
- The purpose of a cast is to immobilize the two ends of the bone and keep the bone in its appropriate alignment.

## VOCABULARY TERMS

**amphiarthroses:** Slightly-moveable joints, for example, the sternum.

**cartilage:** A firm, elastic, flexible type of connective tissue.

**diarthroses:** Joints that move freely, such as the elbow and the knee.

**estrogen:** A female hormone important for bone growth.

**flat bones:** Bones that are generally thin and composed of two parallel plates of compact bone that encase a layer of spongy bone.

**irregular bones:** Bones that have complex shapes and cannot be grouped in other categories, for example, the vertebrae and specific facial bones.

**joints:** The moveable or fixed place or part where two bones or elements of a skeleton join.

**ligaments:** A band of tissue, usually white and fibrous, serving to connect bone to bone.

**long bones:** Bones greater in length than width composed of a shaft with two knob-like ends which are larger than the shaft in diameter.

**musculoskeletal system:** The body system composed of the skeleton, muscles, tendons, ligaments and other components of joints.

**osteocytes:** Mature bone cells.

**osteoporosis:** A progressive decrease in the density of bones that weakens them and makes them more likely to fracture.

**remodeling:** The replacement of old bone tissue by new bone tissue.

**short bones:** Bones that are rather cube-shaped and nearly equal in length and width; they have a spongy texture except at the surface, where there is a thin layer of compact bone.

**synarthroses:** Immovable joints, for example, the bones of the skull.

## PRE-PROGRAM DISCUSSION QUESTIONS

1. Have you ever broken a bone, or known someone who has? Describe the experience. What difficulties were encountered?
2. If we did not have a skeleton, what would our bodies be like? What limitations would we have regarding the structure of our body and its ability to function?
3. Human beings differ from other animals because we have a skeleton that allows us to stand and walk upright. How has our skeleton assisted us in dominating the animal kingdom? Think of other examples of how our skeleton has assisted us in surpassing other animals.
4. Why do you think joints are an important part of movement?
5. Name five bones that it would be impossible to live without. Why did you choose those bones?

## POST-PROGRAM DISCUSSION QUESTIONS

1. How does the muscular system work with the skeletal system to provide movement for our body?
2. How would loss of gravity impact our bones and musculoskeletal system?
3. The musculoskeletal system can be compared to the infrastructure of a building. How and why?
4. Explain this statement: "If disease or injury affects one part of the system, the whole system is affected." Why is this true? Draw an analogy from real life to support your answer.
5. What would happen if bones didn't grow or stopped growing too soon? What are some ways to help with this problem?

## GROUP ACTIVITIES

### Schedule an Operation

Develop a game similar to “Operation” using the correct terminology related to bones and joints. Include at least fifteen bones or joints to “operate” on.

### Guest Chiropractor

Visit a chiropractor’s office, or have a chiropractor speak to the class about the structure of the spine, ways to keep the spine healthy, how the health of the spine is connected to the health of the body, and the job of a chiropractor.

### Skeleton Songs

With a partner or in a small group, write a song or poem incorporating the information you have learned about the musculoskeletal system. Have fun with it, but be sure to include factual information.

### X-Ray Vision

Arrange a trip to the X-ray department of a local hospital, or invite a technician to visit the class. Observe several different X-rays of a variety of bones. Compare two different X-rays of a broken bone: one of the bone when it first was broken, and the second of the bone after it has healed. Is the break visible on the X-ray? Does the bone change in appearance or size after it has healed? Draw diagrams of the “before” and “after” X-rays and highlight areas of interest.

## INDIVIDUAL STUDENT PROJECTS

### My Skeletal System

Draw a life-size poster of your body. Fill in and label the skeletal system with the major bones and joints.

### Range of Motion

Choose three different movements, from very simple to more complex. Present these movements to the group using some form of visual aid (model, poster, etc.). Identify the bones and joints involved in each movement and the subtype(s) of joint involved. (The subtypes are gliding joint, hinge joint, pivot joint, ellipsoidal joint, saddle joint, and ball and socket joint.) Discuss how the subtype affects the range of motion.

