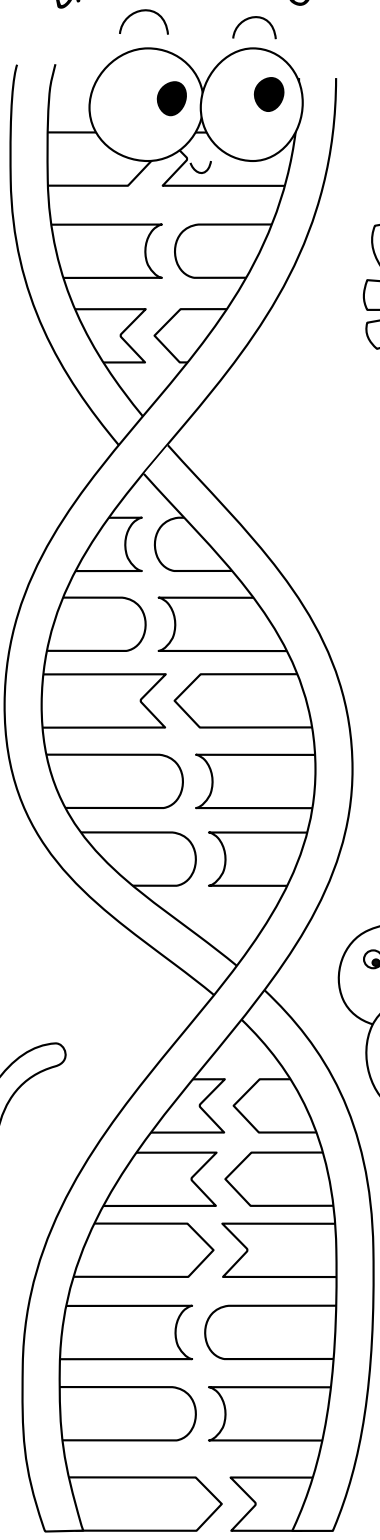
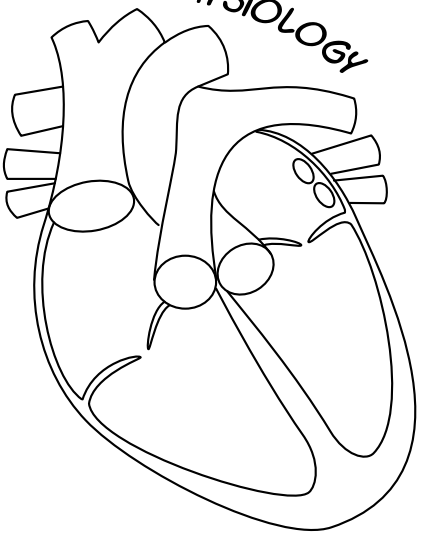
BIOLOGY ONE

