



How Big Is It?

Investigating size and scale using the metric system.

Try this!

1. Students will work in assigned groups
2. Arrange the scale cards in a line across the top of your table, from smallest to biggest.
3. Make a second row of object cards, placing the object card next to the scale card that **best** fits the measurement of the object.
4. Students will then attach a size description card with each picture. They should label each picture as a specific size in exponents of 10. (pico, nano, mm, cm, meter, km...ect.)

Objectives

- 1) **Students will be able to relate the size of nano-sized objects to objects encountered in daily life (macro scale).**
- 2) **Students will apply dimensional analysis in conversion problems.**

Science Content Standards

Indiana Chemistry Standards

There is no Chemistry state content standard for this objective. We include it as an extremely important scaffolding objective toward reaching deeper understanding of the other objectives. (Objective 2)

Next Generation Science Standards

There is no Next Generation Science Standard for this objective. We include it as an extremely important scaffolding objective toward reaching deeper understanding of the other objectives.(Objective 2)

Indiana Chemistry Standards

C.1.2 Observe and describe chemical and physical properties of different types of matter and designate them as either extensive or intensive.

Objective: Students will differentiate between physical and chemical properties.

Objective: Students will recognize and describe physical and chemical changes.

Next Generation Science Standards

HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

21st Century Standards

- Demonstrate ability to reason with numbers and other mathematical concepts
- Collaborate and cooperate effectively with teams
- Respect and appreciate team diversity

Materials

- Set of scale cards
- Set of object cards

Notes to the presenter

You can do this activity with different sets of object cards. The first page of object cards includes more commonly known objects. The second page includes additional, more challenging objects. You can also select objects that are relevant to the scale your students are learning about (larger than one meter, smaller than 1 meter, microscopic objects, etc.)

This interactive website helps students visualize objects at various scales: <http://htwins.net/scale2/>

For a biological focus:

- See also this interactive comparison of objects smaller than 1 mm: www.cellsalive.com/howbig.htm
- See also this comparison of cells, viruses, and biological molecules: <http://learn.genetics.utah.edu/content/begin/cells/scale/>

Credits

The Center for Probing the Nanoscale (CPN) at Stanford University is supported by the NSF under award PHY-0425897. For more information and other activities, visit <http://cpn.stanford.edu>.

