Name: Date:

The Scale of Things

Objectives:

- Learn general names of large/small scale objects
- Experiment with relative size relationships
- Practice order-of-magnitude estimation
- Practice problems with powers of ten

Materials

- ☐ Size comparison images

Cross-Discipline Extension Activities

Below are links to various cross-discipline activities that are extensions of this topic.

Biology
A Cloud in the Hand: http://www.flinnsci.com/media/396251/es10108.pdf
Chemistry
Scanning Electron Microscope Solves a Mystery: http://www.acs.org/content/dam/acsorg/education/resources/highschool/chemmatters/chemmatters-december-2003.pdf
Physics/Physical Science
Metric Mania http://sciencespot.net/Pages/classmetric.html
Earth/Geology/Environmental Science
The Quest for a Clean Drink: http://www.acs.org/content/dam/acsorg/education/resources/highschool/chemmatters/chemmatters-april-2008.pdf
Math
Cryotesting the James Webb Space Telescope: http://spacemath.gsfc.nasa.gov/Grade67/7Page70.pdf Exploring Power-laws: Meteor impacts: http://spacemath.gsfc.nasa.gov/weekly/10Page112.pdf Measuring Stratospheric Ozone with SAGE-III: http://spacemath.gsfc.nasa.gov/weekly/10Page109.pdf
Engineering
English to Metric Conversions http://sciencespot.net/Pages/classmetric.html Be a Scanning Probe Microscope: http://www.tryengineering.org/lesson-plans/be-scanning-probe-microscope?lesson=97

Introduction

Astronomical distances are, well, astronomical. It can be difficult to comprehend how far away even our nearest stellar neighbors are, let alone our nearest galactic neighbors or the size of the Universe. At the same time, many of the astronomer's fundamental tools depend on physics on the smallest scales — those of the atom and smaller. How can we get a handle on these scales?

Activity

(Calculators are discouraged)

1. There are several laminated cards on the table. In groups of three to four, examine the images. See how many things you can name (list them below), and try to put them in some kind of order. Your answers do not need to be perfect here.

2. Fill out the following, using rough order-of-magnitude estimations and scientific notation (e.g. 1,000,000 = 1 x 10^6, and 0.000 000 01 = 1 x 10^{-8})

The Universe (not pictured!) is _____ times larger than
a supercluster of galaxies, which is _____ times larger than
a cluster of galaxies, which is _____ times larger than
a spiral galaxy, which is _____ times larger than . . .

The Universe is _____ times larger than a spiral galaxy.

. . . a spiral arm in a galaxy, which is _____ times larger than
a large nebula, which is _____ times larger than
a small nebula, which is _____ times larger than
the Solar System (the Sun to Pluto), which is _____ times larger than . . .

A spiral arm is _____ times larger than the Solar System.

. . . the inner Solar System (the Sun to Earth), which is _____ times larger than
the Sun, which is _____ times larger than
Jupiter, which is _____ times larger than
the Earth, which is _____ times larger than . . .

The inner Solar System is _____ times larger than the Earth.

. . . Greenland, which is _____ times larger than
a river valley, which is _____ times larger than
a city, which is _____ times larger than
a ballpark, which is _____ times larger than . . .

Greenland is _____ times larger than a ballpark.

. . . a bench, which is _____ times larger than
an arm skin, which is _____ times larger than
a dust mite, which is _____ times larger than
a pollen grain ,which is _____ times larger than
a bacterium, which is _____ times larger than . . .

A bench is _____ times larger than a bacterium.

. . . a cold virus, which is _____ times larger than
a DNA strand, which is _____ times larger than
a molecule, which is _____ times larger than
a nitrogen atom, which is _____ times larger than
a proton.

A cold virus is _____ times larger than proton.

Finally, a supercluster is _____ times larger than the proton.