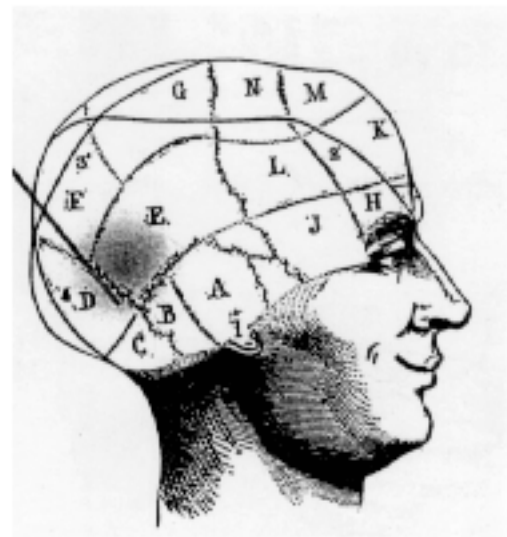
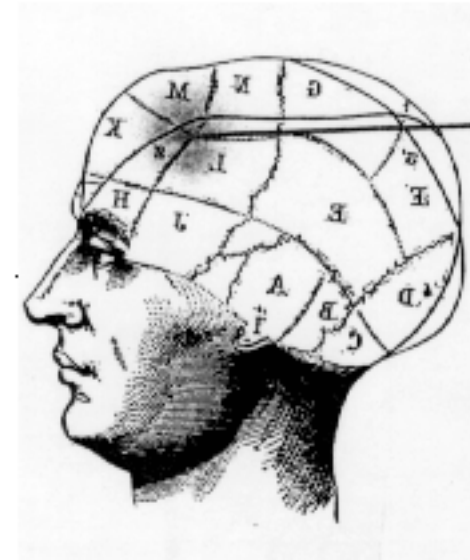




Logical  
Systems



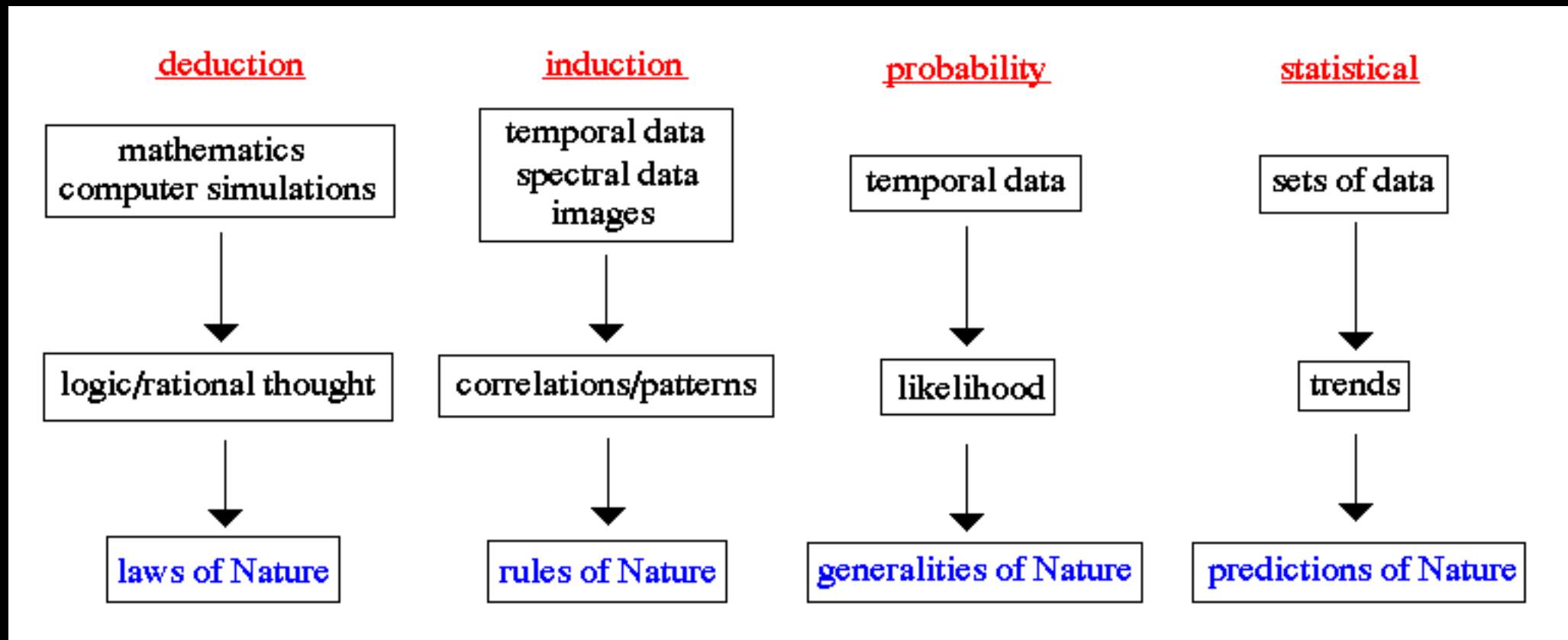
Science = ORDER!

