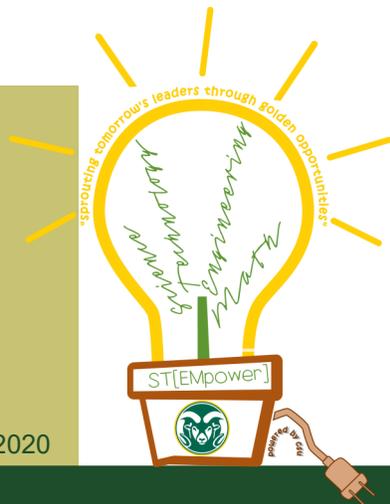


ST[EMpower]



VIRAL-CYCLES: Sizes

VOLUME 10, ISSUE 3, May 12, 2020

How Big? How Small?

THIS ISSUE

- Size page 2
- Cards page 3-4

POWER WORDS

- **beneficial:** resulting in good, favorable
- **infect:** invade an individual, organ, or cell by a disease-producing virus or bacteria
- **hijack:** take over (something) and use it for a different purpose
- **neutral:** neither good nor bad
- **pandemic:** a disease prevalent over a whole country or the world
- **pathogenic:** disease causing
- **replicate:** reproduce or give rise to a copy of itself

Viruses **infect** cells. In order for a virus to **replicate**, it must **hijack** the cell's raw materials, macromolecules, and organelles. Doctors have two ways to deal with viral **infection**:

- treatment—medicine that reduces the symptoms
- vaccination—medicine that prepares our body to fight the disease

Bacteria can be **beneficial**, **neutral**, or **pathogenic**. We have bacteria in our intestines that help us break down food. We call them our gut flora. Bacteria live on our skin. They actually protect us from bad bacteria if we get a cut. There are also pathogenic bacteria, like the bubonic plague, the Black Death. *Yersinia pestis*, killed one-quarter of the world's population. This was the world's most deadly **pandemic**. It is now easily cured with antibiotics, but deadly without them.

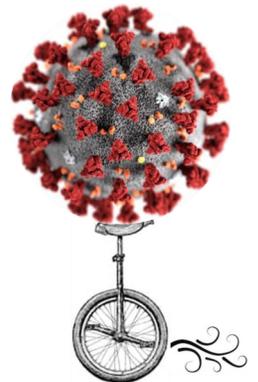
Antibiotics (anti means killing or opposite, bio means life) literally means killing life). Bacteria has

become antibiotic resistant. Scientists race to find new antibiotics to treat these new bacteria.

There are other disease causing organisms. Bacteria have very simple structure. Their DNA floats freely in the cell, and forms a circle rather than the chromosomes, like we have. Protists are a group of organisms that have cells like we do, but are usually single cell organisms. Malaria has killed more humans than any other disease. It is caused by the protist *Plasmodium falciparum*.

Fungi is another group of organisms that can cause disease. Athlete's foot is a fungal infection.

Of course, we also have parasitic animals, like fleas, ticks, and vampire bats. GROSS!



SCIENCE, TECHNOLOGY,
ENGINEERING, AND MATH
COLORADO STATE UNIVERSITY
EXTENSION

COLORADO STATE UNIVERSITY EXTENSION
4-H PROGRAMS ARE AVAILABLE TO ALL WITHOUT DISCRIMINATION

Directions:

- Print the table with 12 images on page 3.
- Cut out the 12 squares.
- Which do you think is the largest? Place that image on the far right.
- Which do you think is the smallest? Place that on the far left.
- Examine the remaining 10 images. Make your best guess to the order of the smallest to the largest. Do not worry about being right. The word “science” means knowledge. If we learn from our efforts, we are doing good science.
- Page 4 has 12 blank squares. Cut out the 12 squares.
- Think about tiny objects. Is there anything smaller than the smallest object (or wavelength) on your first 12 cards? What is it? Draw a picture of it
- Can you think of an object that is between your largest and second largest object? What is it? Draw a picture of it, label and place it in your smallest to largest list.
- Below are 10 more objects. Draw a picture of it on one of your blank squares, label it, and estimate where you would place it from the smallest to the largest.
 - amoeba
 - ebolavirus
 - electron
 - eyelash mite
 - giant red velvet mite
 - hydrogen atom
 - mimivirus (largest known virus)
 - porcine circovirus
 - proton