### Research

How do three members of the medical profession work together to aid people in the health of their skeletal system? Research their jobs and how they work together to provide assistance. How are they interdependent? Write a short summary of each profession.

## INTERNET ACTIVITIES

### Injuries and our Musculoskeletal System

Research an injury to the musculoskeletal system. Discuss body part(s) affected, systems, and treatment and prevention, as well as other pertinent and interesting facts. Use the Internet to gather your information. Present your finding by writing an article that would appear in a magazine or newspaper.



## Bones In Space

Weakening of the bones, due to weightlessness in space, is a potential hazard faced by astronauts. Using the Internet, research the effect weightlessness has on bones and how astronauts protect themselves from this problem while in space. Investigate ways in which observations of astronauts in space can aid researchers in understanding the causes of osteoporosis and developing ways to cure and prevent it. Visit NASA's website to get started: <http://science.nasa.gov>.

## ASSESSMENT QUESTIONS

**Q:** What is the most important job of the musculoskeletal system?

**A:** The most important job of the musculoskeletal system is to provide movement or locomotion for the body.

**Feedback:** Movement occurs when the body signals the muscles to contract. The muscles pull on the bones and joints to cause movement.

**Q:** How do ligaments and tendons share similar functions?

**A:** Both are dense connective tissue which attach one part of the musculoskeletal system to another.

**Feedback:** Tendons, however, attach muscle to bone, while ligaments attach bone to bone.

**Q:** \_\_\_\_\_ provide the bones with nutrients.

- (a) Blood vessels
- (b) Red blood cells
- (c) Ligaments
- (d) Osteocytes

**A:** (a)

**Feedback:** Spaces between the hard components of the bone provide channels for the blood vessels to pass through.

**Q:** What determines whether bones are compact or spongy?

**A:** The distribution of spaces within the bone.

**Feedback:** These spaces make the bone lighter.

**Q:** Blood cell production occurs in the\_\_\_\_\_.

- (a) heart
- (b) osteocytes
- (c) red bone marrow
- (d) ligaments

**A:** (c)

**Feedback:** Red bone marrow also produces some white blood cells and platelets. The process is called hematopoiesis.

**Q:** How are bones categorized?

**A:** Bones are categorized by shape.

**Feedback:** There are four major types of bones, categorized according to shape. They are long, short, flat, and irregular.

**Q:** A cast helps bones to heal by immobilizing the two ends of the bone. (*True or False*)

**A:** True

**Feedback:** This immobilization helps the parts of broken bone to stay in appropriate alignment as the bone heals.

**Q:** Describe the two ways joints are classified.

**A:** Structural classification of joints is determined by the absence or presence of a joint cavity and the type of connective tissue that binds the bones together. Functional classification of joints is determined by the degree of movement the joint is capable of.

**Feedback:** The functional classification includes three types of joints: synarthroses, or immovable joints; amphiarthroses, or slightly moveable joints; and diarthroses, or joints that move freely.

**Q:** \_\_\_\_\_ is a female hormone that is important for bone growth.

- (a) Progesterone
- (b) Calcium
- (c) Testosterone
- (d) Estrogen

**A:** (d)

**Feedback:** Many women lose estrogen as they age. This loss can lead to a condition known as osteoporosis.

**Q:** Which nutrients are essential to normal bone growth and bone replacement?

**A:** The body requires sufficient quantities of calcium, phosphorus, and vitamins A, C, and D.

**Feedback:** Calcium and phosphorus help make bones strong and dense. Vitamin D helps our body absorb calcium and use it in our bones.

## ADDITIONAL RESOURCES

### WEB SITES

#### Human Anatomy Online

[www.innerbody.com/default.htm](http://www.innerbody.com/default.htm)

#### Pennsylvania State University: Biology 129: Skeletal System

[www.bio.psu.edu/faculty/strauss/anatomy/skel/skeletal.htm](http://www.bio.psu.edu/faculty/strauss/anatomy/skel/skeletal.htm)

#### eMuseum@ Minnesota State University, Mankato The Skeletal System

[www.emuseum.mnsu.edu/biology/humananatomy/skeletal/skeletalsystem.html](http://www.emuseum.mnsu.edu/biology/humananatomy/skeletal/skeletalsystem.html)