Search for patterns, laws of Nature

Rationalism = all things have a natural  
cause that is knowable through reason

Problem solving

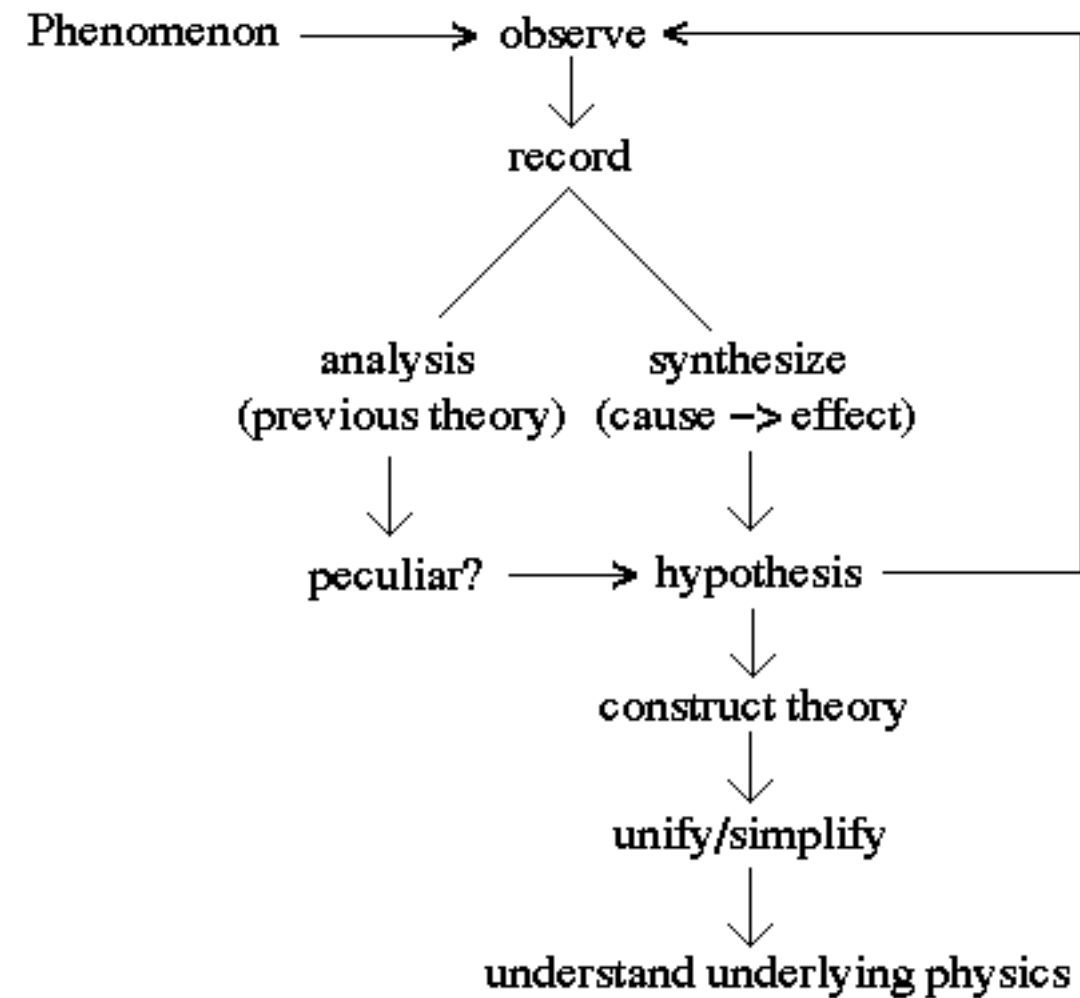
# Ways of Thinking



## Four steps of science

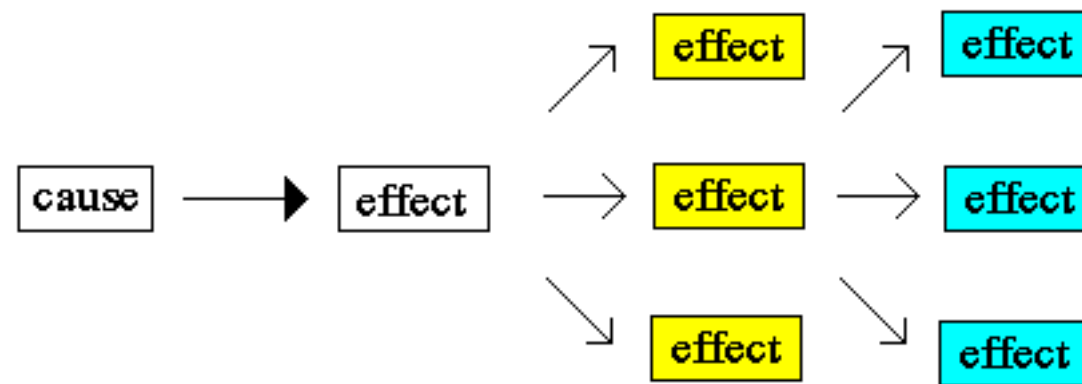
Observation  
Induction  
Hypothesis  
Falsification

