The Bone Case Lab

Name _____

Date _____

Period _____

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Do Now Archaeologists in England found this skeleton. Nobody wrote down how tall the person was. 2 minutes, before you open the lab

A. Which bone do you think is the longest in the body?

☐ The thigh bone ☐ The upper arm bone ☐ The backbone

B. How could a scientist work out how tall this person was, using only the bones?

_____

☐ I can locate and name the major bones of the human skeleton.

☐ I can measure a long bone and use it to estimate a person's height.

Part 1. The dig (Tab 1)

CCC 4 Systems and System Models

Keep **1. Region** on. Click each numbered tag on the photo. Pick the part of the body it is in. Copy from **Your tags**.

1. Write the region for each tag: Head, Trunk, Arm, Hand, Hip, Leg or Foot.

Tag	1	2	3	4	5	6	7	8	9	10
Region										

2. Look closely at tags 5 and 10. Each one sits on ☐ one bone ☐ two bones side by side. Tag 5 is in the _____. Tag 10 is in the _____.

READ FIRST. In the lab, find the green **Learn It** box and read it. Then answer 3 and 4.

3. Press **2. Name**. Name the bone at each tag. Copy the names from **Your tags**.

Tag	1	2	3	4	5
Name					
Tag	**6**	**7**	**8**	**9**	**10**
Name					

4. CCC 4. Tags 5 and 10 each hold two bones. Forearm, thumb side (it turns when you flip your hand): _____ Forearm, pinky side (the point of the elbow): _____ Lower leg, thick shin bone (inside ankle bump): _____ Lower leg, thin bone (outside ankle bump): _____

Part 2. The bone board (Tab 2)

SEP 3 Planning and Carrying Out Investigations

Pick a bone. Slide the block until it turns green and says **Touching both ends**. Press **Record this length**. Do all four bones lying straight. Then do the femur **Crooked**.

5. Copy from **Your measurements**. In cm = the reading in mm ÷ 10.

Bone	Board reading (mm)	In cm
Femur (thigh)		
Tibia (shin)		
Humerus (upper arm)		
Ulna (forearm)		
Femur, lying crooked		

6. Lying crooked, the femur read _____ mm less. Did the bone itself get shorter? ☐ yes ☐ no

READ FIRST. In the lab, find the green **Learn It** box and read it. Then answer 7 and 8.

7. Plan check (SEP 3). Tick one box in each row.

How you measure	Trustworthy	Not trustworthy
Slide the block until it squeezes the bone hard	☐	☐
Line the bone up straight along the board	☐	☐
Read the scale only when the block just touches the bone	☐	☐
Measure from the middle of one end to the middle of the other	☐	☐

8. Why must a scientist measure the femur the same way the people who made the height formula did?

_____

_____

Part 3. How tall? (Tab 3)

SEP 5 Using Mathematics · CCC 3 Scale, Proportion and Quantity

Pick a bone. Use the formula in the lab. Work it out here first. Then press **Show the estimate** to check. Do all four bones. Then try the **Women's** formula on the femur.

Example (not one of yours): a tibia 40.0 cm long. 2.52 × 40.0 = 100.8. Then 100.8 + 78.62 = **179.4 cm**.

9. Height = number × length + number. Show your math for the femur.

Bone	Length (cm)	Formula (men)	Your math	Estimate (cm)	Range (cm)
Femur		2.38 × L + 61.41			
Tibia		2.52 × L + 78.62			
Humerus		3.08 × L + 70.45			
Ulna		3.70 × L + 74.05			

10. Your four estimates run from _____ cm to _____ cm. The scan's skeleton measures _____ cm. How many of the four ranges include that number? _____

READ FIRST. In the lab, find the green **Learn It** box and read it. Then answer 11 and 12.

11. CCC 3. Which bone gives the narrowest range? _____ Why do leg bones predict height best?

12. The same femur: men's formula _____ cm, women's formula _____ cm. Why must a scientist decide man or woman first?

Part 4. The king (Tab 4)

SEP 6 Constructing Explanations · CCC 6 Structure and Function

Read the case file. Click each dashed box on the skeleton and judge it. Then work backward to his femur and press **Check**.

13. Richard III had a strong curve in his spine. Would each part's length still tell his true height? Tick one box in each row.

Part	Still gives his true height	Thrown off by the curve
Humerus	☐	☐
Spine (vertebrae)	☐	☐
Tibia	☐	☐
Femur	☐	☐

14. Work backward (SEP 5). His height from the femur was about 173 cm. So 173 = 2.38 × F + 61.41. First take away 61.41. Then divide by 2.38. Show your math. His femur F = _____ cm

READ FIRST. In the lab, find the green **Learn It** box and read it. Then answer 15.

15. Explain it (SEP 6). Why did scientists use Richard III's femur, not his spine, to estimate his height? Build the explanation in three parts.

Part	Your explanation
What happened (his spine, his limbs, his height)	
The science idea (how the femur is built, and why that matters)	
How the evidence shows the idea	

NYSSLS: HS-LS1-2 (a model of a system and its parts) and HS-LS1-1 (structure and function). Hole's Essentials 3e, Section 7.5 Skeletal Organization (pp. 238 to 243) (AP.4.7.3). Height formulas: Trotter and Gleser (1952), from Trotter (1970), stature in cm. Bone lengths: a 3D scan of a real man's skeleton (BodyParts3D / Z-Anatomy, CC BY-SA). Dig photo: Oxfordshire County Council, CC BY-SA 4.0. Richard III: University of Leicester team, Appleby and others, The Lancet (2014). SEP = Science and Engineering Practice, CCC = Crosscutting Concept.