Image Sources

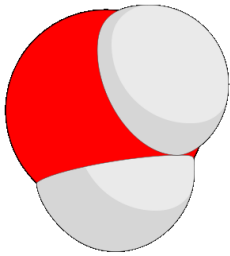
Water molecule: http://kinialohaguy.files.wordpress.com/2009/05/water_molecule.png
Carbon nanotube: <http://www.ewels.info/img/science/nanotubes/tube.angled.jpg>
Virus: <http://www.drugdevelopment-technology.com/projects/fludase/images/1-influenza.jpg>
Candle: <http://www.clker.com/clipart-10942.html>
Bacterium: <http://www.ou.edu/class/pheidole/General%20Bacteria.jpg>
Red blood cells: <http://health-pictures.com/blood/images/red-blood-cell.gif&imgrefurl=http://health-pictures.com/blood/red-blood-cell.htm>
Human hair: http://commons.wikimedia.org/wiki/File:Human_hair_SEM.svg
Penny: www.faqs.org/photo-dict/phrase/749/penny.html
Quarter: <http://www.hung-truong.com/blog/wp-content/uploads/2007/10/quarter.jpg>
Envelope: http://www.clker.com/cliparts/e/3/4/7/11949844071868980516addressed_envelope_with_stamp_01.svg.hi.png
5-year-old child: http://www.dallasnews.com/sharedcontent/dws/img/v3/09-23-2007.NTR_0923Dora.GJD27VKDF.1.jpg
Bus: <http://www.athenstransit.com/our-services/the-bus.html>
Soccer player: <http://www.outdoorfunstore.com/sports/IMAGES/Soccer1.JPG>
"Walking Away": <http://www.laurenassef.com/wp-content/uploads/walking-away.gif>
Airplane: <http://www.dennisholmesdesigns.com/siteimages/airplane.png>
Interstate sign: [commons.wikimedia.org/wiki/File:I-25_\(big\).svg](http://commons.wikimedia.org/wiki/File:I-25_(big).svg)
Cesium atom: <http://www.saburchill.com/chemistry/visual/atoms/055.html>
DNA double helix: <http://www.ec.gc.ca/EnviroZine/images/DNA.jpg>
ATP molecule: http://www3.ntu.edu.sg/home/CXGuo/Energy%20Harnessing_files/main_files/image001.jpg
Transistor symbol: <http://www.freeclipartnow.com/d/40997-2/IEC-NPN-Transistor-Symbol.jpg>
DVD: <http://upload.wikimedia.org/wikipedia/commons/thumb/3/30/DVD.png/250px-DVD.png>
Merino sheep: www.pelage.co.nz/fibres.htm
Dust mite: http://upload.wikimedia.org/wikipedia/commons/thumb/e/eb/House_Dust_Mite.jpg/250px-House_Dust_Mite.jpg
Amoeba: <http://www.arthursclipart.org/biologya/biology/amoeba%25202.gif>
Wedding ring: http://goldprice.org/gold-jewellery/uploaded_images/gold-wedding-ring-780063.jpg
Electrical outlet:
http://www.homefurnish.com/CMS400Min_dev/uploadedImages/homeimprovement/electrical/iStock_000001058487Small_175.jpg
Basketball player: http://www.shutterstock.com/s/_basketball_player_vector/search.html
House: <http://www.fotosearch.com/bthumb/ART/ART194/SUB055.jpg>
Train: <http://files.songbirdnest.com/wp-content/uploads/2008/03/caltrain.png>
Empire State Building: <http://www.newyorkminiaturemodel.com/Buildings/images/Empire%20State%20building.jpg.jpg>

Mt. Everest: <http://ghoomghaam.com/images-articles/mountain-everest.jpg>
Outer space cartoon: http://comps.fotosearch.com/comp/IMZ/IMZ001/outer-space-b_~ski0050.jpg

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width of a water molecule



diameter of a carbon nanotube



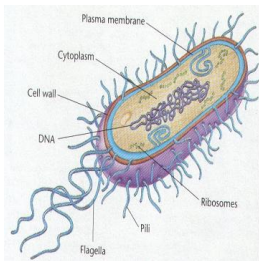
diameter of a flu virus



wavelength of visible light



width of a bacterium



diameter of a red blood cell



thickness of a human hair



thickness of a penny



diameter of a quarter



width of a standard envelope



height of a typical 5-year-old child



length of a standard city bus



length of a soccer field



distance walked in 20 minutes



cruising altitude of an airplane



distance a car can travel on a freeway in 1 hour



$$10^{-10} \text{ m}$$

(1 angstrom)

$$10^{-9} \text{ m}$$

(1 nanometer)

$$10^{-8} \text{ m}$$

(10 nanometers)

$$10^{-7} \text{ m}$$

(100 nanometers)

$$10^{-6} \text{ m}$$

(1 micrometer)

$$10^{-5} \text{ m}$$

(10 micrometers)

$$10^{-4} \text{ m}$$

(100 micrometers)

$$10^{-3} \text{ m}$$

(1 millimeter)

$$10^{-2} \text{ m}$$

(1 centimeter)

$$10^{-1} \text{ m}$$

(1 decimeter)

$$10^0 \text{ m}$$

(1 meter)

$$10^1 \text{ m}$$

(10 meters)

$$10^2 \text{ m}$$

(100 meters)

$$10^3 \text{ m}$$

(1 kilometer)

$$10^4 \text{ m}$$

(10 kilometers)

$$10^5 \text{ m}$$

(100 kilometers)