## Scientific Method



Build a framework

“Standing on the shoulders of giants” Isaac Newton

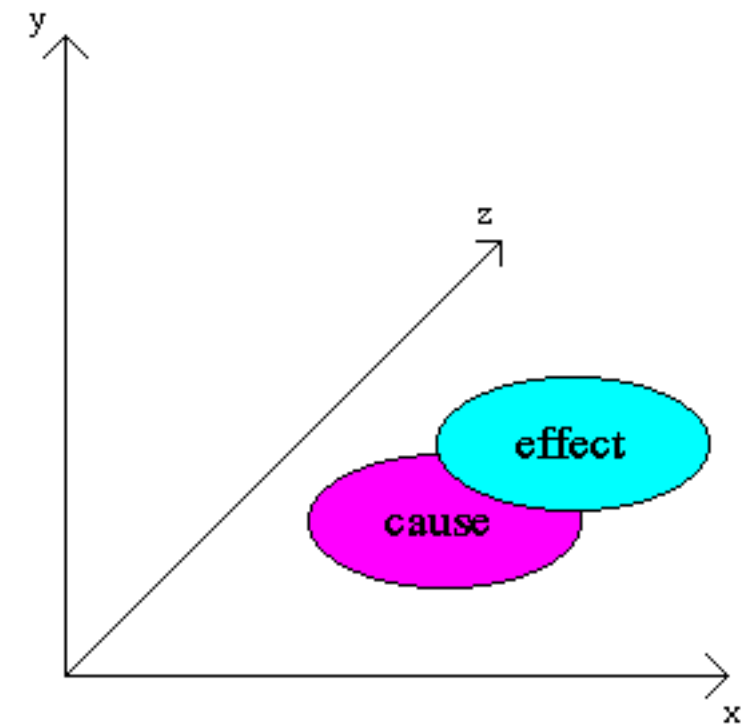


Rationalism requires cause -> effect

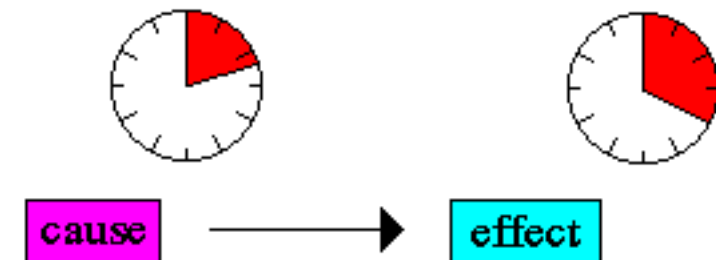
## The chain of causation

contiguity of space  
