STEM 101
Powered by THE STEM ACADEMY

Name: _____
Period: _____

UNIT: MEASUREMENT

BROKEN ARM BLUEPRINT

OBJECTIVE:

Use **precision measurement** tools to measure and compare the physical properties of "replacement parts."

GOAL:

You're acting as a biomedical engineer helping to design a replacement rod for a broken arm. Your job is to measure and test different sample materials and decide which one is the best match for the "reference bone."

MATERIALS:

- ✓ Calipers or ruler (for measuring diameter/thickness)
- ✓ Samples of rod-like materials (pencil, plastic straw, paper straw, wooden dowel, etc.)
- ✓ Digital scale or balance (for weight comparison)
- ✓ Optional: Spring + weights (to test compression)
- ✓ "Reference part" (plastic bone or wooden dowel marked as the ideal)
- ✓ Data recording sheet

STUDENT DIRECTIONS:

1. **Measure Size**
   - Use the **calipers or ruler** to measure the **diameter and length** of each sample rod.
   - Compare those measurements to the reference part.
   - Record all your data in a chart.

   Data Example Table:

Sample	Diameter (mm)	Length (cm)	Matches Reference? (Yes/No)
Pencil			
Dowel			

2. **Compare Strength (Qualitative Test)**
   - Pick up each sample and gently press it down over a table edge to **feel stiffness** (Does it bend? How much?).

- Optional: Stack small weights on top or use a spring compression setup to test how much each sample resists force.
- Observe and record which ones **stay straight, bend, or collapse**.

3. **Check Weight or Density**
   - Use a **digital scale** to find the mass of each sample.
   - Consider how the **weight might affect comfort and usability** if it were inside a human arm.

   Density Tip: A heavier but smaller part may be **denser**, meaning its material is more compact and possibly stronger.

4. **Choose the Best Match**
   - Based on your data, pick the material that is **closest in size, strength, and weight** to the reference part.

Discussion Prompt:

- How does the bulk structure (the way the material is built or packed) affect its strength and function?
  - Think about bones—are they solid or hollow? Why?

    _____

    _____
  - Why might we not always want the heaviest or hardest material?

    _____

    _____
- How does the bulk structure of a material relate to its strength or function?

  _____

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STANDARDS ALIGNMENT

NGSS: HS-PS1-3 **STEL:** STEL 1E, STEL 2E, STEL 3E, STEL 4E, STEL 5E **CCSS:** CCSS.MATH.CONTENT.HSN-Q.A.1, CCSS.MATH.CONTENT.HSN-Q.A.2, CCSS.MATH.CONTENT.HSN-Q.A.3, CCSS.MATH.CONTENT.6.SP.B.4–5, CCSS.MATH.PRACTICE.MP4, CCSS.MATH.PRACTICE.MP5