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.

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| **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 if you can 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 106, 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 ball park.**

. . . 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.**