temporal order  
energy connection

spatial connection

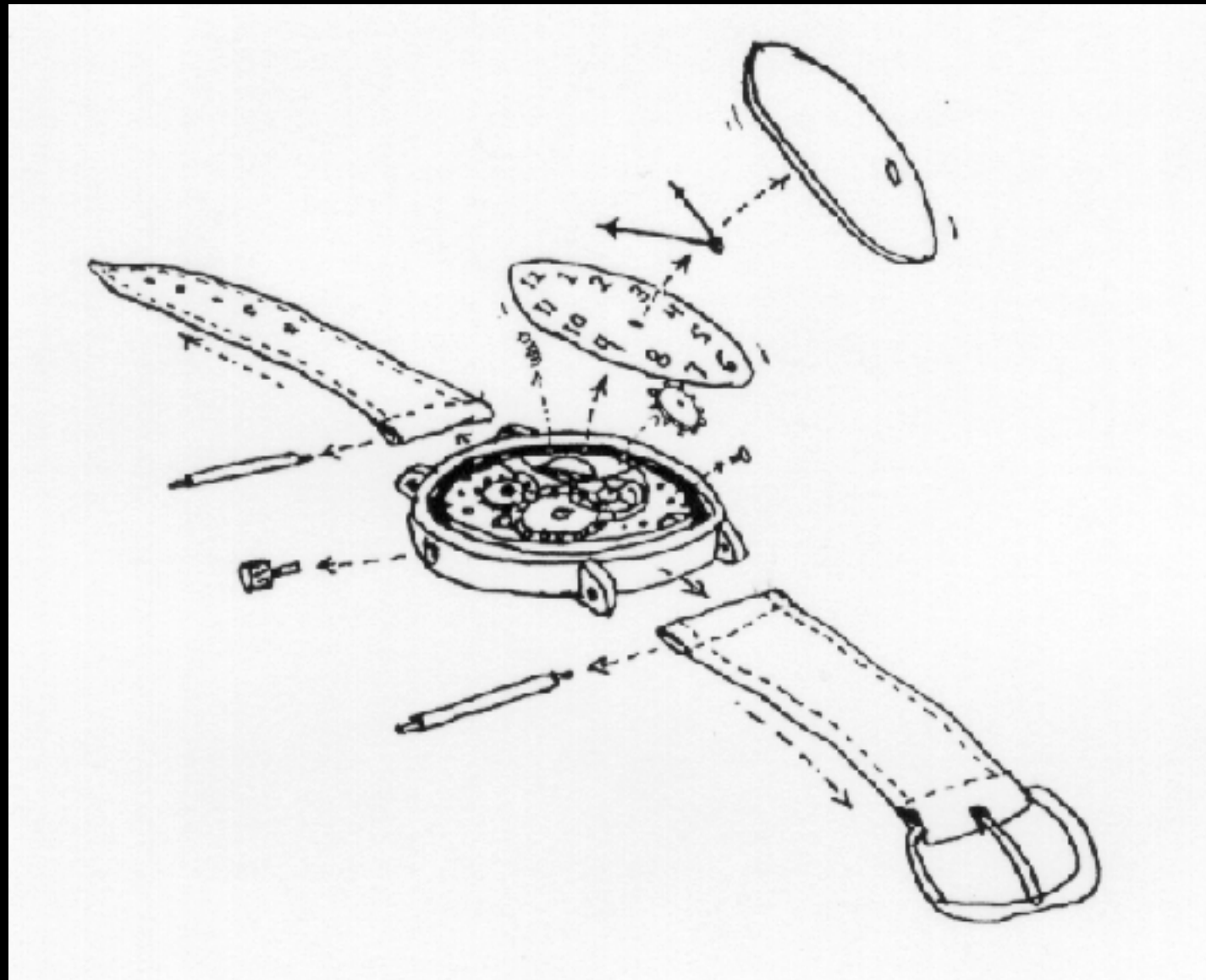


temporal connection



energy connection

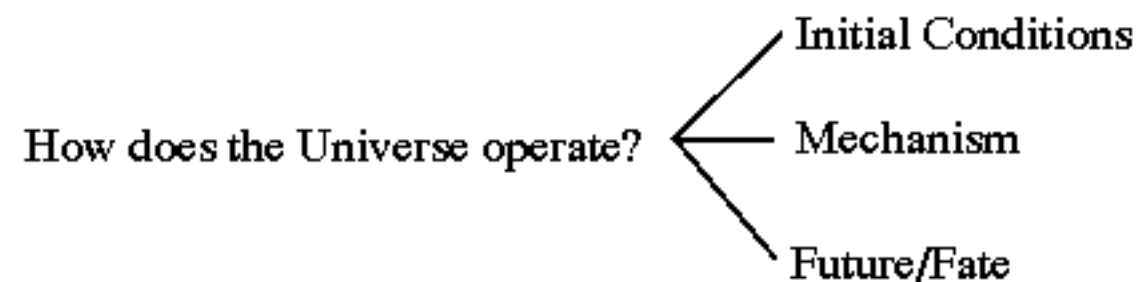
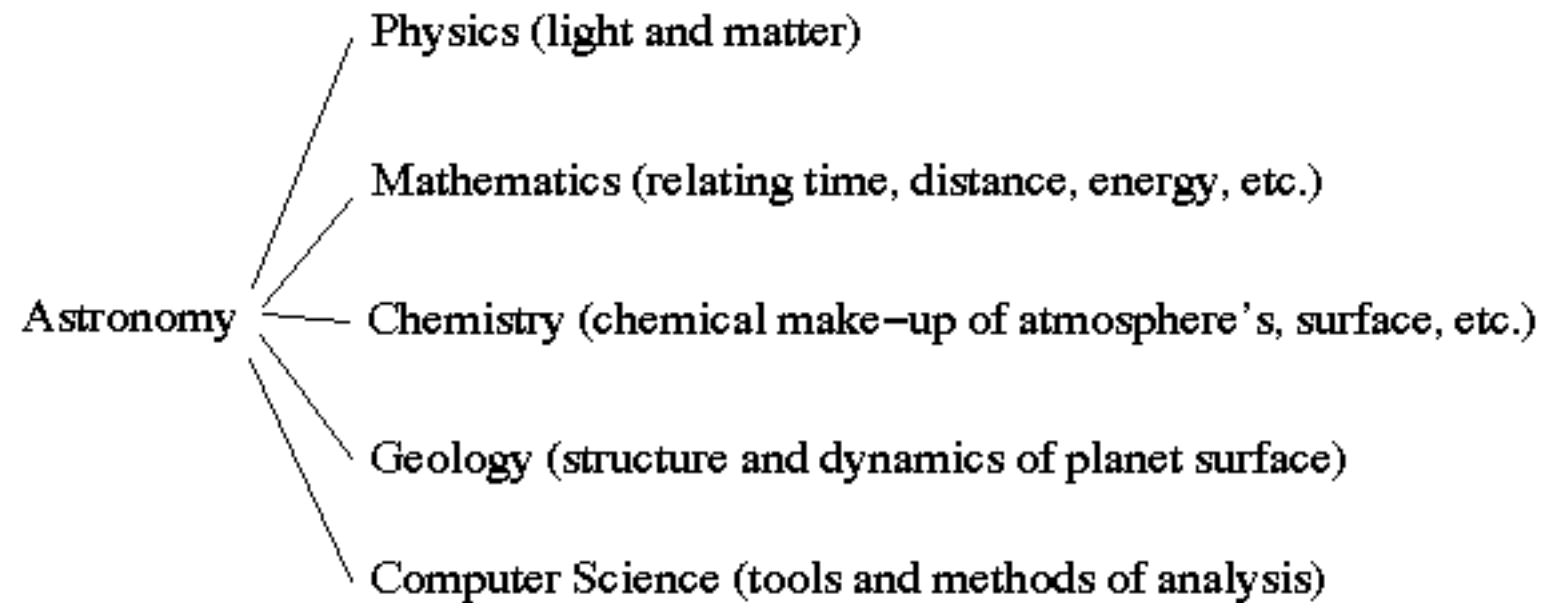




## Reductionism

All complex phenomenon can be explained  
in terms of simpler ones

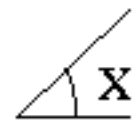
Leads to scientism



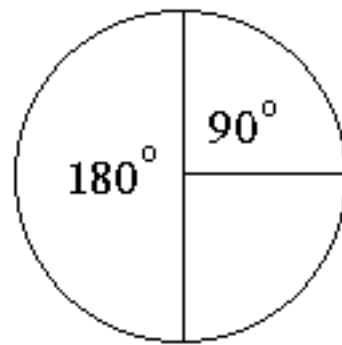
Astronomy differs from other sciences in that:

