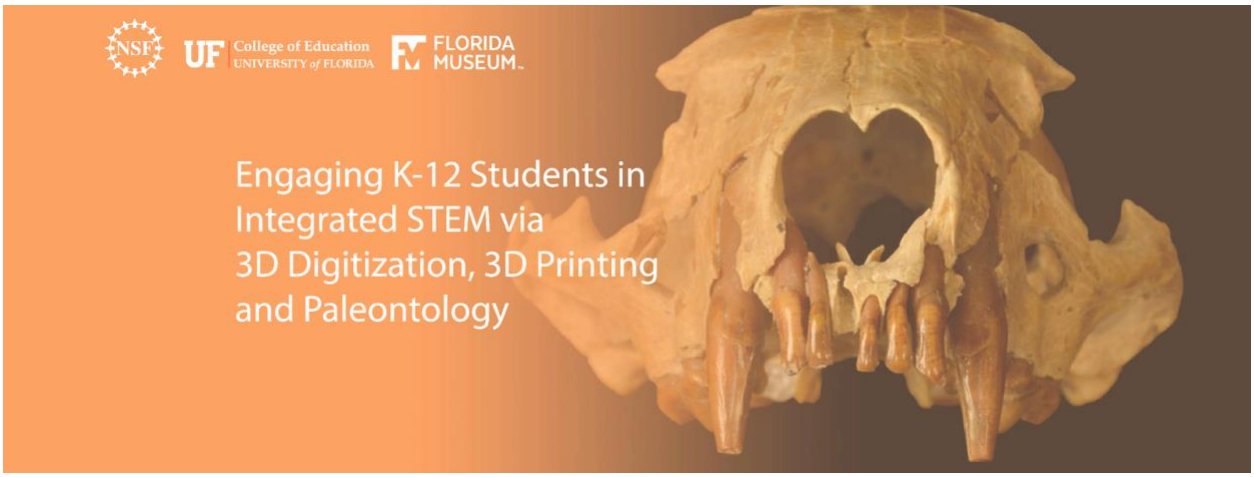


AUTHOR

Becca Mussetter
New Brighton Middle School
Santa Cruz, California

LESSON TITLE

Sizing up Turkeys: An exploration of proportional size

GRADE LEVEL

6th Grade Math

TIME FRAME

3-4 50 minute class periods

DRIVING QUESTION

What is the proportional growth of turkey legs throughout history? If the growth were to continue, what would be the hypothesis of turkey size in 20 million years?

LEARNING GOALS

Students will practice authentic paleontological research techniques in order to analyze 3D scans/prints of museum specimen fossil turkey bones. Through this analysis, students will be able to recognize any relationships or trends between a single element of a species and the corresponding total height associated with the species utilizing important mathematical skills (averaging, ratios, extrapolating estimations from standard equations). Students will work with proportions and making hypotheses using data. Converting measurements will also be practiced.

ANCHORING EVENT

3D prints of fossils turkey bones will be used as a tactile component of the anchoring event to provoke interest allow comparison of fossil/modern turkey bones. Many of the fossil scans come from a site in Florida called Thomas Farm. The Thomas Farm locality has a website with ample information as well as accompanying videos of an active excavation site that will be utilized (https://www.floridamuseum.ufl.edu/florida-vertebrate-fossils/sites/thomas-farm/).

Time Dependent: In preparation for the upcoming Thanksgiving Holiday, ask students to think about turkey size. How many students have turkey on Thanksgiving? How many turkeys do they buy? How many people does that feed? Hmmm…. What if turkeys were bigger and more people could be fed by one turkey? I wonder…do you think that turkeys have always been the same size?

COLLABORATIONS

Collaborating with the research that has been done at University of Florida, students will be able to have access to the 3D files of actual turkey leg fossils. Students will have to work together to compare their results with one another as well as share best practices to ensure that measurements are taken uniformly. Further collaboration will be essential in averaging students' results. Depending on time and scheduling, a video call with a University of Florida researcher on the idigFOSSILS team would be a great opportunity for a virtual classroom visit and to allow students to ask questions about the fossils as well as validate the authenticity and important of the student's research in this lesson!

STEM INTEGRATION

Students will be using 3D printed models of fossilized turkey legs, science of evolution and mathematical skills of proportions.