BIOMOLECULES

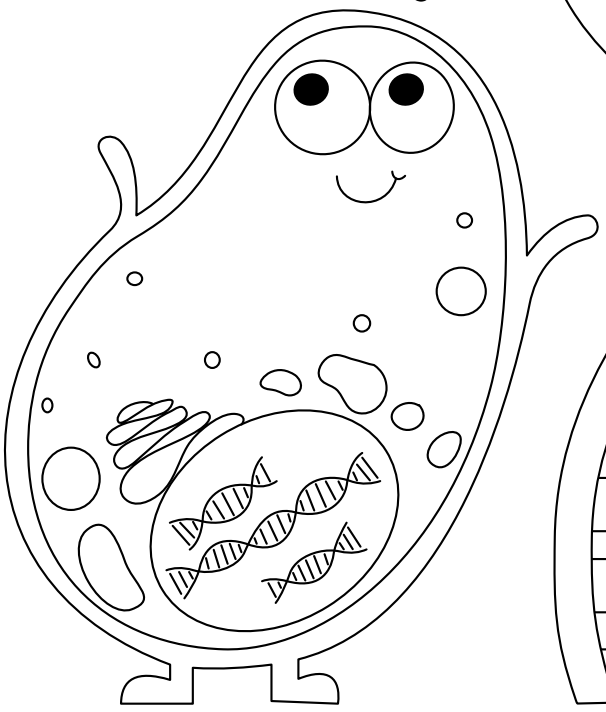


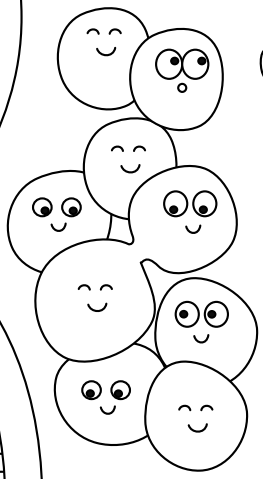
DIVERSITY OF LIFE

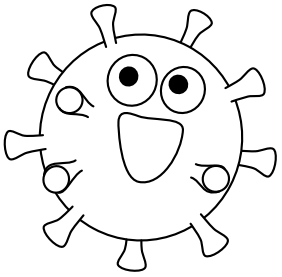
PHYSIOLOGY



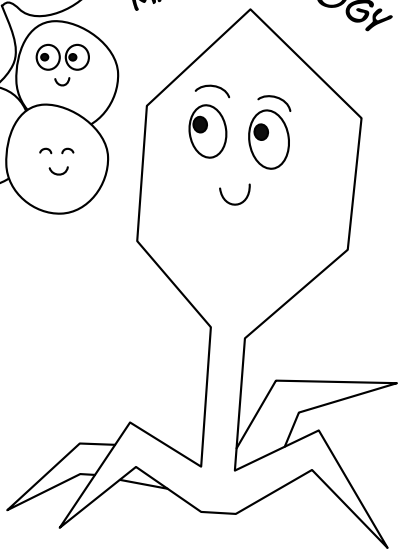
CELLS







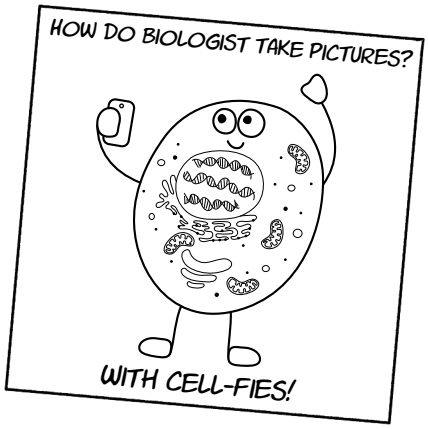
MICROBIOLOGY

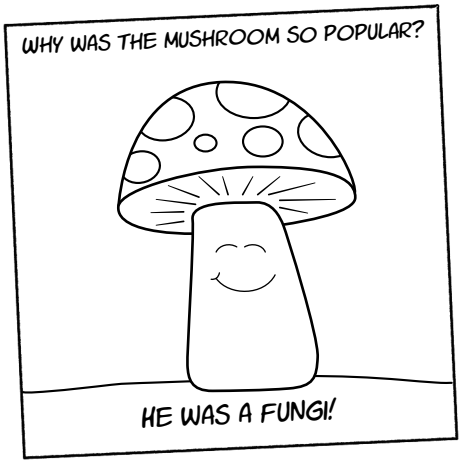


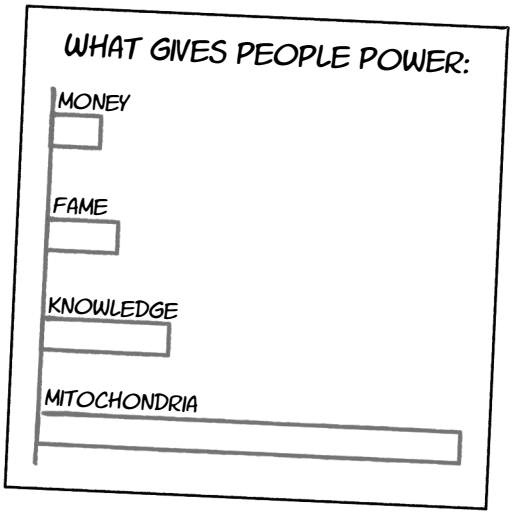
BIOLOGY ONE

~ MICROBIOLOGY ~

There are 5 projects in the course, each listed in bold in this table of contents.
A supply list for all projects and activities can be found on page 5.







Have questions, corrections, or suggestions?
Contact jenny@science.mom or serge@science.mom

Project Supply List

Lesson 2 - Laser Pointer Microscope
- Laser pointer
- Paper clip or plastic pipette
- Tape
- Water from a stream, pond, or pet water dish

Lesson 11 - Extract DNA from Fruit
- 2 fresh strawberries (or bananas or other fruit)
- ½ cup warm water
- 1 tsp salt
- Plastic bag or bowl and fork
- 2 tsp concentrated dish soap
- Rubbing alcohol (91%)
- Coffee filter
- Jar or cup
- Meat tenderizer (if using the split pea option)
- Blender (if using the split pea option)

Lesson 21 - DIY Petri Dishes
- 8 oz boiling water
- 1 bouillon cube
- Cotton swabs
- 4 petri dishes (clean containers with lids)
- 1 Tbsp agar (or 1 packet unflavored gelatin)
- 2 tsp sugar
- Permanent marker

Lesson 30 - Physiology Art Project
- Several pieces of waxed paper or tracing paper
- Pencil
- Markers
- Brads (paper fastener)

Lesson 33 - Most Wanted Microbe Art Project
- Copies of the most wanted microbe template
- Pencil
- Markers
- Butter knife (optional)
- Ink and napkin (optional)

Other (optional) Activities

Lesson 16 - Respiration
- 2 Tbsp Yeast
- 2 Balloons
- 2 Water bottles
- Sugar

Lesson 23 - What is Blood?
- 1/3 c measuring cup
- 6 L of water and two containers
- Timer or stopwatch

Lesson 24 - Why We Breathe
- 2 balloons
- Plastic bottle with bottom cut off

Lesson 25 - How Nerves Work
- Ruler

Lesson 37 - The Problem with Polio
- 2 dice

How to get the most from this course:

This course can be used in a variety of ways! You can participate passively by just watching the videos, or actively by filling out the notes and completing the projects. You can do the entire course at once or participate in one lesson or section at a time.

For BEST learning, we recommend:

☑ Read the pages that go with each lesson before watching the video. Take 10-15 minutes to see if you can fill in the blanks.

☑ On quiz show days, take the practice quiz before you watch the class!

☑ Complete each of the science activities, and then share your work with a family member or friend.

☑ Download the answer key for the notes, but don't look at the answers until after you give things a try yourself!

Next Generation Science Standards

This class covers the following Next Generation Science Standards. Often referred to as NGSS, they are the United States education standards for science.

