# Intro. to Nano Module: Curriculum Development Lab

## An Introduction to the Nanoscale: Surface Area and Volume

**Nanoscience Teacher Workshop**
**Northwestern University**

National Center for Learning and Teaching in Nanoscale Science and Engineering

# Same Material—Different Behavior

The **physical form** of a solid influences the degree to which it interacts with its environment: the more spread out the solid is, the more readily it interacts.

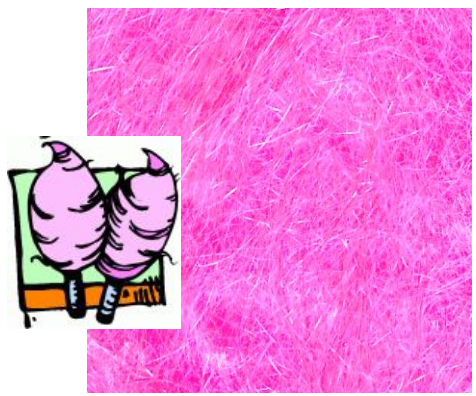
*Which form of steel burns faster?*


*Which form of polymer absorbs faster?*

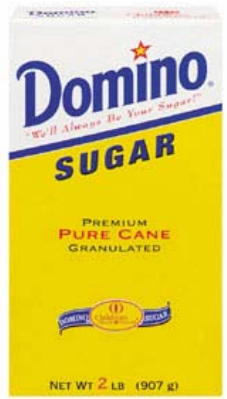

*Which form of candy dissolves fastest?*


mint (3D)

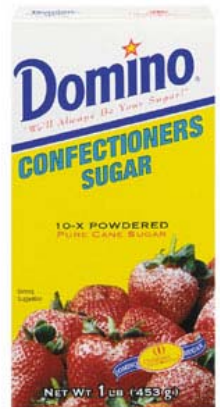

ribbon (2D)



cotton candy (1D)




granulated sugar




powdered sugar

# Powers of 10 and Scale

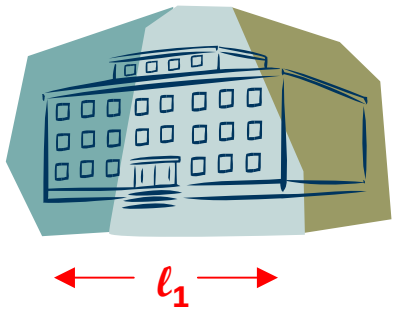
The magnitudes involved with the nanoscale can be represented with powers of 10 and scaling.

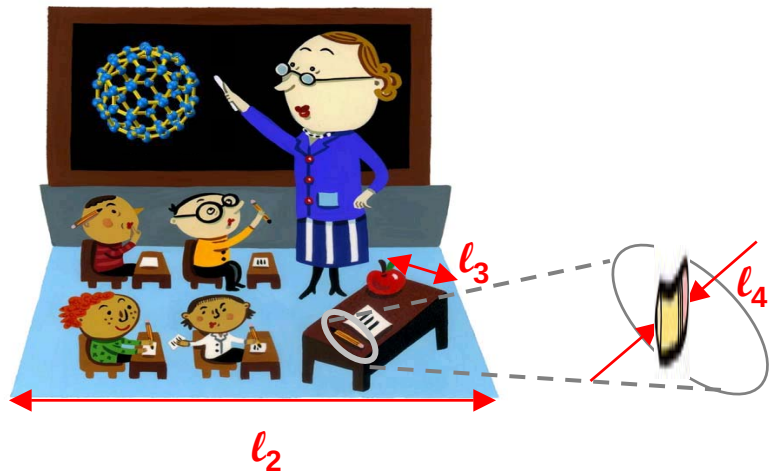
1) ***Express very large and very small dimensional values.***

2) ***Describe relative sizes.***

Measure the dimensional changes of a superabsorbent "animal".

Measure and report lengths.



