



# Flame Proof Designing New Materials guess for Fireproof Technologies



China Lake, CA (Naval Air Warfare Center Weapons Division)—Scientists and engineers create better materials for ships, planes, and space travel. They design and prototype new composite materials that have specific properties (they're tough, waterproof, flameproof and lightweight). Molecules can be designed using 3-D modeling and visualization technologies.

*"Just like engineers build bridges and design airplanes, using the latest in technology we can also build and design molecules."* **Andy Guenthner, chemical engineer**

## Framework

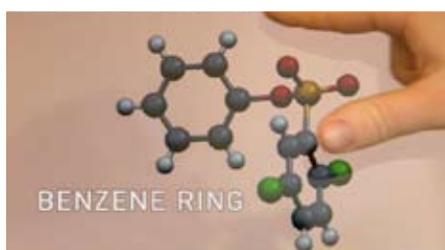
Middle School

## Standards

- NSES - B.i.1 ➤ Materials have characteristic properties.
- NSES - B.i.2 ➤ Chemical reactions form new substances (compounds).
- STL - 2.R ➤ Requirements are parameters placed on the development of a product.
- STL - 9.H ➤ Modeling, testing, evaluating, and modifying are done.
- STL - 19.I ➤ Chemical technologies alter chemical substances.

## Content Illustrated

- Computer models of molecules.
- Layering of materials to form composites.



# Content



## Physical Science

- New materials can be created as a combination, or composite, of two original materials. This technique allows for advantageously combined material properties. For example, carbon fibers (which are very strong) and epoxy resin (which is like a glue) can be made into a composite. The epoxy contains benzene rings which are fire-resistant.
- The properties of tiny molecules affect the performance of the large structures and vehicles.

## Technology

- Scientists can create new molecules using new technology.
- A computerized modeling tool lets scientists and engineers visualize how designed molecules will look in three dimensions. The user can build and rotate representations of molecules to understand their size, shape, and other spatial properties.
- The molecular structures analyzed by the computer can be 100,000 times tinier than the width of a human hair.

## Engineering

- Chemical engineers and scientists identify molecular properties that would benefit the creation of new materials. Such properties include being lightweight, strong, low-cost, fire-resistant, and water-resistant. The materials might be used to build planes, ships, and space stations.
- Engineers perform “torture” tests to identify the limits of the new composite materials. Tests include mechanical blows (for strength) and blasting with a blow torch (for fire resistance).
- Engineers can determine the molecules’ shape and size.
- Making new materials takes time and effort and can be expensive, so material engineers make and test small samples.

## Math

- 3-D modeling (using computer tool).

## Guiding Questions

To think about as you watch:

- What are some ways to represent molecules?
- Why are computers used to design molecules?

## Suggested Activities

- Identify other materials that are fireproof and what makes them so.
- Research the uses of benzene.

## Keywords

benzene ring  
carbon fibers  
composite  
epoxy  
fire-resistant  
molecule  
properties  
water -resistant

- *Flame Proof* can be found online at [www.ndep.us/Flame-Proof](http://www.ndep.us/Flame-Proof). Visit [www.ndep.us/LabTV](http://www.ndep.us/LabTV) for a list of process skills modeled in webisodes.