MS-LS1-1: Lessons 4, 5, and 6
Living things are made of cells

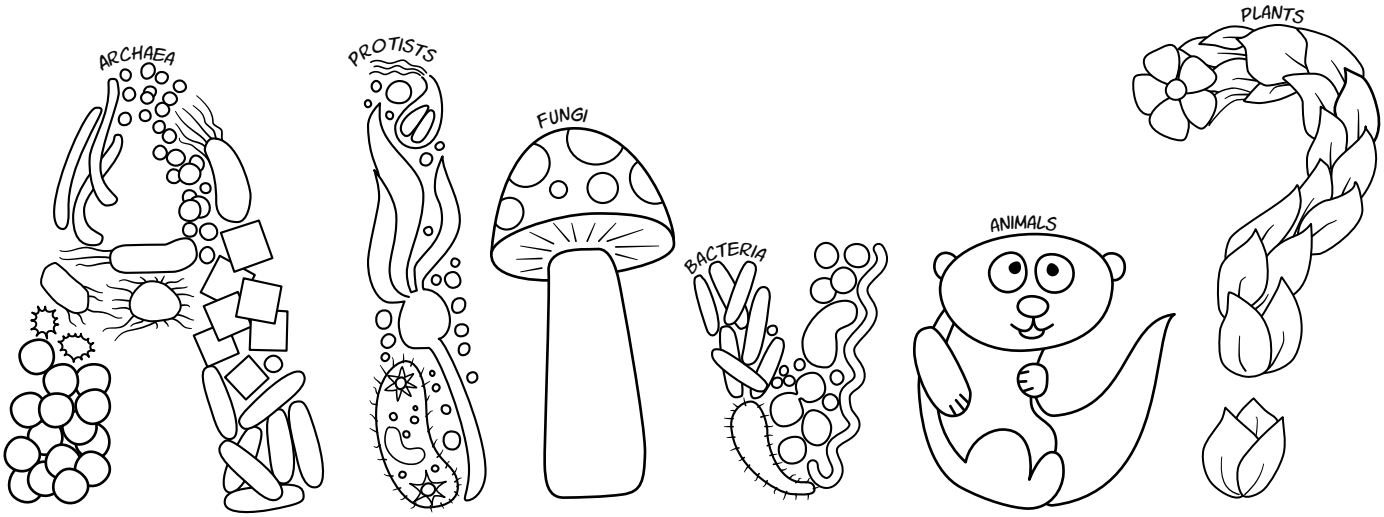
MS-LS1-2: Lessons 3 and 22
The function of a cell as a whole and how the parts of a cell contribute to that function

MS-LS1-3: Lessons 22, 23, 24, 25, and *T*
The body is a system of interacting subsystems composed of groups of cells

MS-LS1-6: Lessons 14, 17, and 18
Photosynthesis and its role in cycling matter and the flow of energy in and out of organisms

MS-LS1-7: Lessons 14, 15, and 16
How food is rearranged through chemical reactions to form new molecules that support growth and release energy

MS-LS1-8: Lesson 25
Sensory receptors respond to stimuli by sending messages to the brain



What makes something alive? This is not an easy question to answer! Most definitions agree that living things include all the following qualities or abilities:

METABOLISM

Uses energy!

Metabolism is defined as the chemical processes that occur within a living organism in order to maintain life. Some living things capture energy from digesting food, others use the energy in sunlight.

HOMEOSTASIS

Keep inside conditions stable!

Homeostasis is the ability to regulate internal conditions. It usually involves maintaining a favorable amount of water and/or nutrients and/or temperature.

GROWTH

Gets bigger!

Growth is an increase in cell size and/or in the number of cells. All living things discovered so far have been observed to grow during their lifespan.

RESPONDS TO STIMULI

Reacts to the world around it!

A stimulus is any detectable change in the environment. Living things can react or respond to changes around them.

MADE OF CELLS

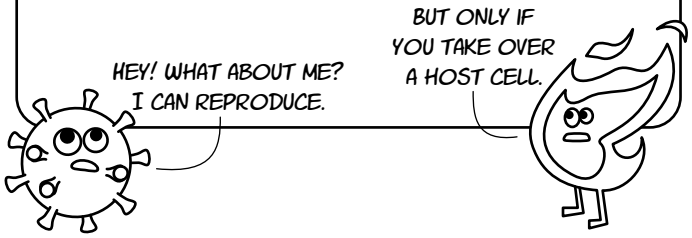
Cells: tiny bags of mostly water!

All things that are commonly agreed to be living are made of cells, which we will be learning more about over the next two weeks.

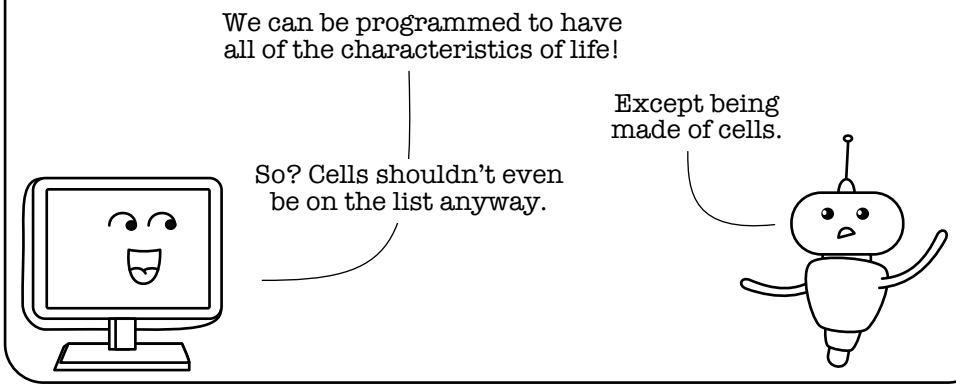
REPRODUCTION

Can make more of itself!

Reproduction is the process of parents creating offspring.



COULD ARTIFICIAL INTELLIGENCE (AI) BE CONSIDERED ALIVE?



The question of whether or not AI is alive is currently being debated, and will be one of the more important questions of the century!

Write down three of the best reasons for each side of the argument and then share your opinion. What do *you* think?

*What are 3 arguments for technology or AI to be considered **alive?***

1. ***Possible answers include:***
   AI can grow and learn as it gets more information.
2. ***Each AI responds to stimulus by executing its programs and altering its output.***
   Each AI is made of distinct bits of code that act together to carry out its objectives,
3. ***and this is similar to individual cells creating a multicellular organism.***
   AI can be programmed to adapt and change.

*What are 3 arguments for technology or AI to be considered **nonliving?***

1. ***Possible answers include:***
   AI do not carry out their own metabolic process (energy conversion process).
2. ***AI do not reproduce in the usual sense.***
   AI is not made up of physical cells.
3. ***AI cannot exhibit the various characteristics of living things (like response to***
   stimuli or adapting and learning) without first being programmed to do so.

What is your opinion?

The Discovery of the Cell

FOR THOUSANDS OF YEARS, PEOPLE KNEW THAT CURVED GLASS MAGNIFIED DETAILS.

I WROTE ABOUT IT WAY BACK IN 160 BCE!

CLAUDIUS PTOLEMY
Famous philosopher

THEN, IN 1590, TWO GLASS MAKERS CREATED THE FIRST COMPOUND MICROSCOPE.

