Class Starters & Enders

Making the Most of Instructional Time
Five Minute Lessons

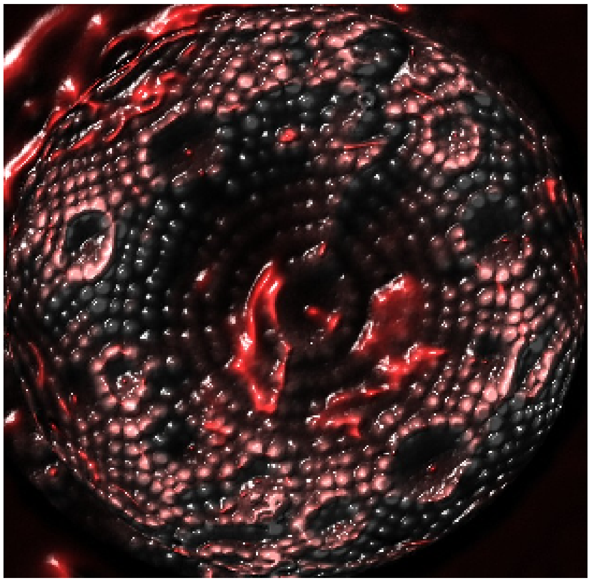
Class Starters and Enders help utilize the last minutes of class when a lesson ends but there is not enough time to start another, or for an interest approach at the beginning of class. Mini-lessons correlate to GPS in the programs areas below.

Nano

Program Areas: Engineering & Technology and Healthcare Science

Instructions: Read the narrative and make notes of important points, answer questions, if provided, and be ready to discuss this topic.

Nano is a prefix used in the **SI** system of weights and measures. When appended to the front of a unit, it means 10^{-9}, or one one-billionth. For example, a nanometer is one one-billionth of a meter. Such small numbers are needed to describe things such as the wavelength of visible light, which falls between 400 and 700 nanometers, or the time taken by the fusion reaction in a hydrogen bomb, 20 to 40 nanoseconds. When not used as a prefix to a unit of measurement, **nano** refers to a field or subject that deals with phenomenon on a very small scale, such as the term nanotechnology. These fields are significantly different from their macro-scale counterparts because chemical, electrical and electromagnetic interactions are very different on a nanoscopic scale. The wavelike properties of electrons can be changed by rearranging matter on a nanoscopic scale, allowing such physical properties as melting point, magnetism, and charge capacity to be altered without changing the physical composition of the material. On the nanoscopic scale, the wavelength of light becomes comparable to the size of matter, allowing **optical** effects to arise, such as **polarization** and color filtering. A good example of the difference between the macroscopic and nanoscopic scales is in the modeling of gases; the macroscopic gas model assumes that the particles of a gas are evenly distributed and move randomly. On the nanoscopic scale this no longer holds true; the distribution of particles can be altered by temporary magnetic fields, charge interactions, or simply chance. **Nanotechnology** opens new possibilities in **biomedical engineering** because biological systems are organized on a nanoscopic scale; the ability to alter the **human genome** would be an example of nanotechnology; specifically, **nanomedicine**. A commonly-discussed piece of nanotechnology is the **carbon nanotube**; a nanoscale tube made of bonded carbon atoms. These structures are the subject of much research because of their unusual strength and electromagnetic properties. Advancements such as these hold great promise for the future applications of nanotechnology.



A field ion microscope image of the sharpest man-made object; a tungsten needle with a point just one atom wide. The round features visible are individual atoms.

Review

1. Name an example of a piece of nanotechnology.
2. Why do we need units of measurement that are so small?
3. What does nano mean when used with another term?
4. What optical effects result from interactions on a nano scale?
5. What does the prefix nano mean as a unit of measurement?
6. What makes nanoscopic fields different from their macroscopic counterparts?
7. What physical properties can be altered by rearranging atoms on a nanoscopic scale?
8. What fields of science and engineering might be concerned with nanoscopic interactions?
9. What assumptions does the macroscopic gas model make that do not hold at the nanoscopic level?
10. What future applications of nanotechnology can you think of?

Science Connection

Research and write definitions for terms in notes.

biomedical engineering	carbon nanotube
nano	human genome
nanotechnology	nanomedicine
polarization	optical
	SI

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