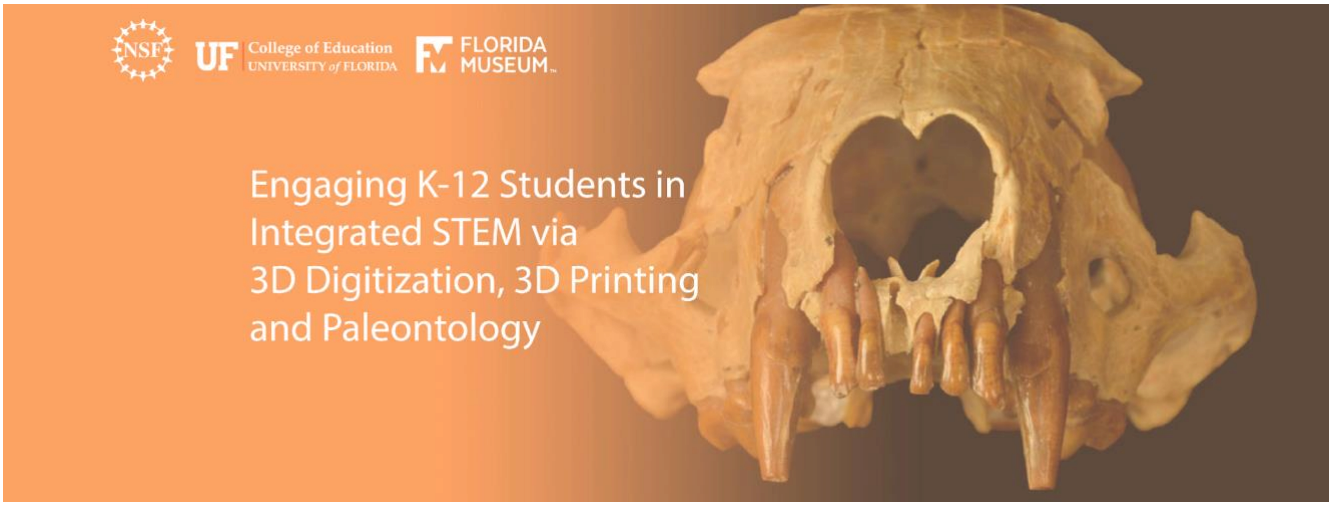


AUTHOR (S)

Leigh Ann Cooper

LESSON TITLE

Talking Teeth

GRADE LEVEL

High School, 9th - 12th

TIME FRAME

3 50-minute class periods

DRIVING QUESTION

What can teeth tell us?

LEARNING GOALS

- Identify basic mammalian tooth structure and function.
- Classify the teeth of 4 different species into groups based on observation.
- Use calipers to measure the basin of an unidentified molar tooth specimen.
- Use evidence to construct an explanation for the dietary needs of unidentified specimens.

ANCHORING EVENT

Think-Pair-Share activity in which various incomplete photo examples of mammal fossils, 3D printed examples of fossils, and/or actual bones/fossilized bones are passed out for observation; then, students will discuss how the habits and characteristics of a mammal can be determined by scientists through a Think-Pair-Share activity.

COLLABORATIONS

- iDigFossil Team (University of Florida)
- Morphosource and the on-site 3D printing technology crew at Howe High School

STEM INTEGRATION

- 3D printed specimens from Morphosource.org for tooth and mandible downloadable replicas.
- 3D View app to view and digitally measure the basin of the first lower molar for applet data input.
- Student chromebooks with 3D View app.