IF WE PUT LENSES ON BOTH SIDES OF A TUBE, THE OBJECTS ON THE OTHER SIDE ARE EXTRA MAGNIFIED!

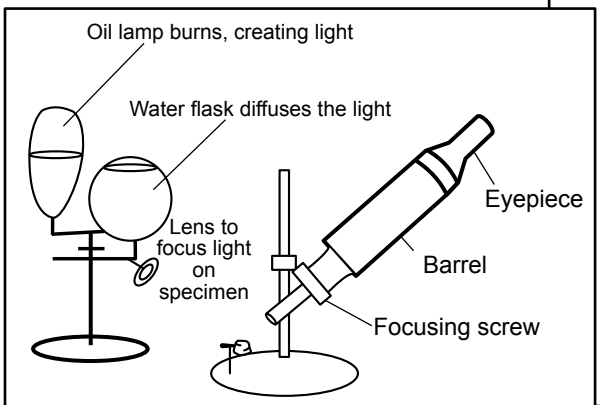
LENS
LENS

WE CAN SEE EVEN MORE! YIPPEE!

HANS & ZACHARIAS JANSSEN
Dutch glassmakers

THE NEXT CENTURY SAW HUNDREDS OF EXPERIMENTS ON IMPROVING THE MAGNIFICATION OF MICROSCOPES AND MANY PUBLICATIONS ABOUT WHAT WAS OBSERVED UNDER THE LENS.

THE MOST FAMOUS OBSERVATIONS WERE MADE BY ROBERT HOOKE…



ROBERT HOOKE'S MICROSCOPE 1665

THIS SPECIMEN OF CORK PLANT IS FULL OF PORES! THEY LOOK LIKE THE PLAIN UNFURNISHED ROOMS OF MONKS.

YOU'RE RIGHT. THEY DO LOOK LIKE EMPTY ROOMS! WHAT WILL YOU CALL THEM?

CELLS.

CELLS? THE SAME NAME FOR EMPTY ROOMS?

WHY NOT? THEY LOOK LIKE HONEYCOMB CELLS TOO.

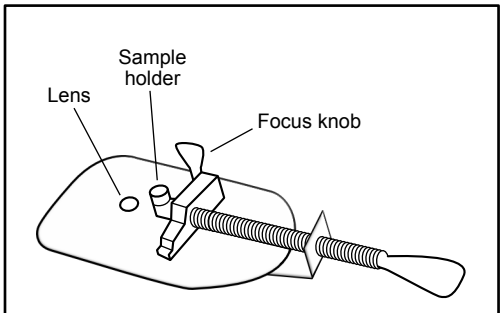
AND LOOK! THERE ARE EVEN CELLS IN FOSSILS!

I THOUGHT FOSSILS WERE JUST ROCKS.

ROCKS THAT USED TO BE ALIVE!

BLIMEY!

…AND DUTCH SCIENTIST ANTON VON LEEUWENHOEK.



LEEUWENHOEK'S MICROSCOPE 1676

I MADE INCREDIBLY TINY LENSES BY MELTING, GRINDING, AND BLOWING GLASS.

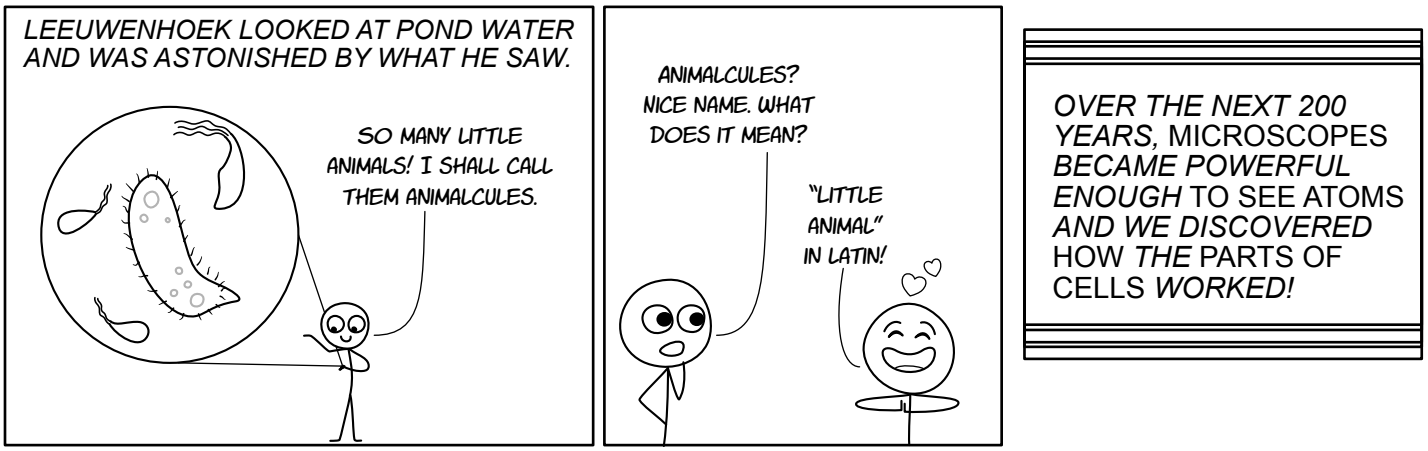
THERE IS ONLY ONE LENS IN THIS MICROSCOPE, BUT THE QUALITY IS SO GOOD I CAN SEE WITH 200 TIMES MAGNIFICATION!

SUPER TINY MICROSCOPE

MY MICROSCOPE HAS BETTER MAGNIFICATION THAN HOOKE'S!

#1

CONTINUED ON NEXT PAGE…



Your notes:

Possible things to note from class would be the discovery of the first ultramicroscope in 1903 which allowed people to see things smaller than the wavelength of light and the invention of the electron microscope in 1938. By 1951, scientists had invented microscopes powerful enough to see individual atoms.

