

I'm No Lazybones

Movement and the Musculoskeletal System

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Grade Level	9th – 12th Grade	**Time Frame**	150 minutes
Subject	Science	**Duration**	2-3 periods
Course	Biology		

Essential Question

How do the muscular and skeletal systems interact to produce movement?

Summary

In this lesson, students will explore the tissues, structures, and functions of the musculoskeletal system, with a specific emphasis on skeletal muscle and bodily motion. They will observe tissues under a microscope and compare tissue structure with the functions of muscle, bone, and connective tissues. Using this understanding, they will model in two ways how the muscular and skeletal systems interact to produce movement: through a kinesthetic demonstration and an animated and/or physical model of their own creation.

Snapshot

Engage

From video clips, students compare the movement of a "weasel war dance" and people doing parkour.

Explore

Students observe musculoskeletal tissues under a microscope.

Explain

Students take notes on the musculoskeletal system and discuss the relationship between the structure and function of its tissues.

Extend

Students solve the problem of how bodies move at a joint if muscles can only pull in one direction.

Evaluate

Students create a flipbook, a stop-motion animation, or a physical model to demonstrate how the parts of the musculoskeletal system work together to produce a simple motion.

Standards

ACT College and Career Readiness Standards - Science (6-12)

SIN202: Understand the tools and functions of tools used in a simple experiment
EMI301: Identify implications in a model
EMI401: Determine which simple hypothesis, prediction, or conclusion is, or is not, consistent with a data presentation, model, or piece of information in text

Next Generation Science Standards (Grades 9, 10, 11, 12)

HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Oklahoma Academic Standards (Biology)

B.LS1.2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Attachments

- Examining Tissues—I'm No Lazybones - Spanish.docx
- Examining Tissues—I'm No Lazybones - Spanish.pdf
- Examining Tissues—I'm No Lazybones.docx
- Examining Tissues—I'm No Lazybones.pdf
- Lesson Slides—I'm No Lazybones.pptx

Materials

- Lesson Slides (attached)
- Examining Tissues (attached, one per student)
- Digital microscope (with LCD screen preferred, see Explore)
- Anatomy slides (product names may include "histology," see Explore)
- Materials to create a musculoskeletal model (optional, see Evaluate)

10 minutes

Engage

Use the attached **Lesson Slides** to guide the lesson. Display **slides 3** and **4** to review the essential question and lesson objectives to the extent you feel necessary. Have students use a piece of notebook paper to draw a T-chart with the labels of stoat and people on the T-chart. Move to **slide 5** and have students watch the "Stoat Hypnotizes Rabbit" video, which demonstrates the hunting behavior of a stoat, colloquially referred to as a "weasel war dance." Have them take notes on the left side of the T-chart about how the stoat moves as they watch the video.

Embedded video

https://youtube.com/watch?v=ODEUK5sB5vE

Move to **slide 6** and have students watch "The World's Best Parkour and Freerunning," which shows people performing parkour. Have them take notes on the right side of the T-chart about how the person moves as they watch the video.

After viewing the videos, tell students to compare their ideas with an elbow partner.

Ask for a few volunteers to describe the similarities and differences they noticed between the videos. Then, ask the class if they think there is a difference in what makes the stoats and people move the way they do, and if so, what is the difference?

Guiding Student Responses

If they do not bring it up on their own, prompt students to list what parts of the body help animals move. Either confirm students' answers or tell them that it is the combination of the muscular system and skeletal system working together that produces movement.

20 minutes

Explore

Teacher's Note: Lesson Preparation

Set up microscope stations before the class period in which they will be used. Ideally, each station will have a microscope and one slide, but if access to microscopes is limited, include multiple slides at each. It is recommended that stations include examples of all tissue types found in the musculoskeletal system, but at minimum be sure to provide an example of skeletal muscle, tendon, bone, ligament (or elastic tissue), and cartilage.