#### Community Learning Network: Skeletal System Theme Page

[www.cln.org/themes/skeletal.html](http://www.cln.org/themes/skeletal.html)

#### Kid's Health: How the Body Works

[http://kidshealth.org/misc\\_pages/bodyworks/bodyworks.html](http://kidshealth.org/misc_pages/bodyworks/bodyworks.html)

### BOOKS

*Exploring The Way Life Works: The Science of Biology* by Mahlon B. Hoagland, Bert Dodson, Judith Hauck. Jones & Bartlett Pub. 2001. ISBN: 076371688X

*The Skeletal System* by Laura Gilbert. The Rosen Publishing Group, New York, NY. ISBN: 0823933385



*All About Bone: An Owner's Manual* by Irwin M. Siegel. Demos Medical Publishing, 1998.  
ISBN: 1888799161

*Eyewitness Visual Dictionary of the Skeleton* by Richard Walker. Dorling Kindersley Publishing, 1995. ISBN: 0789401355

## OTHER PRODUCTS

*Integumentary, Nervous, and Musculoskeletal Systems*, CD-ROM,  
Cambridge Educational

This program helps students understand that the human organism has systems dedicated to specific body functions. After completing Part 3 of the CD-ROM Series, students will understand the function of the nervous and musculoskeletal systems of the human body. In addition, they will be introduced to how these systems interact with one another, and how each system is important to the overall health of a person.

Order # 32698, [www.cambridgeeducational.com](http://www.cambridgeeducational.com), 1-800-468-4227

*Systems of the Body Poster Set*, Cambridge Educational

Simply indispensable in the classroom, this set of ten posters vividly depicts and describes the human body's major systems. Each poster features inset illustrations providing highly detailed looks at key organs and system components, along with "neat-to-know" supplementary facts. Set includes Circulatory System, Respiratory System, Digestive System, Urinary System, Endocrine System, Reproductive System, Lymphatic System, Integumentary System, Nervous System, Musculoskeletal System

Order #: 33021, [www.cambridgeeducational.com](http://www.cambridgeeducational.com), 1-800-468-4227

*Skeletal and Muscular Systems*, VHS, Educational Video Network

Learn how skeletons support our bodies, protect our organs, aid in movement, produce blood cells, and store important minerals.

1-58950-037-7: [www.edvidnet.net/shopping/product\\_details.php?id=754](http://www.edvidnet.net/shopping/product_details.php?id=754), 1-800-762-0060

*The Skeletal System Medical Illustration*, Poster, The Doe Report

This medical exhibit diagram features a comprehensive overview of the human skeletal system. Three full standing skeletons are shown from the anterior, lateral and posterior views. In addition, there are two illustrations displaying the bones of the hand and foot.

Order #: exhR0033, [www.doereport.com/generateexhibit.php?ID=1974](http://www.doereport.com/generateexhibit.php?ID=1974), 1-800-338-5954

*The Skeletal System*, VHS, Nimco: Anatomy and Physiology Videos

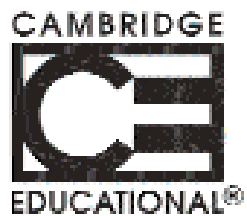
Understanding the skeletal system and distinguishing between the different types of bones. Discusses the five basic functions of bony tissue and explains osteoblasts, osteocytes, and osteoclasts. Included are characteristics of synovial, cartilaginous, and fibrous joints.

Order #: NIM-1200-3-VW, [www.filmo.com/nim-ana.htm](http://www.filmo.com/nim-ana.htm)

*Piecing Together: The Skeletal System Flip Chart Book*, Chart, eGeneral Medical Inc.

This flip chart book incorporates illustrations with important information and descriptions of the following anatomy: the skeleton, skull, thorax, upper limb, hand, pelvic region, lower limb, knee, and foot. The book includes a self-folding easel and is twenty pages.

Order #: AC8943FC, [www.egeneralmedical.com/pitosksyflch.html](http://www.egeneralmedical.com/pitosksyflch.html), 1-919-844-9402



For information on other programs

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