EXCERPTED FROM:
A TEACHER'S GUIDE WITH ACTIVITIES IN SCIENCE, AND TECHNOLOGY,
EG-1997-08-110-HQ, EDUCATION STANDARDS GRADES 5–8 (∆), 9–12 (❑)

Zeolites are crystals made up of the elements silicon, aluminum, and oxygen. The crystals consist of alternating arrays of silica (beach sand, SiO2) and alumina (aluminum oxide, Al2 03) and can take on many geometric forms such as cubes and tetrahedra. Internally, zeolites are rigid sponge-like structures with uniform but very small openings (e.g., 0.1 to 1.2 nanometers or 0.1 to 1.2 X 10-9 meters). Because of this property, these inorganic crystals are sometimes called "molecular sieves." For this reason, zeolites are employed in a variety of chemical processes. They allow only molecules of certain sizes to enter their pores while keeping molecules of larger sizes out. In a sense, zeolite crystals act like a spaghetti strainer that permits hot water to pass through while holding back the spaghetti. As a result ot tnis filtering action, zeolites enable chemists to manipulate molecules and process them individually.
The many chemical applications for zeolite crystals make them some of the most useful inorganic materials in the world. They are used as catalysts in a large number of chemical reactions. (A catalyst is a material that has a pronounced effect on the speed of a chemical reaction without being affected or consumed by the reaction.) Scientists use zeolite crystals to produce all the world's gasoline though a chemical process called catalytic cracking. Zeolite crystals are often used in filtration systems for large municipal aquariums to remove ammonia from the water. Because they are environmentally safe, zeolites have been used in laundry detergents to remove magnesium and calcium ions. This greatly improves detergent sudsing in mineral-rich "hard" water. Zeolites can also function as filters for removing low concentrations of heavy metal ions, such as Hg, Cd, and Pb, or radioactive materials from waste waters.

ANTEN CHEMICAL

Zeolite FAQs

Zeolites are used by everyone in the world. Many people may not have a lot of experience with zeolites but would like to learn more. For these people, Anten Chemical has posted answers to some commonly asked questions about zeolites as an introduction to what zeolites are and what they do in real-world applications.

1. What are zeolites?
Zeolites are three-dimensional, microporous, crystalline solids with well-defined structures that contain aluminum, silicon, and oxygen in their regular framework; cations and water are located in the pores.

2. When were zeolites discovered?
In 1756, the Swedish mineralogist Axel Fredrick Cronstedt discovered that stilbite, a natural mineral, visibly lost water when heated, and he named the class of materials zeolites from the classical Greek words meaning 'boiling stones.' Zeolites were considered an obscure group of minerals with unique properties for almost 200 years. (Not entirely true as we will learn)

3. What are some of the major applications for zeolites?
Adsorption - Zeolites are used to adsorb a variety of materials. This includes applications in drying, purification, and separation. They can remove water to very low partial pressures and are very effective desiccants, with a capacity of up to more than 25% of their weight in water. They can remove volatile organic chemicals from air streams, separate isomers and mixtures of gases.
Ion Exchange - The largest volume use for zeolites is in detergent formulations where they have replaced phosphates as water-softening agents. They do this by exchanging the sodium in the zeolite for the calcium and magnesium present in the water.

4. What makes zeolites special when compared with other inorganic oxide materials?
The combination of many properties, among them: the microporous character of the uniform pore dimensions, the ion exchange properties, the ability to develop internal acidity, the high thermal stability, the high internal surface area. These make zeolites unique among inorganic oxides.

5. Are zeolties safe? Studies have demonstrated that zeolites are essentially non-toxic via oral, dermal, ocular, and respiratory routes of exposure; Zeolite was also found to be safe for the environment. Please consult the MSDS for product(s) of interest.

Sample Lesson Plan Format
Course:
Date:
Materials needed:

I. Class Objectives: Write out the goals or objectives for class. Try to limit these to one or two things.
II. Connection to Course Goals: Describe how your daily objectives connect to the overall course goals.
III. Anticipatory Set: Sometimes referred to as a "hook" to focus students' attention at the start of class. This activity should be brief and directly related to the lesson.
IV. Introduction: Write down what you'll need to inform students of the daily goals and class procedures.
V. Procedures: List your activities, including any discussion questions and transitions along the way.
VI. Conclusion: Describe the objective for the lesson and point students forward by connecting your objective to the conclusion.

I. Class Objectives: TO EXPLAIN THE "EVOLUTION" OF ZEOLITE USE IN OUR WORLD
II. Connection to Course Goals: UNDERSTANDING THE EVOLUTION (ADVANCEMENT) OF ALL TECHNOLOGY FOR USE IN SOCIETY
III. Anticipatory Set: DIRTY GREY WATER IN THE WASHING MACHINE…
IV. Introduction: **ADSORPTION** IS THE PROCESS IN WHICH ATOMS, IONS OR MOLECULES FROM A SUBSTANCE (IT COULD BE GAS, LIQUID OR DISSOLVED SOLID) ADHERE TO A SURFACE OF THE ADSORBENT… ABSORPTION INVOLVES THE ENTIRE VOLUME OF THE ABSORBING SUBSTANCE.
V. Procedures: MAKE USE OF THE WEBSITE TO EXPLAIN THE SCIENCE OF ZEOLITES AND THE REPURPOSING OF ZEOLITES FOR USE IN THE FOOD SERVICE INDUSTRY
VI. Conclusion: DISCUSS FUTURE USES OF ZEOLITES TO REINFORCE THE CONCEPT OF THE EVOLUTION OF TECHNOLOGY.