IS IT MADE OF CELLS OR NOT? *Write the words below in the correct oval:*

salt tomato wood cement mold sand cabbage
pepper water onion platypus plastic yogurt grass

Made of cells or came from cells

Tomato, wood, mold, sand, cabbage, pepper, onion, platypus, yogurt, grass

NOT made of cells or derived from cells

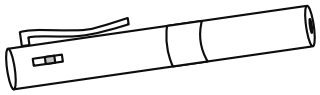
Salt, cement, water, plastic, sand

Note: Sand can be created from both living and non living sources! Beach sand often comes primarily from fragments of coral and shells. Sand in a desert dune is usually created from bits of rock that were eroded by wind.

Hands-on Science Project

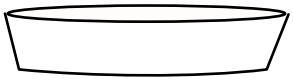
LASER POINTER MICROSCOPE

MATERIALS:


Laser Pointer

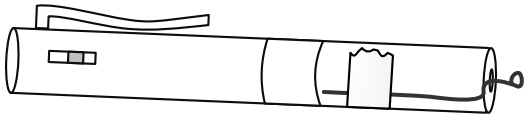

Paperclip


Tape


Water from a pond, dog dish, aquarium, or other source that will have microbial life.

SAFETY WARNING

NEVER POINT A LASER BEAM AT ANYONE'S EYES. LOOKING DIRECTLY AT A LASER BEAM CAN PERMANENTLY DAMAGE YOUR EYES.



1. Straighten out a large paper clip and then bend one end so that it forms a small loop.

2. Test the loop to be sure that It holds a water droplet. When you dip it in water and then lift it out again, a drop of water should stay inside the loop. If the loop does not hold water then bend it again and make it smaller.

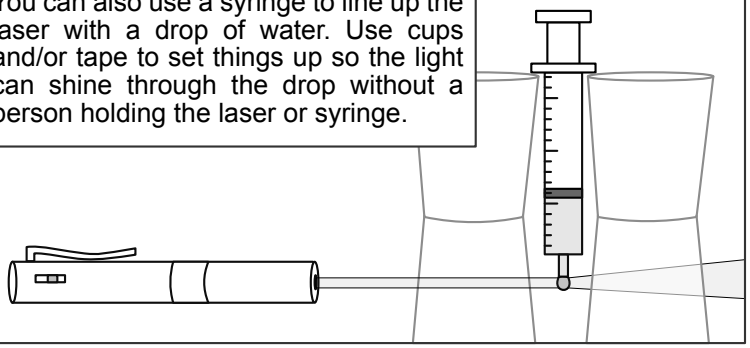
3. Attach the paperclip to the laser pointer with tape so that the loop is directly in the path of the beam.

4. Carefully dip the wire loop into a water source that will have bacteria and other microbial life. Pond water, aquarium water, or water from a pet drinking dish are all good choices.

5. Shine the laser toward a white surface. For best results, conduct this activity in a darkened room.

6. Observe your results and experiment with different sources of water.

AN ALTERNATIVE APPROACH:
You can also use a syringe to line up the laser with a drop of water. Use cups and/or tape to set things up so the light can shine through the drop without a person holding the laser or syringe.



For BEST results

Choose a source of water that is chlorine free and exposed to sunlight.

Observe multiple drops of water from different sources.

Set up the laser in a dark room and shine it on a flat white surface.

Arrange the laser so that no one is touching it. The less it moves, the better you'll see the microbes in the water.

Adjust the distance between the laser and flat white surface to see which distance gives you the best view.

SAFETY TIP

WASH YOUR HANDS AFTER HANDLING SAMPLES OF WATER THAT COULD CONTAIN MICROBES.

Which source of water had the most microbes?

It's time to go exploring! Gather some clean containers or plastic bags and collect water from several sources. If using the paper clip method, be sure to use different paper clips OR to clean your paperclip before testing each sample. If you gather a saliva sample, do NOT put the paperclip in your mouth! Spit into a container and sample the saliva from there. Before you gather your samples, make a prediction about which water will have the most microbes. Then, after observing each sample put a **check mark** by the type of water that had microbes, and a **zero** by water that was microbe-free. Put a **double check mark** by the water that had the MOST microbes. Write NA if you didn't test that type of water.

YOUR PREDICTION:

The water with the most microbes will be ***All predictions are valid! But hopefully you expected outdoor water to contain more microbial life than the water from your kitchen sink.***

- ☐ Water from the kitchen sink.
- ☐ Water from a natural outdoor source that looks clean like a lake or river.
- ☐ Water from a natural outdoor source that looks dirty or scummy like a puddle, swamp, or pond. ***If the water is especially scummy it will block the light of the laser microscope and you won't see anything.***
- ☐ A drop of saliva. ***This one requires a lot of patience to set up because bubbles will interfere with how the light refracts.***
- ☐ Water from a pet's water dish.
- ☐ Water from the tank (not the bowl!) of a toilet. ***Water in the toilet tank may be dirty from water deposits, but because it comes from the same clean water as the kitchen sink and is cycled frequently, it's usually quite clean. Water in the toilet bowl is not!***
- ☐ Other: _____

YOUR RESULT:

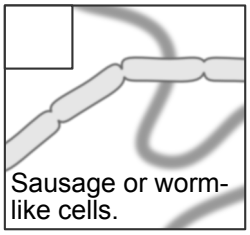
The water with the most observed microbes was _____.

Which of these did you observe using your laser pointer microscope?

Check all that apply.

☐ Clean water with no microbes.

☐ Circular cells that drifted.



☐ Sausage or worm-like cells.

☐ A swimmer! A cell that is moving itself through the water rather than drifting.

☐ Something with a tail or flagella.

Your notes:

Leeuwenhoek observed all of these types of organisms with his small hand-held microscope when he looked in pond water. But this took a lot of patience and time and many samples. It is perfectly fine if you don't see each of these! Just put a check mark by the ones you do observe.

