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# A Comparison of Scale Assessment

## Knowledge Probe (KP) Pre-test

### Instructor Guide

#### Notes to Instructor

This is the knowledge probe for *A Comparison of Scale: Macro, Micro, Nano*. It assesses the participants' current knowledge of three scales (macro, micro, nano) and the challenges faced working within these scales. This KP can be compared with the results of the final assessment in order to provide information on what was learned as a result of completing the supporting PK and activities.

The *Comparison of Scale Learning Module* consists of the following.

- **A Comparison of Scale: Knowledge Probe (KP) Pre-test**
- A Comparison of Scale: Macro, Micro, Nano (PK)
- Scale Inquiry Activity: Cut to Size
- The Scale of Biomolecules Activity
- Scale Activity: Zoom in / Zoom Out
- A Comparison of Scale Assessment

This companion Instructor Guide (IG) contains both the questions and answers for the assessment questions. The answer to each question is in **red**.

#### A Comparison of Scale Knowledge Probe

*In order to grasp many of the concepts associated with micro and nano-size devices, one needs to understand scale and the size of objects associated with different scales. This learning module introduces various concepts associated with scale, and a comparison of the macro, micro and nano-scales. Activities provide the opportunity to further explore the macro, micro and nano scales and their associations with micro and nanotechnology.*

This knowledge probe determines your current knowledge of three these scales (macro, micro, nano) and the challenges faced when working within these scales.

There are 12 assessment questions below. Answer them to the best of your knowledge.

1. A micrometer is
  - a. One one-hundredth of a meter
  - b. One one-thousandth of a meter
  - c. **One one-millionth of a meter**
  - d. One one-billionth of a meter
2. A nanometer is
  - a.  $10^{-1}$  meter
  - b.  $10^{-3}$  meter
  - c.  $10^{-6}$  meter
  - d.  **$10^{-9}$  meter**
3. Which of the following is a correct metric scale from largest to smallest?
  - a. **Deci, milli, micro, nano, pico**
  - b. Milli, centi, micro, nano, pico
  - c. Milli, centi, micro, pico, nano
  - d. Centi, micro, milli, nano, pico
4. A human hair that is 60 micrometers in diameter is \_\_\_\_\_ times larger than a DNA molecule that is 2 nanometers in diameter
  - a. 300,000
  - b. **30,000**
  - c. 3,000
  - d. 300
5. Which of the following is a “relative term”?
  - a. Nano-sized
  - b. Micron
  - c. **Extremely small**
  - d. Approximately the width of a dime
6. The nanoscale is 100 nano to 1 nano in range. Which of the following objects is NOT in the nanorange?
  - a. Virus agent
  - b. **Red blood cell**
  - c. Water molecule
  - d. Silicon atom
7. The microscale is considered the range of 100 nano to 100 micro. Which of the following objects is NOT in the micro-scale range
  - a. Red blood cell
  - b. The diameter of a human hair
  - c. **ATP synthase motor**
  - d. Bacteria
8. Which of the following BEST defines microtechnology?
  - a. The exploitation of the properties of particles and molecules in the micro-scale.
  - b. The mass production of micro-sized components used to replace components with equivalent tasks in the macro-scale.
  - c. The technology that copies tasks found in nature to create artificial devices and components that perform the same tasks.
  - d. **The art of creating, manufacturing, or using miniature components, equipment, and systems that have been mass-produced.**

9. Which of the following microsystems applications was one of the first applications to use piezoelectric crystals to move fluid from a reservoir and through a nozzle?
  - a. Inkjet printheads
  - b. Drug delivery systems
  - c. Gas delivery systems
  - d. The artificial heart
10. Homeland security is currently using which of the following MEMS in its baggage check procedures?
  - a. Digital communication systems
  - b. Vibration sensors
  - c. Gas detection sensors
  - d. Pressure sensors
11. When constructing micro-sized systems, microtechnology normally uses the \_\_\_\_\_ approach to fabrication.
  - a. top down
  - b. bottom-up
  - c. piece-mill
  - d. molding
12. In today's world, micro and nanotechnology have merged. Many MEMS have nano-sized components. Which of the following is a nano-sized component that is currently found in MEMS?
  - a. Electrode arrays
  - b. Monolayer films
  - c. Pressure sensors
  - d. Cantilever arrays

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