Teacher's Note: Recommended Materials

- It is recommended to use an LCD microscope for this activity where available. A device like the *Celestron TetraView LCD Microscope* effectively exposes students to a more advanced scientific tool and supports accessibility for students who may have physical difficulties using a traditional microscope. An electronic microscope also provides the opportunity to show the content of a slide on a projector.
- The *Basic Anatomy and Atlas Slide Set* from Carolina Biological includes 75 histology slides. If using this set, include the following slides: skeletal muscle, tendon, muscle-tendon junction, one or both of the bone slides, hyaline cartilage, fibrocartilage, elastic cartilage, and elastic tissue. Resources permitting, include the cardiac muscle and smooth muscle slides as well.
- If you do not have access to microscopes or tissue slides, the Histology Guide Slide Box has 275 virtual slides available as an alternative resource. Be sure to identify specific slides ahead of time so you can quickly direct students to the relevant images.

Transition to **slide 7**. Tell students that they will be examining different tissues from the muscular and skeletal system under the microscope and provide classroom-specific instructions for how students are expected to move through stations. Pass out the attached **Exploring Tissues** handout. Be sure to adjust the number of entries in advance based on how many slides students explore.

As they observe the slides, students should describe in words and draw what they see under the microscope on the Exploring Tissues handout. Non-scientific language is acceptable to describe what they observe since most are unlikely to have seen histology slides before.

25 minutes

Explain

Teacher's Note: In-Depth Content for Teacher

For a refresher on the musculoskeletal system, consider reviewing the following videos. They are at an inappropriate level for the content of this lesson for students, but they contain useful background information for facilitating the lesson.

- Big Guns: The Muscular System
- Skeletal Muscles, Part 2 - Organismal Level
- The Skeletal System: Crash Course A&P #19
- Joints: Crash Course A&P #20

At this point, it is appropriate to engage students in a mini-lecture and note-taking exercise. Consider using the STAR Notes strategy to help students organize the information on a piece of notebook paper.

Move to **slide 8**. Make clear that what we commonly refer to as the musculoskeletal system is actually a combination of the muscular system and the skeletal system. This system may also be referred to as the locomotor system. Transition to **slide 9** and ask for volunteers to share what they know about the parts of the system before continuing on to the notes.

Use **slides 10-13** to review the basic structures and functions of the musculoskeletal system. As you cover each of the components, have students describe the characteristics they observed in the microscopes. Ask them to speculate on how the structures they observed under the microscopes support the function of the tissues (e.g., density of bone tissue on a slide relative to the strength of bone). Through this discussion, highlight student ideas that support the concept of hierarchical organization: systems are made of many parts and each individual system is part of a larger system (e.g., muscle cells make up individual muscles, which make up the muscular system, which are part of the larger musculoskeletal system).

Guiding Student Responses

Even though three types of cartilage were explored in the slides, it is not necessary for students to distinguish between the types at this level. They only need to know where cartilage is found, what it does, and the *concept* (not the specific details) that different types of cartilages have different structures and functions.

Teacher's Note: *A Photographic Atlas for the Anatomy and Physiology Laboratory*

The Carolina Biological anatomy slides mentioned in the Explore section come with one copy of *A Photographic Atlas for the Anatomy and Physiology Laboratory (7th Ed.)*. Chapters 5-8 address the musculoskeletal system. If you have the book, select photos from those chapters to support discussion of the systems. If you do not, inexpensive used copies of the book are available online and you may find it valuable to have a teacher copy.

10 minutes

Extend

Return students attention to the videos they watched in the Engage. To help students move from the scale of the entire musculoskeletal system down to a simple motion, facilitate a brief, open-ended discussion as a class about how the structures of the musculoskeletal system relate to the motion students observed in the videos. For example, connective tissue like tendons and ligaments keep the individual parts of the system together.

After students have taken notes, they will apply this information to determine how the musculoskeletal system interacts to produce movement. Display **slide 14** and present students with the following problem:

> Body movement happens at joints. If each muscle is only able to pull in a single direction, how is movement possible?