The Parts of a Cell

FILL IN THE BLANKS USING THESE WORDS:

DNA	proteins	living	organelles
plasma membrane	dead	cytoplasm	diversity

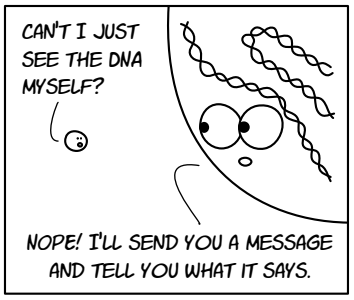
The cells that Robert Hooke saw in the bark of a cork tree were actually ***dead***. This is why they looked so empty. ***Living*** cells contain several important parts or ***organelles*** that help them survive. Ribosomes build ***proteins***. If the cell has a nucleus, it contains the ***DNA***. Mitochondria or chloroplasts are involved in digesting or creating food for the cell, and all of this activity is contained within a cell wall or ***plasma membrane***. The liquid inside a cell is called the ***cytoplasm***. Not every type of cell will contain all of these parts. There is incredible ***diversity*** between different types of cells!

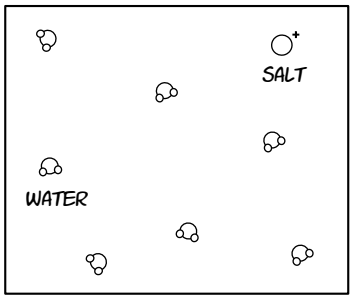
DRAW LINES TO CONNECT THE NAME & DESCRIPTION WITH THE CORRESPONDING PICTURE

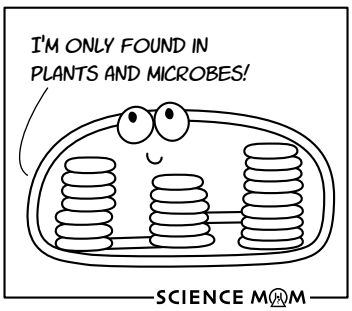
Cytoplasm
The liquid inside the cell. It's mostly water.

Nucleus
Keeps the DNA separate from the rest of the cell.

Chloroplast
Uses CO_2 and sunlight to create sugars.







Plasma Membrane

Keeps the cytoplasm inside the cell.

Cell Wall

Keeps the cytoplasm inside the cell.

Flagella

Helps the cell move. Works like a little paddle or tail to push it through the water.

Ribosome

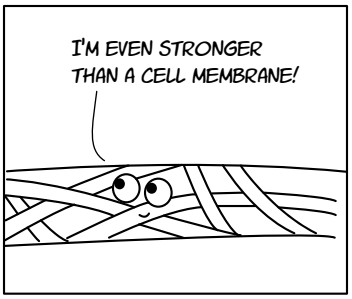
The thing that makes the proteins.

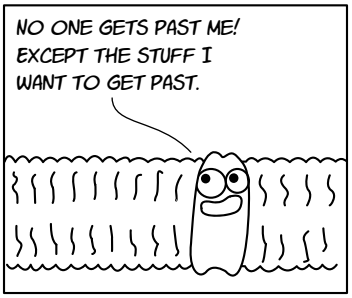
DNA

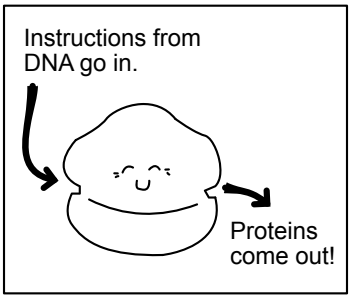
The instructions for making proteins and other stuff for the cell.

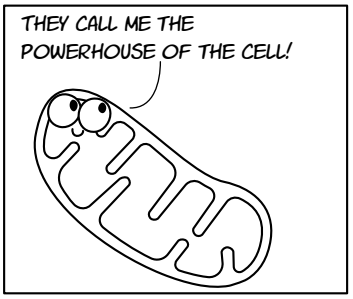
Mitochondria

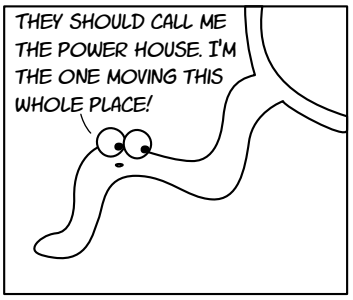
Uses oxygen and sugar to create energy for the cell.

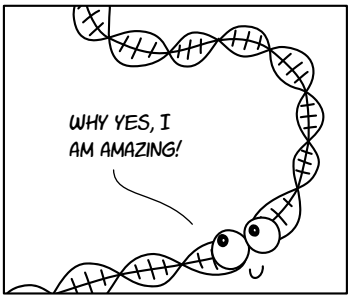




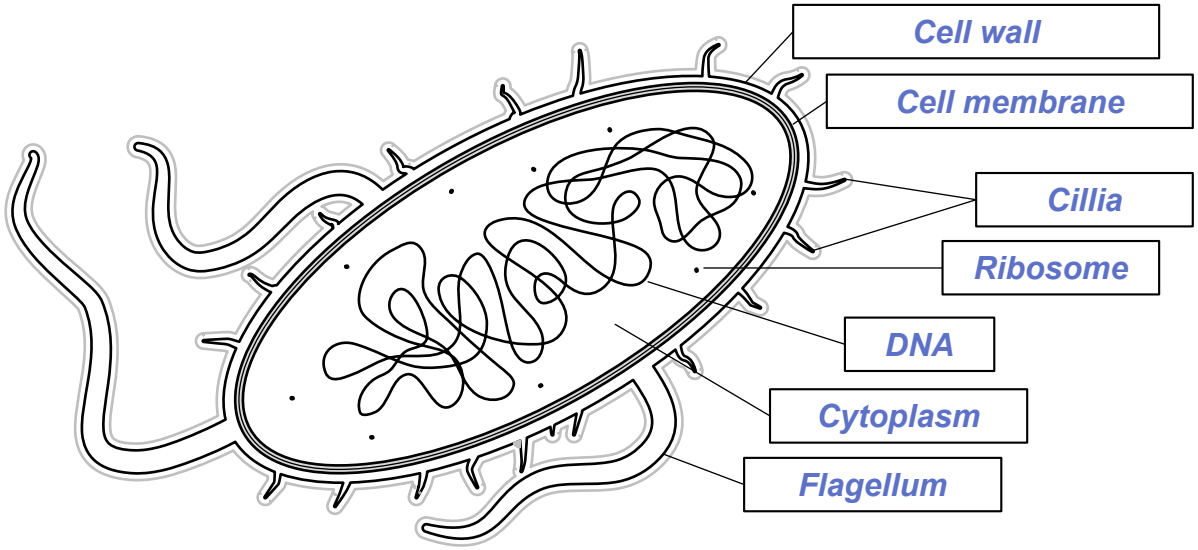








Prokaryotic Cells



FILL IN THE LABELS ABOVE USING THESE WORDS:

