Teacher's Preparatory Guide

THE PINCH TEST

The Right Tool for the Right Object

Purpose: This lesson will be used as to assess student knowledge of size or SI prefixes and which equipment/tools you would need to view objects of particular sizes. The lesson can be used to see how much students know before teaching; to introduce them to the topic; or to assess what they have learned after teaching about size and SI prefixes. The concept of size and scale is important for students to learn so that they can understand how small the nanoscale is – objects between 1-100 nanometers. One nanometer is one billionth of a meter ($1x10^{-9}$).

Time Required:
30 to 60 minutes

Level: High School chemistry or biology

Big Ideas in Nanoscale Science: Size and Scale; Tools and Instrumentation

Teacher Background: Scale can be divided into worlds – macro, micro, nano, and atomic. Student often have difficulty in placing objects into the scales below the macro level and most definitely with those objects in the nano and atomic worlds. In nanoscale science and engineering, size and scale are very important. It is at this scale that materials behave differently and forces that are important at the macroscale (gravity) are no longer dominant. Instead, electromagnetic forces play a dominant role. Another important size property at the nanoscale is surface area to volume ratio. As an object becomes smaller its surface area to volume ratio increases which in turn can change the way the object functions or behaves. While this activity does not cover these topics, it is important for students to understand these difference worlds of scale.

Teaching Strategies:
This activity is called a "Pinch Test" because students pinch, between thumb and forefinger, their answer choice from a group of images. Student answer choices (attached) can be printed so all of the answer choices are on a half sheet of paper or printed separately on cards. Each student will have a set of answers choices.

The activity focuses on showing students a series of PowerPoint slides with either pictures of objects or SI units such as nanometer and meter. All students then pinch the correct equipment/tool that would be needed to see the object. For example, a cat would be seen with the eye while a plant cell would require a microscope.

The lesson is designed to stimulate conversation, targeting misconceptions and understanding of size and scale as well as SI units. The lessons helps student understand which tool is most appropriate to use given the size of the object.

Students enjoy competition, so the Pinch Test can be played as a game with the students divided into teams. It is important that each student play or pinch their answer. To encourage all members of the class to play, use the

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rule that the team gets a point only if everybody on the team gets the correct answer. Students also enjoy playing the class against the teacher.

Show the "question." The "question" doesn't have to be in question format. Use pictures, words, values in scientific notation or a combination (see accompanying PowerPoint example). You can decide the pictures; words; values to use; or let the students submit them as a class assignment prior to the activity. For example you could focus on the flower itself which would be seen with the eye or the pollen on the stamen which would use a microscope. Show the "question" using power point slides; active/smart board flip charts; pictures on paper. The visual is shown without discussion and students are provided time to think about his/her answer before they pinch and hold up their answer. They can not talk to each other or ask for clarification. Watch to see when they are ready. Some questions will need less time than others. Push them a little to think fast.

When they are ready, say "answers up." Each student must put the paper (with answer choices) up with their answer choice being pinched. (Demonstrate so they know what is acceptable.)

Check their answers. Then provide the correct answer. There is no need to discuss each answer in length as you want to keep the game/discussion moving. Remember, whether they all get it right or not, this is the time for them to have some great discussion. They can ask questions of each other or you to clarify their understanding. If students have a variety of answers, ask them to explain their choice. Ask the students who have the correct answer to explain it to those that don't.

This activity is not a test but a way to assess student knowledge and understanding of size and scale. You can create a scoring sheet if you wish to be able to know each student's level of comprehension.

A magnifying glass is typically 2 – 5X
A jeweler's loupe used here is 20X
A typical student microscope would range between 40 and 400X but could go as high a 1000X
A scanning electron microscope can go up to 500,000X
The human eye can distinguish about 0.04mm or the width of a human hair

Materials:

- Computer with Microsoft PowerPoint
- Projector
- The Pinch Test slides
- Copies of the answer choices - one for each student

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Pinch the best Answer….

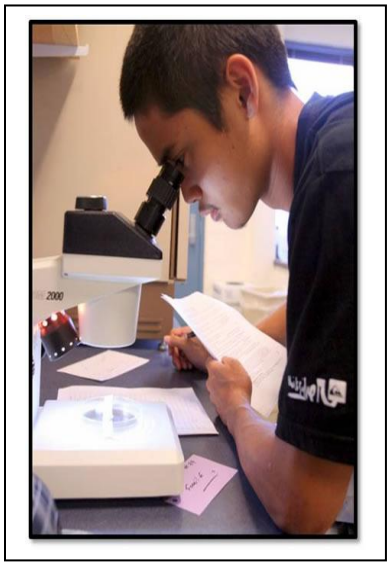

Image courtesy Hitachi HTA

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Questions:
Depending on how you plan to use the lesson, choose the "questions" that are most appropriate for your students. These are in no order and are only suggestions. Put the pictures or words on power point slides to flash up on the screen. Or low tech - print each on a card or sheet of paper large enough for the students to see or print as a pack of cards for each student. They can keep the cards face down on their desk but be sure to number them the same so students are all using the same "question."

Slides/ "Questions":
1. Title Slide-show this slide while you get the answer sheets passed out.
2. Shows how to pinch the answer choice. Use this slide to review with the students how to express their answer. Remind them not to put the answer up for you to see until you say "ANSWERS UP". When they put the answer sheet up the answer must be pinched.
3. 10^{-5}
4. centi-
5. penny
6. animal cell
7. red blood cell
8. sugar crystal
9. micro-
10. hydrogen bonds
11. flower/stamen/pistal/pollen-you can use any one of these.
12. 10mm
13.10^{-3}
14. cat
15. molecule
16. cell nucleus
17. yellow flower
18. covalent or ionic bond
19. atom
20. rust
21.bug eye
22. nano-
23. 1m
24. gum
25. buying a diamond
26. egg
27. bug hairs
28. 10^{3}
29. plant cell
30. tomato
31. 10^{-9}
32. diameter/width of bracelet
33. shoes
34. angstrom

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National Science Content Standards
Standard A Understandings about scientific inquiry
Standard E Understandings about science and technology

Principles and Standards of School Mathematics

- Measurement
    - Understand measurable attributes of objects and the units, systems, and processes of measurement
- Numbers and Operations
    - Understand numbers, ways of representing numbers, relationships among numbers, and number systems

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