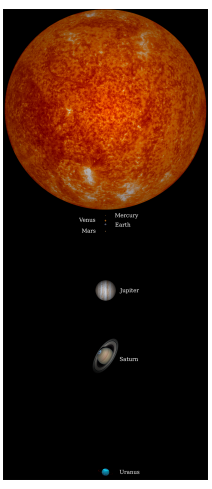
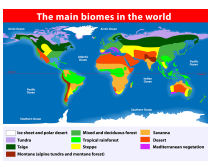
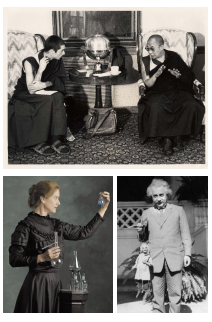
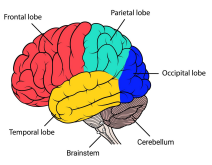
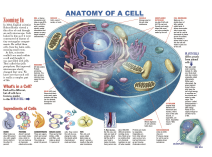
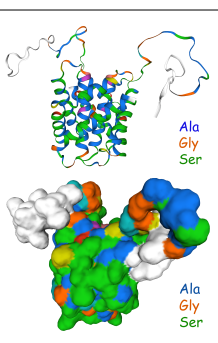
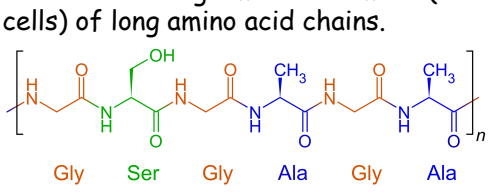
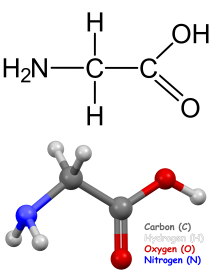
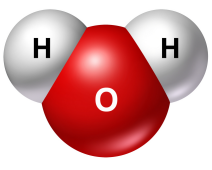
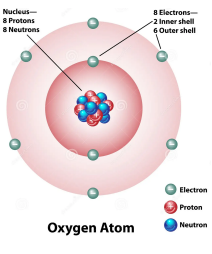
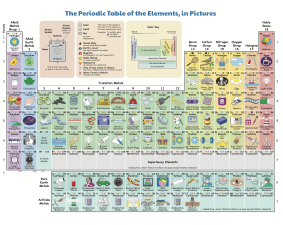
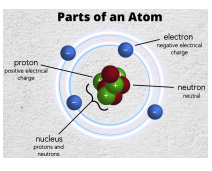
Levels of organization and 1D spatial scale

Level	Figure	Description	Example (with approximate length)
Galaxy		**Superclusters are components of the universe.** **Galaxy groups are components of galaxy clusters & superclusters.** **Galaxies are components of galaxy groups.**	**Ex: Milky way galaxy (diameter** (isophotal)**)** **≈ 823 exameters (Em)** ≈ 823 quintillion (10^{18}) meters ≈ 5.5 billion astronomical units (AU) ≈ 87,400 light years
Solar/ star system		**Star systems are components of galaxies.**	**Ex: Sun to nearest star, Proxima Centauri** **≈ 40 petameters (Pm)** ≈ 40 quadrillion (10^{15}) meters **Ex: Saturn to the Sun (orbital distance)** **≈ 1.4 terameters (Tm)** ≈ 1.4 trillion (10^{12}) meters **Ex: Earth to the Sun (orbital distance)** **≈ 150 gigameters (Gm)** ≈ 150 billion (10^{9}) meters ≈ 149,597,871 km = 1 Astronomical unit (AU)
Biosphere, planet		**Planets are components of solar/star systems.**	**Ex: Earth (diameter at equator)** **≈ 13 megameters (Mm)** ≈ 13 million (10^{6}) meters ≈ 12,756 kilometers
Biome		**Biomes are components of biospheres.**	**Ex: Cryosphere ⇒ ice sheets & polar deserts** **≈ kilometer → megameter scale**
Bioregion		**Bioregions are components of biomes.**	**Ex: Everglades National Park, FL (width)** **≈ 80 kilometers (km)** ≈ 80 thousand (10^{3}) meters
Ecosystem		**Ecosystems are components of bioregions.**	**Ex: Muir Woods, Marin, CA (width)** **≈ 1.5 kilometers (km)** ≈ 1.5 thousand (10^{3}) meters **Ecosystems are in the meter → km scale**
Organism		**Populations are components of ecosystems.** **Organisms are components of populations.**	**Ex: Human adult (height)** **≈ 1.5 → 2 meters (m)** ≈ 1.5 → 2 x 10^{0} meters
Organ		**Organs are components of organisms.**	**Ex: Human brain (length)** **≈ 150 millimeters (mm)** ≈ 150 thousandths (10^{-3}) of a meter
Cell		**Tissues are components of organs.** **Cells are components of tissues.**	**Ex: Human red blood cell (diameter)** **≈ 7 micrometers (µm)** ≈ 7 millionths (10^{-6}) of a meter Micrometer scale particles
Molecule (DNA)		**DNA molecules are components of cells.** The DNA (deoxyribonucleic acid) molecule determines every inherited physical characteristic of every living thing.	**Ex: DNA double helix (diameter)** **≈ 2 nanometers (nm)** ≈ 2 billionths (10^{-9}) of a meter
Molecule (Protein)		**Protein molecules are components of cells.** Proteins are large molecules made (in cells) of long amino acid chains. 	**Ex: Fibroin (diameter)** **≈ 2 nanometers (nm)** ≈ 2 billionths (10^{-9}) of a meter Fibroin is a protein made of 3 amino acids: • Alanine (Ala) • Glycine (Gly) • Serine (Ser)
Molecule (Amino acid)		**Amino acid molecules are components of protein molecules.** Our bodies use 20 different amino acids to make proteins. Nine of these we can not make, and must get them from food. They are called 'essential amino acids'.	**Ex: Glycine $C_2H_5NO_2$ (length)** **≈ 390 picometers (pm)** ≈ 390 trillionths (10^{-12}) of a meter
Molecule (H_2O)		**Water molecules are components of cells, ecosystems, & the biosphere.**	**Ex: H_2O, water molecule (diameter)** **≈ 282 picometers (pm)** ≈ 282 trillionths (10^{-12}) of a meter
Atom		**Atoms are components of molecules.** Oxygen, atomic number 8, has: • 8 protons • 8 neutrons • 8 electrons 	**Ex: Oxygen atom (diameter)** **≈ 120 picometers (pm)** ≈ 120 trillionths (10^{-12}) of a meter
Subatomic particle		**Subatomic particles are components of atoms.** There are 3 types of subatomic particles in each atom: • Proton (positive charge) • Neutron (neutral charge) • Electron (negative charge)	**Ex: Proton (diameter)** **≈ 1.6 femtometers (fm)** ≈ 1.6 quadrillionths (10^{-15}) of a meter

Notes	Powers of 10 and scientific notation
• Component ⇒ Building block, part, element, and/or structure within a larger whole. • Click or right click figure or emoji (in pdf file) to open full version or infographic.	• 10^{3} = 1,000 (10 x 10 x 10) ⇒ 1 followed by 3 zeros • 10^{6} = 1,000,000 (one million) ⇒ 1 followed by 6 zeros • $10^{-3} = \frac{1}{1,000}$ (one thousandth) • $10^{-6} = \frac{1}{1,000,000}$ (one millionth)