PLASMA MEMBRANE | DNA | CILLIA | CYTOPLASM | CELL WALL | FLAGELLUM | RIBOSOME

Example: Salmonella
Size: 2-5 Microns long

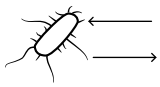
Your notes:

Most prokaryotic cells are 10 to 100 times smaller than eukaryotic cells. They have DNA but it isn't specially wrapped or packaged, it just floats inside the center of the cell. The word prokaryote comes from Greek words meaning "before" and "nut" or "kernel," in reference to the fact that these cells do not have a nucleus. The prokaryotic cells that you hear about most often are bacteria. Some bacteria are beneficial to humans but others (like salmonella) cause disease.

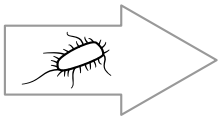
IS SOMETHING AS SMALL AS A SALMONELLA BACTERIUM REALLY *ALIVE*? LET'S CHECK:

METABOLISM ✓

IT EATS FOOD AND PRODUCES WASTE.



RESPONDS TO STIMULI ✓

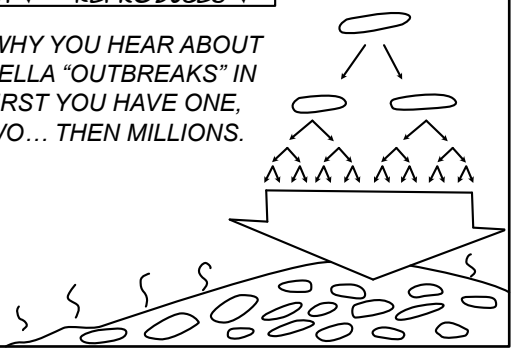


WILL MOVE TOWARD A WETTER AND BETTER ENVIRONMENT

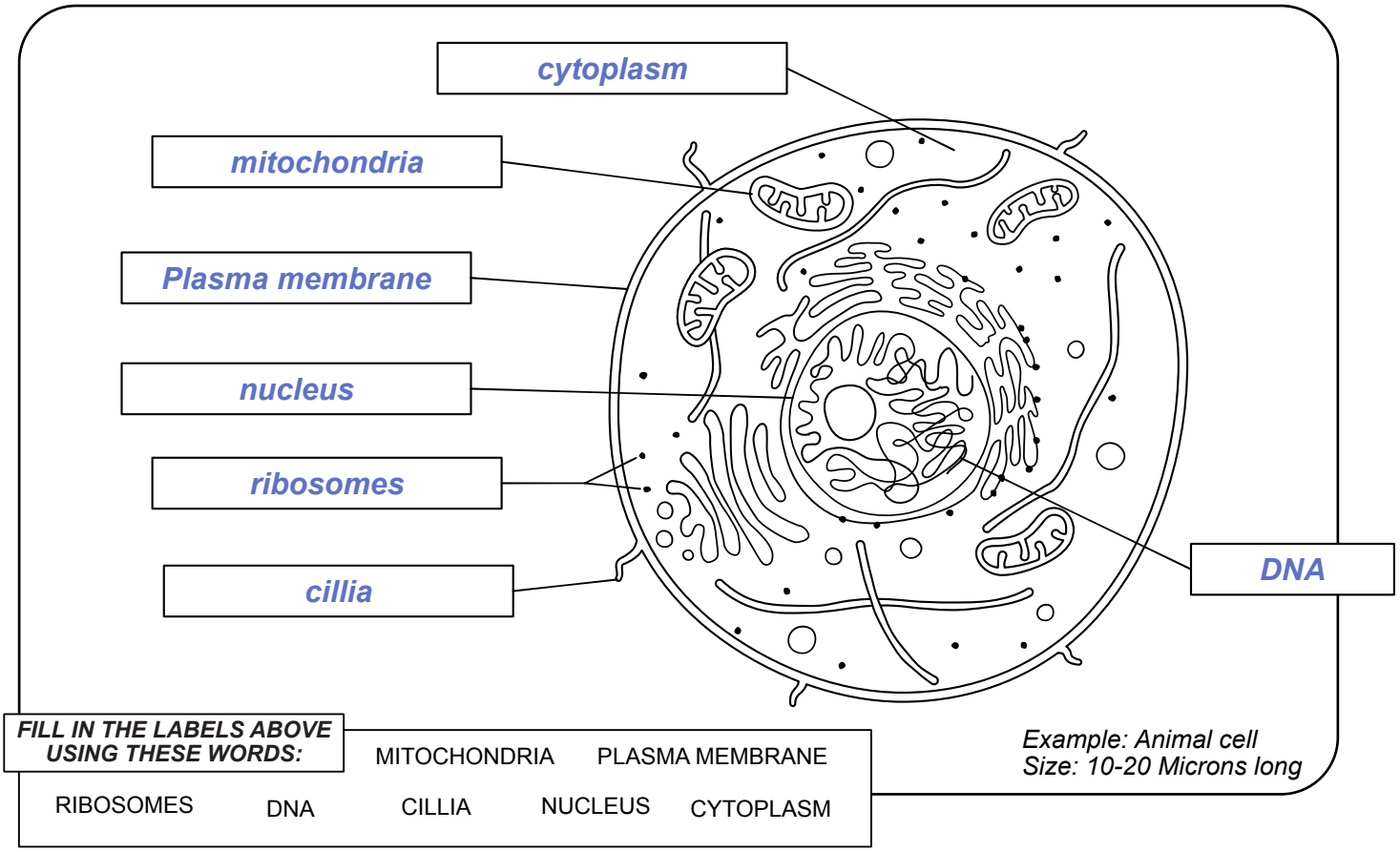
*WHEN IT FINDS A GREAT LOCATION IT FORMS A **BIOFILM**, A COLONY OF CELLS STUCK TOGETHER WITH SLIME.*

GROWTH ✓ REPRODUCES ✓

THIS IS WHY YOU HEAR ABOUT SALMONELLA "OUTBREAKS" IN FOOD. FIRST YOU HAVE ONE, THEN TWO… THEN MILLIONS.