- tardigrade water bear (also called moss piglets)
- The blue whale (*Balaenoptera musculus*) is estimated to be the largest animal to ever exist; up to 190 tons. *Argentinosaurus huinculensis* is the longest dinosaur known, 130 feet long, and 110 tons. *Bruhathkayosaurus*, found in India, may have been up to 140 feet long, but that is based on fragmentary bones. Would you include it on this list? Why or why not?
- After you have your 24 cards aligned in front of you, smallest to the largest, read the answer key for the first 12 (page 5). Write the sizes of the object/organism on the cards.
- Look up the sizes on the internet for the new 12 cards. Write the size on each card.
- How close were your guesses? Realign your cards into the correct order, smallest to largest.
- Watch the video on sizes:



<https://www.youtube.com/watch?v=h0xTKxbIEIU&t=1s>

POWER WORDS

- **exponent:** an exponent of a number says how many times to use that number in a multiplication; it is written as a small number to the right and above the base number; examples
 - $2^2 = 2 \times 2$
 - $2^3 = 2 \times 2 \times 2$
 - $2^4 = 2 \times 2 \times 2 \times 2$
 - **exponential:** expressed by a mathematical exponent
 - **mean:** average of numbers
-
- Watch <https://www.youtube.com/watch?v=44cv416bKP4> on **exponential** numbers.
 - The largest mammal is the blue whale. The smallest animal is the bumblebee bat and Etruscan shrew. What animal is the average (**mean**) size? (Answer on page 5)

MATERIALS

- print page 3 and 4
- scissors
- computer with internet
- color pencils

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CITATIONS

Information:

- <https://www.exploratorium.edu/snacks/life-size>; National Geographic <https://www.nationalgeographic.com/science/2020/04/factors-allow-viruses-infect-humans-coronavirus/#close>; <https://www.cdc.gov/>;

Images:

- Coronavirus <https://www.cdc.gov/coronavirus/2019-nCoV/index.html>; *E. coli* <https://www.cdc.gov/media/subtopic/images.htm>; Protein <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3233603/> Marks, Debora S., Colwell, Lucy J., Sander, Chris (2011) Protein 3D Structure Computed from Evolutionary Sequence Variation. PLoS One 6(12); e28766; CSU Bug Mugs Carpenter Ant <http://agbio.agsci.colostate.edu/wp-content/uploads/sites/20/2013/03/Carpenter-Ants.pdf>; Human Skin Cells <https://www.brightcareermaker.com/cell/>; Ribosome <https://www.news-medical.net/life-sciences/Ribosome-Structure.aspx>; Visible Light Spectrum <https://web.pa.msu.edu/courses/2000fall/phy232/lectures/emwaves/visible.html>; Sneeze CDC Public Health Image Library <https://phil.cdc.gov/Details.aspx?pid=11161>; Antibody University of California San Francisco <https://www.ucsf.edu/news/2020/04/417246/promise-and-uncertainties-antibody-testing-coronavirus>; DNA <https://www.nih.gov/about-nih/who-we-are/nih-director/statements/statement-nih-director-iom-report-addressing-role-recombinant-dna-advisory-committee-oversight-clinical-gene-transfer-protocols>; N95 mask <https://www.usamedicalsurgical.com/3m-1860-surgical-mask/>

Metric Scale:

1 meter =
 100 centimeters =
 1,000 millimeters =
 1,000,000 micrometers =
 1,000,000,000 nanometers =

1 meter is about 3 feet
 100 centimeters is about 3 feet
 1,000 millimeters is about 3 feet
 1,000,000 micrometers is about 3 feet
 1,000,000,000 nanometers is about 3 feet

Average size mammal is a house cat.

Answer (smallest to largest):

1. DNA (diameter of a single strand): 2 nanometers
2. protein: 5-50 nanometers
3. antibody: 15 nanometers
4. ribosome: 25 nanometers
5. coronavirus: 40 nanometers (viruses range from 20 to 100 nanometers)
6. N95 professional grade mask pore size: 300 nanometers
7. wavelength of blue light: 400 nanometers
8. sneeze droplet: 0.5-12 micrometers (50-12,000 nanometers)
9. bacteria: 1-5 micrometers (100-500 nanometers)
10. human cell: 10-100 micrometers (10,000-100,000 nanometers)
11. dot in 24-point font: 1 millimeter (1,000,000 nanometers)
12. ant: 5 millimeters (5,000,000 nanometers)