ASSESSMENT

a) Formative assessments:

- Think-Pair-Share during Anchoring Event to assess prior knowledge
- Pre-Lab questions (individual)
- Measurement and food percentage data collection table (individual)
- Estimation of the plant and animal food percentages in the diet of early hominids based on measurements and data analysis. (small group)

b) Summative assessment(s):

- Class discussion, Day 1 - "How are fossils made?"
- Individual discussion with data analysis and essay question - Use evidence to infer the dietary needs of extinct hominids and the extant Homo sapiens. (individual)

PROCEDURE

Day 1:

Engage: Skulls of extant mammals will be on display and available to touch as they enter the classroom. In a large-group discussion, we will make student-led observations with instructor-written notes on display (i.e. a whiteboard or SmartBoard). Instructor written notes transition student observations into technical vocabulary. (up to 10 minutes)

Explore: Think-Pair-Share: After observing the skulls on display, have students pair up and discuss the answer to the question, "How do scientists determine the habits and characteristics of extinct or unobservable mammals through their incomplete fossilized remains?"

Explain: Start the 'Mammalian Teeth' (https://docs.google.com/presentation/d/10sgsMFTz28B5FHtKBF4jL_rTojJRiHOtu59ls-M2uYk/edit#slide=id.p) slides and notes until the 1st video in the slideshow (slide 6) from HHMI, "What Can Fossil Teeth Tell Us?". Play the video and then pause the slideshow for a teacher-led discussion and review of fossils. Ask, "How are fossils made?", so that a discussion of the special circumstances in which remains can be preserved and then found make fossils unique and often incomplete; and "Why could Baron George Cuvier (from the video) boast that he was capable of recreating an animal based on only one tooth?" so that students recognize that the clues in tooth structure contain identifiable characteristics in physiology and anatomy. (15 minutes)

Day 2:

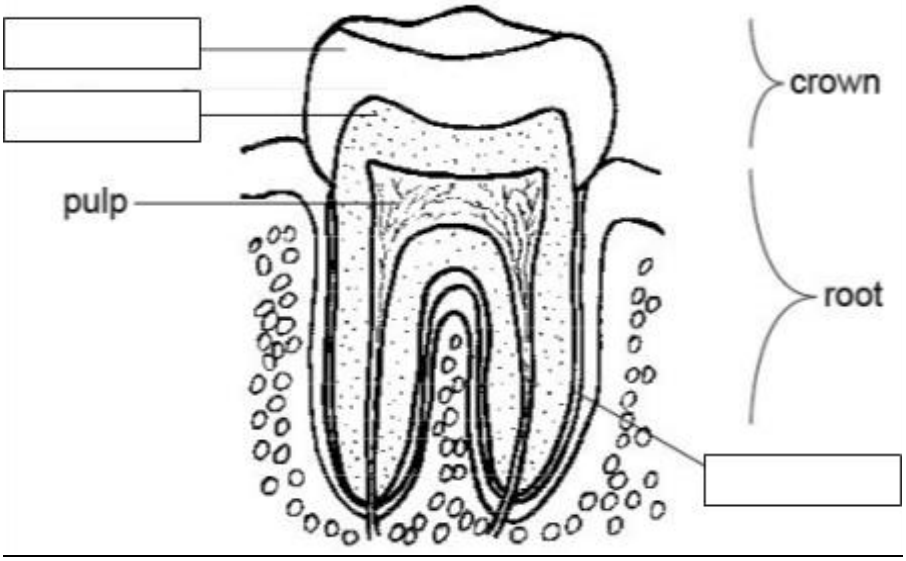
Explain (continued): Replay the short HHMI video (if needed) and remind students of the previous day's discussion. Resume Mammalian Teeth slideshow at slide 7 and finish the slideshow with the Ted-Ed video, "The Evolution of Teeth". (30-40 minutes) Return observation worksheets and mandible sets. Have students complete pre-lab questions and tooth structure diagram on the worksheet (see blank version in link or picture below & completed student examples in resources section at the end of this lesson plan).

Mammalian Teeth Observation Report

Name:
Date:

-Think- How do scientists determine the habits and characteristics of extinct or unobservable mammals through their incomplete fossilized remains?	**-Pair-** What are the thoughts of your partner?	**-Share-** What will you share with the class?

Mammalian Teeth Observation Report



Pre-Laboratory Questions:

1. Why do you think Baron George Cuvier (from the video) boasted that he was capable of recreating an animal based on only one tooth?