Science: Students will use fossilized/modern tarsometatarsus bones to investigate turkey size throughout the geologic timescale (Miocene – Modern Day).

Technology/ Engineering: Students will be using 3D printing to have "hands-on" access to the fossilized specimens.

Mathematics: Mathematical computations using measurement, multiplication, order of operations, proportionality (ratios) are used in the calculation turkey lengths. In addition, students will gain further comprehension of geologic time scale.

ASSESSMENT

Students will be assessed throughout the activity. Students will be expected to fill out their own results sheet (attached in the "handouts" section) and be assessed through informal teacher observation as well as mathematical checks of length and proportion data. Since groups will all have the same set of fossils, data should be similar- but may be different due to rounding and errors. This will make a great conversation about scientific accuracy and agreement upon rounding and number value. The final project will be to design what they believe a wild turkey would look like in 20 million years. Students will have to provide rationale for their design and should reference the proportions of the previous turkey legs. Designs must include claim,

evidence and reasoning to receive full credit. A proficient student will need to use evidence gathered from trends in data or supplemental articles (optional) to back-up their thinking

PROCEDURE STANDARDS

Day 1- Engage and Explore

Hook: In preparation for the upcoming Thanksgiving Holiday, ask students to think about turkey size. How many students have turkey on Thanksgiving? How many turkeys do they buy? How many people does that feed? Hmmm…. What if turkeys were bigger and more people could be fed by one turkey? I wonder…do you think that turkeys have always been the same size? We are going to be doing a math and science activity where you will be hypothesizing turkey size on some extinct birds based on measurement and mathematical calculations of a modern turkey. First off, let's talk turkey! What is a turkey?

Students will use https://www.allaboutbirds.org/ as well as any other sites they can find on the internet to try to find some basic information about turkeys. Divide students into 4-5 groups and assign a few brief research goals. The following are examples of good topics kids could research:

1. Appearance
2. Size- specific measurements of length, weight, etc.
3. Location and prevalence
4. Habitat
5. Diet
6. Mating Rituals
7. Origin of why turkey is eaten on Thanksgiving

Give students about 25 minutes to research and record their information. Next, spend about 10 minutes sharing out their findings.

Day 2 - Explain "Math Day"- Lead the following lesson. Be sure to pass out the worksheet so that students can record their answers.

A tarsometatarsus bone is the lower part of the leg bone. This is the turkey bone we will be measuring. You have 5 samples of this bone to work with. Each one is from a different time period. Use the table below to learn the age of each turkey:

Catalog Number	Time Period	Age of Turkey
UF24064	Modern Turkey	Modern
UFPB8014	Late Pleistocene	.24-.014 million years old
UF421031	Middle Pleistocene	1.8-.24 million years old
UF20716	Early Pleistocene	4.9-1.8 million years old
UF333806	Early Miocene	20.6-16.3 million years old

3D files are available through the University of Florida Database (see resources)

Observations:

1.Please sketch a picture of each of the tarsometatarsus bones on the attached page. Please make your sketches as accurate to size as possible.

2. Label each of your pictures to include the catalog number and age of turkey.

3. Measure the length of each bone using your caliper, and record the measurement in each box. Make sure that you label using the correct units. For example, if you are using millimeters, label in mm!

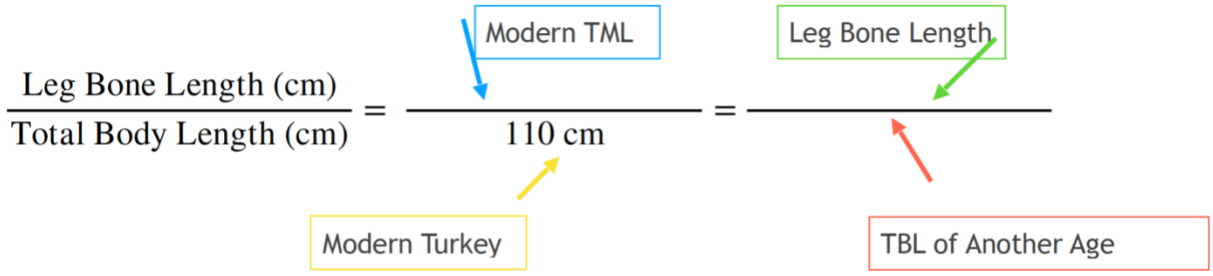
4. What do you notice about the shape and features of the tarsometatarsal?

