SYNOPSIS:

For centuries, scientists and engineers have been making things bigger and better. Now some scientists are trying to make things smaller and better in hopes of solving some of the world's biggest problems. These scientists and engineers are working in specialties of micro engineering and nanotechnology to develop microscopic and atom-sized solutions in fields such as medicine, environmental pollution and information technology.

Scientists working in the specialty of nanotechnology are experimenting with moving individual atoms and molecules to create new materials with unimagined practical uses.

This program explores the growing fields of micro engineering and nanotechnology to see how scientists are trying to solve big problems with small solutions.

CURRICULUM UNITS:

Biology
Chemistry
Computer Science
Engineering
Electronics
Environmental
Health
Physics

CAREER OPPORTUNITIES:

Biologist
Microscopist
Materials Science Engineer
Molecular Biologist
Mechanical Engineer
Physicist
Aquaculturist

PROGRAM OVERVIEW:

The program shows scientists developing a complete water-testing laboratory on a microchip. Testing water for infectious microorganisms can be difficult, expensive, and lengthy. To improve and speed up water testing, scientists have been developing the chip-size lab. Students see how the micro laboratory analyzes a water sample and how infectious particles in the sample are identified.

Students also learn about a discovery that human cells line up and move along microscopic grooves. Using this information, engineers cut a variety of grooves into certain materials that were then used as a bandages for injured patients. Time-lapse photography shows students how the bandages effected the movement and bonding of fibroblasts and, in turn, accelerated healing.

The program shows students the dramatic collapse of the Tacoma Narrows Bridge in Washington State when it was hit by winds in 1940. The bridge began to vibrate, sway, and eventually fall apart because of resonance. Students see a demonstration that explains resonance and how micro engineering is finding ways to help bridge builders and jet engine designers find microscopic stress cracks caused by resonance.

Students also learn about the scanning tunneling microscope and how scientists are unlocking the mysteries of atomic arrangement. They see how scientists use this information to perfect the technique of manipulating atoms so that, one day, they may create new materials.

ISSUES & CRITICAL THINKING:

1) After showing the program, ask the class the following:
   a. Recall three micro-engineering or nanotechnology projects described in the program.
   b. What is nanotechnology?
   c. What is resonance?
   d. Explain how scientists can predict that one day it will be possible to store 24 volumes of an encyclopedia on the head of a pin.
2) The program shows a bandage with microgrooves that promote the healing of damaged cells. Ask students to brainstorm about other applications that might use the discovery that fibroblasts move along microscopic grooves.
3) Ask students to research the collapse of the Tacoma Narrows Bridge and write a newspaper story about it as if they were reporters for a Tacoma newspaper.
4) Simulate the demonstration of resonance shown in the program by using a "Slinky" toy or a jump rope and two student volunteers to create vibration.
5) Have students brainstorm new types of materials that could be created by manipulation of atoms.
6) Assign students to research how a scanning tunneling microscope works and how it differs from other types of microscopes.
7) Lead a brainstorming discussion with the class about the consequences for education if the entire Library of Congress was stored on a device the size of a person's hand.
8) The program shows how important it is for engineers to detect stress cracks caused by resonance in bridges, jet engines, and nuclear power plants. Ask the class to list other items and structures in which it would be important to know the effect of resonance.
9) If your classroom is connected to the Internet, ask students to explore the images made with a scanning tunneling microscope at the IBM laboratory in Almaden, CA. This can be seen at: http://www.almaden.ibm.com/vis/stm/stm.html

GLOSSARY:

Chemotherapy- The treatment of an ailment by chemicals especially by killing micro-organisms or cancerous cells.

Fibroblasts- A type of cell that synthesizes the extra-cellular matrix and collagen, the structural framework (stroma) for animal tissues and plays a critical role in wound healing.

Hologram- Holograms are 3-D images that have been projected and captured on a 2-D surface.

Microchip- A set of electronic components on a single unit.

Resonance- Occurs when a system is able to store and easily transfer energy between two or more different storage modes.

Scanning Tunneling Microscope- A scanning tunneling microscope (STM) is an instrument for imaging surfaces at the atomic level.

Tendon- A tough band of fibrous connective tissue that usually connects muscle to bone and is capable of with-standing tension.

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