



## NANOSMORES & PHOTOLITHOGRAPHY

**Objective:** Students will create an edible, layered cookie (smore) that represents the process used to create a patterned silicon wafer using a substrate and a photoresist.

### Background:

Photolithography is one process through which very small (less than a few micrometers) 3-D features can be produced. It is the basis for manufacturing microelectronic chips used, for example, in computers. The lithography process involves a series of steps that builds up successive layers of materials. The top layer is exposed to radiation using a **mask**, which contains a pattern that is transferred to the top layer. The process begins with a **substrate**. Silicon is the preferred material. A primer is applied that acts to help bind the next layer, the photoresist, to the substrate. The **primer** is applied, and then the photoresist is layered on afterward, building up on the substrate layer in a sandwich like fashion. The **photoresist** is a chemical that is sensitive to radiation (e.g. light) and whose properties (*i.e.* solubility) are changed when exposed to radiation. The **mask** contains opaque (block radiation) and clear areas (allow transmission of radiation), which allows the radiation to pass through only selected areas to create the desired pattern.

**National Science Education Standard:** Science and Technology Standards, Levels 9-12, Abilities of technological design

**NYS MST Learning Standard:** Standard 1.1, Engineering design is an iterative process involving modeling and optimizations finding the best solution within given constraints which is used to develop technological solution to problems within given constraints.

**Materials:** graham crackers, chocolate bars, marshmallows, heat gun, mask template made of teflon, tongs

### Check for prior learning:

How do we create patterns on silicon wafers? (photolithography)

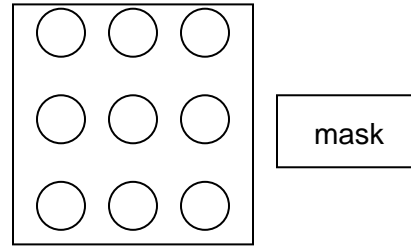
What materials are used? (silicon wafer, primer, photoresist, mask, radiation)

### New learning:

Share lithography background information with students. Students create the nanosmore, explaining aloud what each layer represents. Students expose the final layer (marshmallow) through the mask with the dryer. The last step is to put the top on the cookie and enjoy!



Graham cracker = silicon wafer (substrate)  
Chocolate bar = primer for photoresist  
Marshmallow = photoresist  
Teflon template = mask  
Heat gun = radiation (light)



**Check for learning:**

What is the purpose of a substrate and a photoresist in the lithography process?