2. Compare and contrast incisors and molars. How are they alike? Different?

3. Why do you think herbivores have a large, flat basin rather than tall cusps and crests used for mastication?

4. What is the function of the canine teeth in carnivores?

Day 3:

Elaborate: Use student Chromebooks, Google Classroom, and 3D View app to digitally view and measure the length and width (in millimeters) of the first (lower) molar on provided specimens with different dietary needs. Provide a putty or clay for students to make impressions of the teeth for enriched observations. One of the specimens should compare diets of other mammals to a hominid species. Record the length and width measurements on the provided worksheet and then answer the questions on the back of the page (see blank version in link or picture below & completed student examples in resources section at the end of this lesson plan).

Mammalian Teeth Observation Report (Front)

Specimen Name:	Impression	Tooth Width (mm)	Tooth Length (mm)	Proportion (width / length)	Common Name:	Diet:

Use this website to find the common name and dietary needs: https://animaldiversity.org/

Mammalian Teeth Observation Report (Back)

1. Why is the shape of the molar so important to determining the dietary needs of animals (extinct or alive)?

2. Did you see a pattern in the proportions of each of the animals? What was it?

3. What kind of proportion were you more likely in a herbivore? Carnivore? Omnivore?

4. The last sample was that of an extinct hominin species. What type of diet do you expect that hominin to have had?

5. Based on this evidence, what type of diet do you think the species Homo sapiens should have? Give 2 points of evidence.

STANDARDS

LS1.A: Structure and Function: Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)

Science Practices	Connection to the Lesson
Constructing Explanations and Designing Solutions: Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-LS1-1)	Students conduct an investigation into the structure and function of mammalian teeth with varying dietary needs by making careful observations, creating impressions of the teeth in playdough, and measuring the length and width of the first lower molar.
Disciplinary Core Ideas	**Connection to the Lesson**
Evidence of Common Ancestry and Diversity: Systems of specialized cells within organisms help them perform the essential functions of life.(HS-LS1-1)	Mammalian teeth are studied through a lesson with videos that express the tooth's basic structure while exhibiting the diversity of the functions provided. Then, students make observations of molars using 3D printed 1st lower molar replicas.
Crosscutting Concepts	**Connection to the Lesson**
Structure and Function: Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-LS1-1)	Students investigate the mammals behind the teeth and make inferences about the diets of those animals based on the structures of the 1st lower molar.

CCSS STANDARDS

CCSS.ELA-LITERACY.W.9-10.2.F

Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

OTHER STANDARDS

P21 Framework

Apply Technology

- Effectively use technology as a tool to research, organize, evaluate and communicate information
- Use digital technologies (computers, PDAs, media players, GPS, etc.), communication/networking tools and social networks appropriately to access, manage,

integrate, evaluate and create information to successfully function in a knowledge economy

Work Creatively with Others

- Develop, implement and communicate new ideas to others effectively
- Be open and responsive to new and diverse perspectives; incorporate group input and feedback into the work

ISTE Standards

Computational Thinker

5b: Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.

RESOURCES & MATERIALS

3D printed mandibles from Morphosource:

- *Smilodon fatalis* https://www.morphosource.org/Detail/SpecimenDetail/Show/specimen_id/2731
- *Homo habilis* https://www.morphosource.org/Detail/SpecimenDetail/Show/specimen_id/2019

Mammalian Teeth Slides (Notes)
Mammalian Teeth Observation Worksheet Part 1, Worksheet Part 2 (with data table)
HHMI Video, "What Can Fossil Teeth Tell Us?"
Ted-Ed Video, "The Evolution of Teeth"