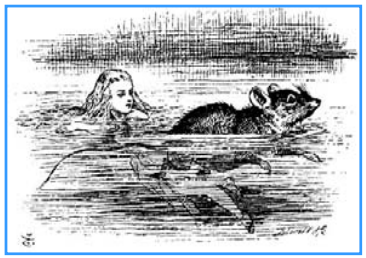



# Powers of 10 and Scale – cont.

## Scale Alice (in Wonderland)

$\frac{9}{5}$

$\frac{1}{12}$



## Scale students


$$\frac{1}{5\times10^{7}}$$

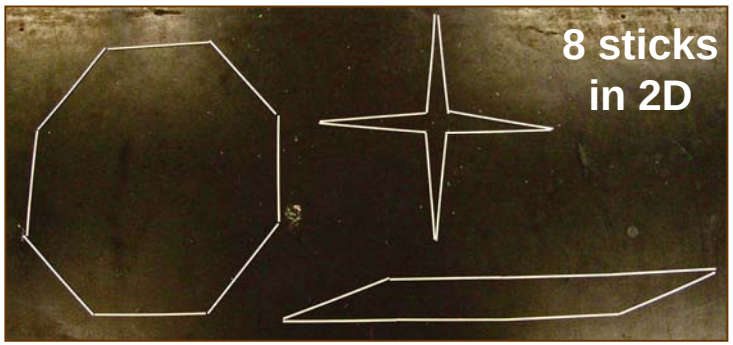
**presentation:**

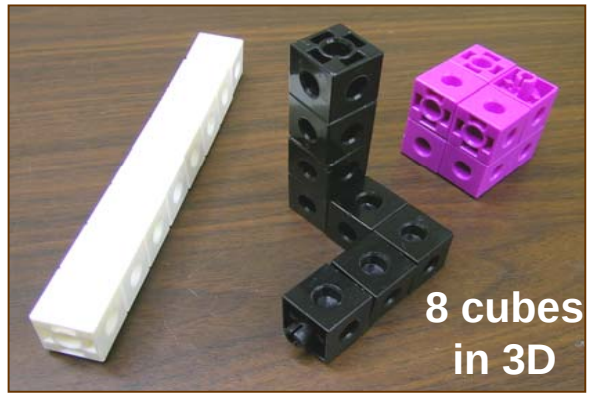
**Macro ⟷ Nano**

# Surface Area and Volume

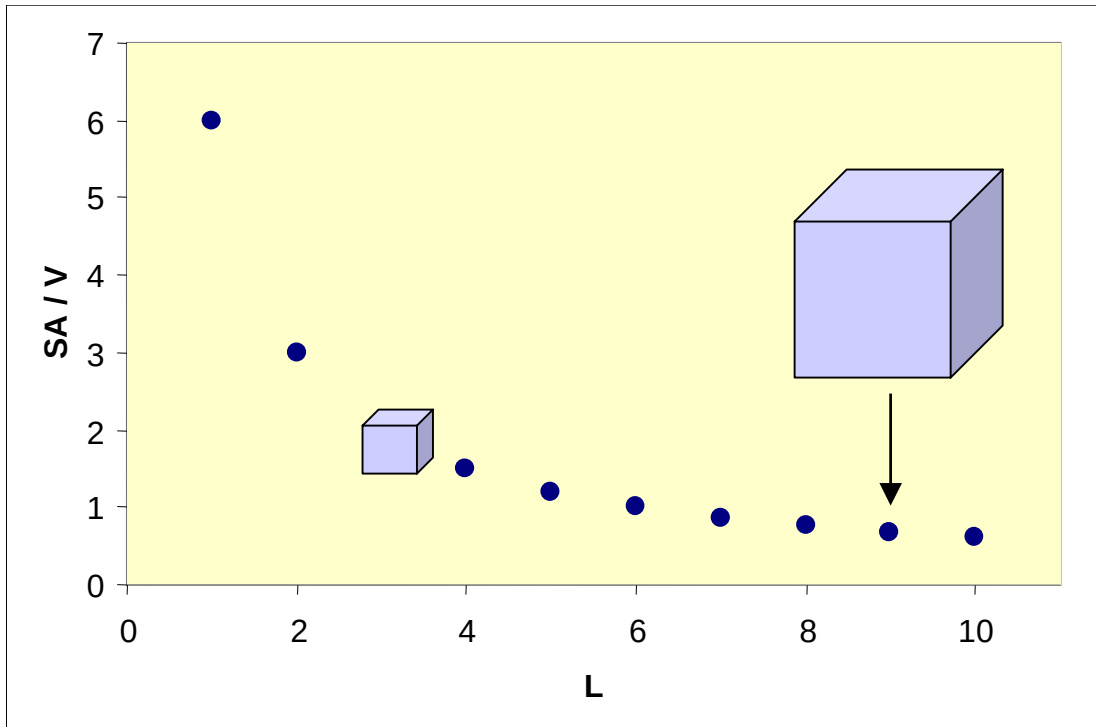
The **surface-area-to-volume ratio** changes with the **shape** or **size** of an object. This ratio changes dramatically in the nano scale.

*How do the perimeter, surface area, and volume change as a function of **SHAPE**?*




*How do the surface area and volume change as a function of **SIZE**?*



# Design

generic

"Activities" are *guided*.

∴ some aspects of **inquiry** may not occur.

*Such as …*

Engineering design projects provide opportunities to develop these thinking skills.

*But don't tell the students.*

# Generic DESIGN Process Steps

1) *Write*: need / shortcomings of other solutions / goals.
2) *Brainstorm.*
3) *Plan.*
4) *Make a prototype.*
5) *Evaluate* prototype.
6) *Improve* the design.
7) *Present* prototype to colleagues in other groups.
8) *Prepare* a final *report*.