

Title of Lesson: Bones and Joints

Subject

Science & Technology, Cycle Two, Sec III

Big Idea of Science

Understanding the human body and its functions

Driving Question

How does the skeletal system work and why do we need it?

By the end of this lesson, students will be able to :

- Name the main parts of the skeleton (head bones, trunk bones, spinal column bones, upper and lower limb bones)
- Describe the functions of the main parts of the skeleton
- Label the parts of a long bone
- Describe how joints work (linking bone to bone, mobility)
- Describe types of joint movement (e.g. flexion, rotation)

The lesson, designed for grade 9 (secondary 3) students requires approximately 300 minutes of class time, which includes time required for activities & a laboratory.

The activities included in this plan incorporate the core practices of Ambitious Science Teaching:

1. Engaging students with major science concepts
2. Eliciting student thinking and activating prior knowledge
3. Helping students develop new ideas to revise explanations
4. Engaging students in useful discourse around evidence to support explanations

Period 1

The first activity has the aim of identifying students' useful prior knowledge and activating it by asking a series of questions. Connections are made to the previous chapter on the nervous system. Students are given a piece of paper and are asked to draw their hands, without further

instructions of how to draw them, but are given options and hints such as to draw them to scale or not, to draw only the outline or include the skeleton etc. The students are then asked to leave their drawings on their tables and walk around to look at each other's drawings through a gallery walk. Students are then asked questions to lead a discussion through questions such as:

1. Look at your finger and bend it. How many bends are there?
2. How does your finger know to bend? (nervous system link)
3. Are all your fingers the same length? Why not?
4. What is different about the thumb when compared to the other fingers?

As the students raise their hands to answer the questions above, answers are noted on the board. Students are asked to rephrase each other's answers in their own words through questions like "Would anyone like to explain what this student has just said?"

When a student mentions the word "bone" for any of the questions above, ask them (or the whole class) to define what a bone is. This is done through asking questions such as

1. "Who thinks they understand what has been said and can explain it in their own words?"
2. "Does anyone have anything to add to what has just been said?"

Lead the discussion towards different types of bones (in length, location) and show them a labeled skeleton with the names of bones. To wrap-up and organize the ideas that have been mentioned, the teacher can say: "We just mentioned that bones are present in different parts of our bodies and are of different sizes, they are the framework needed for movement; who would like to mention a key point from our discussion?"

By the end of this period, the students understand that the nervous system controls and coordinates the movement of the body, but the system that actually makes movement possible is the musculoskeletal system.

Period 2

Students are asked again to bend their fingers, but this time to different degrees. They are asked to slightly bend their fingers, then more, and more. They are then asked "What makes the difference between these different bends?". This is used to engage the students in useful discourse and link the ideas between bones and joints.

Activity:

Materials needed: 2 pens/pencils, some poster putty (a small ball per student).

Students are asked to take 2 pens/pencils and put them end to end. They are prompted to keep one pen in place and move the other, in such a way that it mimics the movement of 2 bones in the finger.

They are then asked to repeat the same steps with placing a ball of poster putty between the two pens.

Students are given a minute to think about their observations: “What is different between the two scenarios?”, “How does the movement change?”. They are then asked to pair up and discuss for 5 minutes.

Students are then brought back for a class discussion. They are asked to present their findings: “What did you find? What is the difference between including the poster putty and not?”.

Students are also asked to rephrase each other’s findings and to agree or disagree: “Does anyone agree with this student’s finding? Why or why not?”. They are then prompted to make links between bones by being asked: “Are the bones in your fingers touching each other?”. In this step, evidence-based explanations are developed to help the students alter their preconceptions. Some common misconceptions are that the bones are touching each other. Students develop evidence-based explanations through conversations in the class as a whole or through the conversations they have when paired up. It is important for the teacher to probe, restate, and reorient students to each other’s ideas in order to reach the instructional goals. For example, if a student says that the bones in one’s fingers are touching each other, the teacher could say “Do you hear a creaking sound when bending your finger? Is pain felt from the bones rubbing against one another?”.

Period 3

Pre-lab: Before heading to the lab, the teacher asks the students some pre-lab questions such as “What are some expected differences between the calf and adult bone we are able to look at?” “What are some features we expect to see on the bones?” “What do you think different parts of the bones will feel like?” This is to get their thinking going before even stepping foot into the lab. This recalls some knowledge of what has been talked about in the past 2 periods and gives a refresher on the material. It is also a way to engage students with major science ideas.

Lab: Students will have a hands-on opportunity to look at real bones. The goal of this activity is to have students observe a real bone. The students engage in an exciting lab - A demo dissection of a calf bone and an adult cow bone. Both bones being dissected are femurs. The students are invited up close in small groups to observe and touch the bones. Having small groups allows me to answer their questions while they are up-close to the bones. They are encouraged to take down observations and to describe the process through words, phrases, or even models. This is a way to make students represent their thinking and observations in several ways instead of restricting them, and gives them the opportunity to choose a way that suits their needs. After the dissection is done, they are allowed to touch the bones and consequently take down any observations made from touching.

Lab worksheet: After they make their observations, they answer the questions on the lab report and fill out the blanks on the diagram to identify the parts of the bone. They turn it in to be graded next class. Some questions found in the worksheet include:

“What does the periosteum feel like? What does it do?”, “What is the difference between compact and spongy bone?”, “What is stored in the medullary cavity?”, “What does bone marrow feel like? What does it do?”. These are all questions that may come up on the quiz or on the test. By answering these questions through physical touch and observations the answers are more concretely stored.

By the end of the period they will have made many observations and used physical touch to answer their questions.

Period 4

Reviewing and correcting lab worksheet (informal lab report): 30 minutes are taken to review the lab report from last class. To help students develop new ideas to revise explanations, the students compare their pre-lab thoughts to the actual findings from the lab. They write a short reflection outlining the differences. This allows them to reflect, analyze their results and draw conclusions. The lab reports are shuffled and peers correct each other's work with the teacher out loud. At this time they are able to ask any last minute questions and have the responsibility to correct someone else's work.

Individual review time for the quiz: The students are then given 15 minutes of review/study time. They are able to use their notes, the lab report, the workbook pages or textbook for reference.

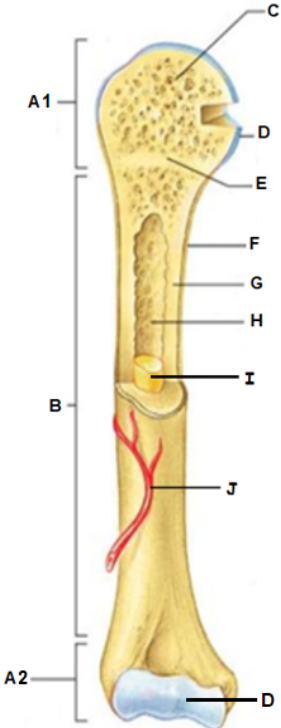
Quiz: The students are given a 20 minute quiz to test their overall knowledge of the chapter on bones and joints. On the quiz, they need to be able to identify the parts of a long bone (Figure 1) and describe different joint movements given a word bank to guide them.

By the end of the period the students will have solidified their knowledge on bones and joints.

By the end of this lesson (Periods 1 through 4), students will have had the opportunity to express their knowledge and show their understanding through modeling and through a traditional written exam.

Figure 1

Image of a Bone for Annotation



References

Windschitl, M., Thompson, J., & Braaten, M. (2018). *Ambitious science teaching*. Harvard Education Press.