Worksheet #1 Completed Student Example

Mammalian Teeth Observation Report

Name: Student Example #1

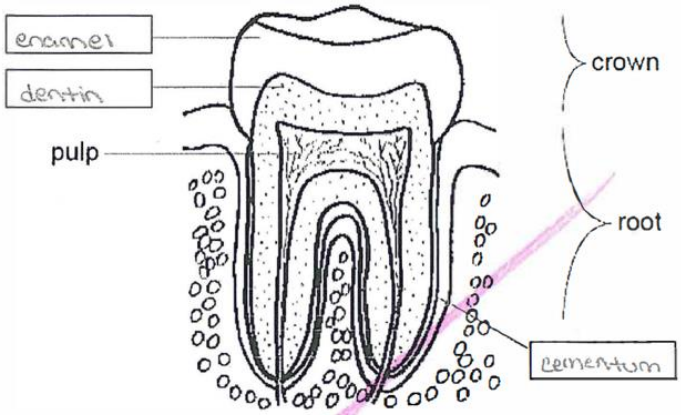
Date: 11-30-18

Class: 3rd hr

-Think- How do scientists determine the habits and characteristics of extinct or unobservable mammals through their incomplete fossilized remains?	-Pair- What are the thoughts of your partner?	-Share- What will you share with the class?
If they find a tooth they can tell what it ate.	That teeth are interesting in a weird way.	That it is crazy how Scientists can possibly figure out what animal it is by its teeth.

Student Example #1

Mammalian Teeth Observation Report



Pre-Laboratory Questions:

1. Why do you think Baron George Cuvier (from the video) boasted that he was capable of recreating an animal based on only one tooth?

   Just by seeing one tooth you can tell what the animal ate.

2. Compare and contrast incisors and molars. How are they alike? Different?

   molars are used for grinding food while incisors are used to break food down into smaller pieces and hold onto the food tightly.

3. Why do you think herbivores have a large, flat basin rather than tall cusps and crests used for mastication?

   Herbivores use the large flat basin teeth to grind up their food. They don't need the tall cusps and crests because they don't tear through flesh.

4. What is the function of the canine teeth in carnivores?

   They are used to tear through flesh.

Worksheet #2 Completed Student Example

Mammalian Teeth Observation Report

Name: Student Example #1

Date: December 14, 2018

Class: Biology Wiggy

Specimen Name:	Impression	Tooth Width (mm)	Tooth Length (mm)	Proportion (width/ length)	Common Name:	Diet:
Arctocebus calabarensis		6mm	6mm	1 mm	Cal a'oon potto	Carnivore insects and fruit, sap or other plant fluid
Ateles geoffroyi ornatus		12 mm	12 mm	1 mm	Spider monkey	Omnivorous Plants, bird eggs, bugs
Smilodon fatalis		10 mm	18 mm	1.8 cm mm	saber-toothed tiger	Carnivore elephants, horses, bison
Bison bonasus		19 mm	9 mm	2.1 mm	European Bison	grass and sedges
Homo habilus		5 mm	4 mm	1.25 mm	Homo Habilus	Broad Range of foods

Use this website to find the common name and dietary needs: https://animaldiversity.org/

Name: Student Example #1

Mammalian Teeth Observation Report

1. Why is the shape of the molar so important to determining the dietary needs of animals (extinct or alive)?

   The molar tells us what kind of food they ate. The shape of the tooth determins their diet. If they had sharp teeth we can guess they ate meat.

2. Did you see a pattern in the proportions of each of the animals? What was it?

   All of the proportions were around 1-2 cm.

3. What kind of proportion were you more likely in a herbivore? Carnivore? Omnivore?

   Herbivore was 1 cm
   Carnivore was 1.8
   omnivore was 2.1

4. The last sample was that of an extinct hominin species. What type of diet do you expect that hominin to have had?

   I expect the diet of the extinct hominin was fruits, berrys, meat, and plants.

5. Based on this evidence, what type of diet do you think the species Homo sapiens should have? Give 2 points of evidence.

   Homo sapiens are hunter-gathers. They ate wild plants and animals.

KEY ACADEMIC AND/OR SCIENTIFIC LANGUAGE

anatomy, arthropods, bilateral symmetry, canine, carnassials, carnivore, diastema, extant, extinct, herbivore, homologous structure, homology, incisor, insectivore, mastication, mandible, molar, physiology, premolar, vertebrates

PRIOR KNOWLEDGE

Students should have knowledge of metric measurement, specifically for length and width in millimeters. Experience with computers and the use of apps would be useful.