As a whole class, ask students to give you instructions one step at a time for how to move (e.g., taking a step, raising and lowering an arm), and demonstrate the motion as they call it out. Encourage them to describe the movement in terms of which muscle is pulling which bone (by location not name; e.g., the muscle at the upper part of the arm is pulling the forearm bone). Ask them to explain their reasoning for each step and redirect or ask probing questions if they are offering ideas that do not work. They should reach the conclusion that muscles must work in pairs to produce movement.

Students can follow the same procedure in pairs/small groups as well, but the activity is often more engaging as a group exercise.

40 minutes

Evaluate

Transition to **slide 15** and pass out approximately 10-20 sticky notes to each student. Tell students to create a stop-motion or flipbook animation to explain how the musculoskeletal system components interact in order to create movement, specifically simple flexion/extension (e.g., bending and extending your forearm at the elbow) or abduction/adduction (e.g., arm motion during jumping jacks). Note that students do not need to identify the names of these motions or distinguish between them for the purpose of this lesson.

Optional Tech Integration

A free program like Cloud Stop Motion is a useful tool to create these animations.

Teacher's Note: Project Timeline

It will be useful for students to make a rough draft of their animation (e.g., "storyboard," sketches on a stack of sticky notes, written step-by-step outline, etc.) before they create a final version.

If you are asking students to create the flipbook entirely in class, you likely need to allot additional class periods.

Students may give a written or oral explanation (e.g., voice over, class presentation) which should identify the relevant components, their functions, the connections between them, and how these together produce motion. As long as students provide some context for their animation, there are a variety of choices you could give students for executing this, including:

- picking a specific joint to model, using the actual muscles involved
- creating a generic model of a joint
- choosing a non-human animal as their subject
- identifying a simple motion from the videos

Optional Physical Model

Rather than an animated model, students could instead create a dynamic physical model (i.e., one that moves). Specific materials for this approach are open to your and your students' creativity but may include things like strings and straws.

Teacher's Note: *A Photographic Atlas for the Anatomy and Physiology Laboratory*

If you have a copy of the book, show students the pictures of flexion, extension, abduction, and adduction on pages 62-63 to help them understand what kind of motion they're modeling. If you do not own the book, a Google image search for "angular motion anatomy" is a reasonable alternative.

Resources

- Cloud stop motion. (n.d.). Cloud Stop Motion - make stop motion animation in your browser. https://cloudstopmotion.com/home/schools
- CrashCourse. (August 27, 2012). *Big guns: The muscular system - crashcourse biology #31*. YouTube. https://youtu.be/jqy0i1KXUO4
- CrashCourse. (May 26, 2015). *Joints: Crash course anatomy & physiology #20*. YouTube. https://youtu.be/DLxYDoN634c
- CrashCourse. (June 15, 2015). *Muscles, part 2 - organismal level: Crash course anatomy & physiology #22*. YouTube. https://youtu.be/I80Xx7pA9hQ
- CrashCourse. (May 18, 2015). *The skeletal system: Crash course anatomy & physiology #19*. YouTube. https://youtu.be/rDGqkMHPDqE
- *File:Axial Skeleton Diagram blank.svg*. Wikimedia Commons. (n.d.). https://commons.wikimedia.org/wiki/File:Axial_skeleton_diagram_blank.svg
- Histology Guide Slide Set https://histologyguide.com//slidebox/slidebox.html
- K20 Center. (n.d.). Star Notes. Strategies. https://learn.k20center.ou.edu/strategy/69
- K20 Center. (n.d.). T-Chart. Strategies. https://learn.k20center.ou.edu/strategy/86
- Nat Geo Wild. (October 1, 2012). *Stoat hypnotizes rabbit: World's deadliest*. YouTube. https://youtu.be/ODEUK5sB5vE
- PKFRTV. (February 2, 2022). *The world's best parkour and freerunning*. YouTube. https://youtu.be/PqeBGJXH-uQ