Name _____ Date _____ Class _____

TECHNOLOGY NOTE

The Smallest Particles

A fundamental principle of physics holds that the smaller an object is, the greater the amount of energy required to see it. Scientists at Fermi National Accelerator Laboratory near Chicago, Illinois, apply this principle on a grand scale. More than 850 physicists at Fermilab rely on Tevatron, a huge particle accelerator, to help them search for the smallest, and therefore most basic, particles of matter.

For a long time, scientists thought that the most basic particles of matter were atoms. Then when the protons, neurons, and electrons found in atoms were discovered, these particles were thought to be the most basic. Now the honor goes to particles called *quarks* and *leptons*. The illustration to the left shows these increasingly smaller particles. As you can see, however, recent evidence suggests that quarks may also be composed of something even smaller.

Because the amount of energy needed to see subatomic particles does not exist naturally, scientists have to build up enough energy to break apart these particles so individual parts can be isolated for study.

Tevatron, shown above, is an underground, ring-shaped tunnel, 6.4 km in circumference. It is built of 1,000 super-conducting magnets that move beams of tiny particles at increasingly higher speeds. As they gain speed, the particles build up energy.

When the energized particles are moving near the speed of light (299,792,458 m/s), they are directed to hit either a fixed target or particles moving in an opposite direction. At impact, the particles split. The byproducts of the particles are separated and scattered. The smaller particles, quarks, and leptons among them, are isolated by a collider detector.

For now, the nature of subatomic particles may seem far removed from earth science. However, research into matter's most basic particles may one day influence the work of earth scientists by changing basic theories ranging from the ultimate structure of matter to the origin of the universe.

The word atom comes from the Greek word meaning "indivisible." Is an atom really indivisible? Explain your answer.