- 1) an astronomer can not change the parameters of an experiment, i.e. only passive observations are allowed
- 2) the distances are very large
- 3) timescales are very long
- 4) we are exploring very exotic phenomenon, yet we are limited by current physical framework

## Angular Measure



angle X is a measure of an opening or arc expressed in degrees or radians



360 degrees = circle =  $2\pi$  radians

# Exponent Notation

$$10^0 = 1$$

$$10^1 = 10$$

$$10^2 = 100$$

$$10^3 = 1000$$

$$10^{-1} = 0.1$$

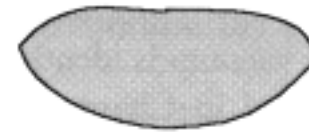
$$10^{-2} = 0.01$$

$$10^{-3} = 0.001$$

$$10^{-4} = 0.0001$$

Square 1:

5 mm



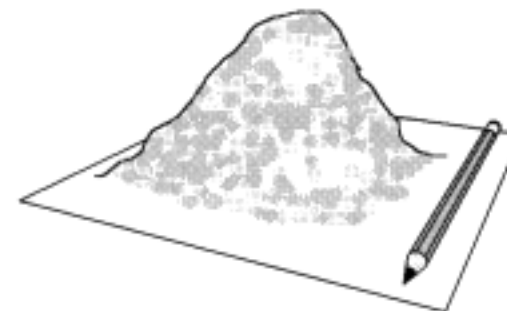
1 grain

Square 10:



$2^9 = 512$  grains

Square 19:



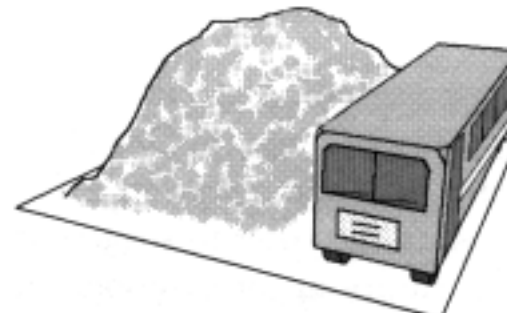
$2^{18} = 262,144$  grains

Square 28:



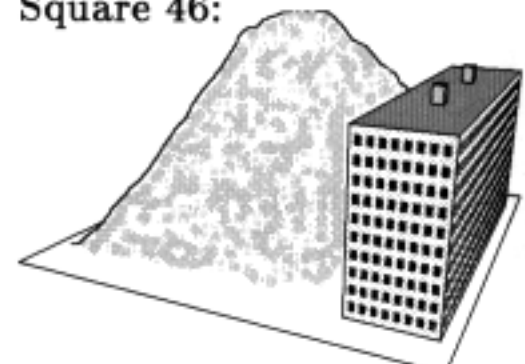
$2^{27} = 134,217,728$  grains

Square 37:



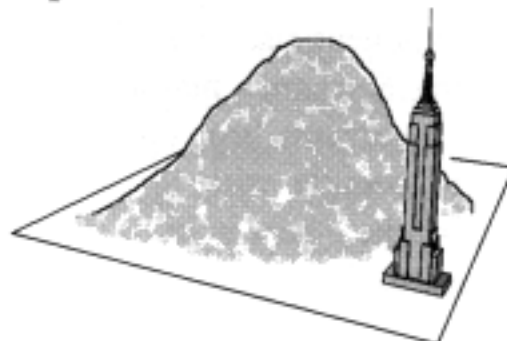
$2^{36} = 68,719,476,736$  grains

Square 46:



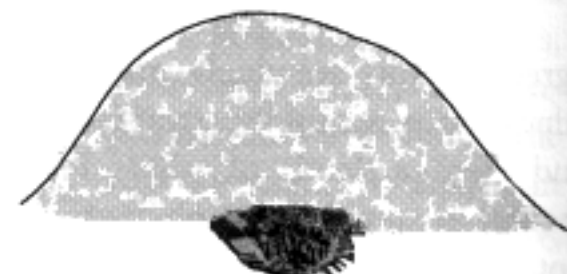
$2^{45} = 35,184,372,088,832$  grains

Square 55:



$2^{54} = 18,014,398,509,481,984$  grains

Square 64:



$2^{63} = 9,223,372,036,854,775,808$  grains