5. Do you see any relationship between the size of the bone and the age of the bone? Explain.

Day 2 Continued - "Elaborate"

Mathematical Calculations: Reminder** Make sure that you use consistent units. You must choose between centimeters or millimeters. Both the top and bottom number must be in the same unit BEFORE figuring out your ratio value.

1. Measure the length of the modern turkey bone (tarsometatarsal) and record your answer here. _____ (be sure to label units). If the average total body length of a modern wild turkey is 110 centimeters. How would you write a proportion comparing total body length (TBL) to tarsometatarsal length (TML)? Fill in the proportion below



2. Now, fill in the tarsometatarsal length of a different age turkey. Be sure to write this measurement as the numerator. Next, use cross-multiplication to find the value of x. The value you get for x would be the total body length (TBL) of that turkey!

3. Play around with the different leg bones and proportions and fill in the chart below with the body lengths of each one.

Catalog Number	**Age of Bone**	**Tarsometatarsal Length**	**Total Body Length**

4. What is the difference in size of the length of the early Miocene tarsometatarsal (TMT) leg bone and the modern TMT bone length? (hint: subtract)

   _____.

5. That means that in the last 20 million years, turkey leg bones have grown that much! Pretend that it is 20 million years from today. If the proportion stays the same, what would you expect the total body length to be of turkey in the 20 million year future?

   _____

6. Work with your group to measure and draw your "future turkeys". The measurement must be accurate. Picture must also include a reflection that consists of the following:

    -What is the math that led you to your answer? Justify your calculations using words, pictures, and/or equations.

    -Reflect on what life might be like with future turkeys running around.

    -If you were going to investigate this further, what would be your next question?

Day 3-4: Evaluate

The final project will be to design what they believe a wild turkey would look like in 20 million years. Students will have to provide rationale for their design and should reference the proportions of the previous turkey legs. Designs must include claim, evidence and reasoning to receive full credit.

STANDARDS

NGSS Disciplinary Core Ideas: Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.

NGSS Cross-Cutting Concepts: Scale, proportion, and quantity. In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

CCSS.MATH.CONTENT.6.RP.A.3
Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.

CCSS.MATH.CONTENT.6.RP.A.3.D
Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.

RESOURCES & MATERIALS

Calipers and/or metric tapes
- Large butcher paper/poster paper
- Calculators (all math levels can access learning)
- Computers/Chromebooks
- University of Florida Fossil Database

- 3D printed fossil turkey legs. Enough for each group to have 1 set.
- Work Data Sheets For Students

Modern Turkey (UF24064): Bring into classroom as modern analogue
Late Pleistocene Turkey (PB8015), Late Pleistocene Turkey (UFPB8014), Middle Pleistocene Turkey (UF 11601), Early Pleistocene Turkey (UF20713), Early Pleistocene Turkey (UF20716), and Early Miocene (UF333806): Print from Morphosource (https://www.morphosource.org/MyProjects/Dashboard/dashboard/select_project_id/705)

KEY ACADEMIC AND/OR SCIENTIFIC LANGUAGE

Tarsometatarsal-A tarsometatarsus bone is the lower part of the leg bone.
Miocene- A time period 23.03 to 5.3 million years ago
Pleistocene- the time period that spanned from 2.6 million to 11,700 years ago.
Proportion- a part, share, or number considered in comparative relation to a whole.
Scale- a ratio of size in a map, model, drawing, or plan.
Ratio- the quantitative relation between two amounts showing the number of times one value contains or is contained within the other.
Millimeters- one thousandth of a meter
Inches- A twelfth of a foot
Feet- 12 inches in a foot. 30.48 centimeters in a foot.
Fossa- a shallow depression or hollow.
Pneumatic- A bone that is hollow or contains many air cells. Bird bones.

PRIOR KNOWLEDGE

Measurement conversion
Ratios
Multiplication and division
Critical Thinking Skills: Students should be able to make basic inferences and analyses.
Quantitative Data Collection: Students are expected to use a measuring device to collect quantitative data to estimate overall body size.
Written Expression of Ideas and Information: Students should be capable of using the scientific language/key academic vocabulary in their interpretations.

Catalog Number_____

Age of Turkey Bone _____

Catalog Number_____

Age of Turkey Bone _____