Eukaryotic Cells



FILL IN THE LABELS ABOVE USING THESE WORDS:

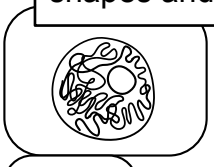
MITOCHONDRIA PLASMA MEMBRANE RIBOSOMES DNA CILLIA NUCLEUS CYTOPLASM

Example: Animal cell
Size: 10-20 Microns long

Your notes:

Eukaryotic cells are much larger and more complex than prokaryotic cells and their DNA is contained in a membrane called a nucleus. Their name comes from the Greek "eu" which means good and "karyon" which means nut or kernel. So Eukaryote literally means "good nut!" They are much more complex than prokaryotic cells.

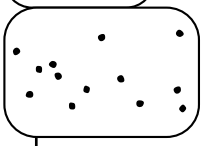
Eukaryotic cells can have incredibly different shapes and parts, but they will always contain:



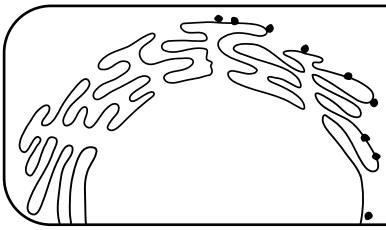
A NUCLEUS which holds the DNA

MITOCHONDRIA which provide energy

MEMBRANE which surrounds the cell



RIBOSOMES which make proteins

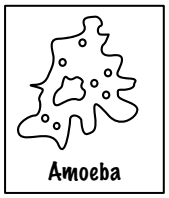


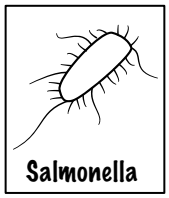
BONUS ORGANELLE!

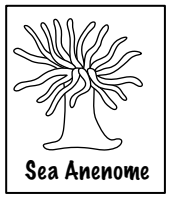
What is the crazy-shaped thing around the nucleus with ribosomes stuck to it? It's called the ***endoplasmic reticulum*** and it helps make proteins. We won't be talking about it more in this class, but of all the organelles, it has one of the coolest names!

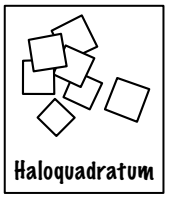
Cellular Life

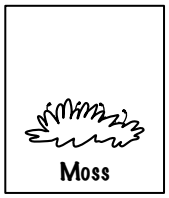
Can you place each of these organisms in their matching category?

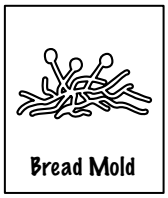

Amoeba


Salmonella


Sea Anenome


Haloquadratum

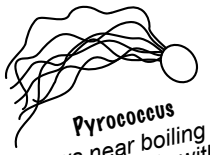

Moss


Bread Mold

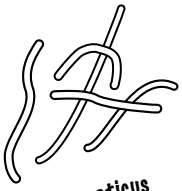
Unicellular

Multicellular

ARCHAEA


Pyrococcus
Grows near boiling hot deep sea vents with no oxygen


Arman
Grows in extremely acidic mine drainage

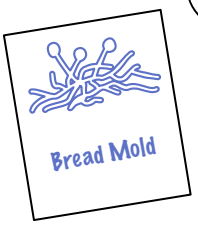

Thermus aquaticus
Heat-loving. Lives in hotsprings.


Haloquadratum

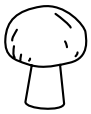
FUNGI


Candida albicans


Bakers Yeast


Bread Mold

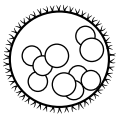

Giant Puffball


Bracket Fungus

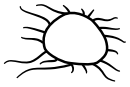
Button mushroom

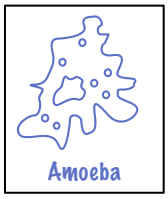
PROTISTS

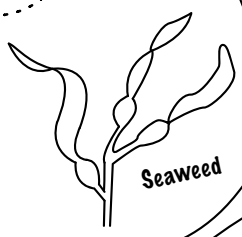

Malaria


Volvox

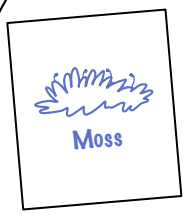

Slime mold

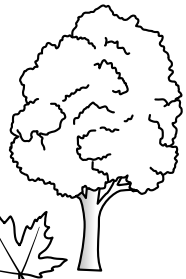

Paramecium


Amoeba


Seaweed

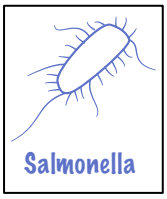
PLANTS

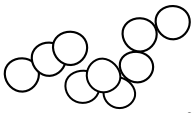

Moss


Maple Tree

BACTERIA


Borrelia Burgdofen
(causes lyme disease)

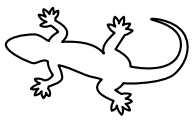

Salmonella

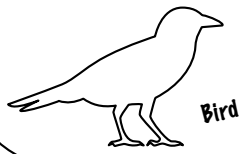

Staphylococcus


Lactobacilis

ANIMALS


Octopus


Lizard


Bird


Sea Anenome

Taxonomy *is the study of classifying groups of organisms based on shared characteristics. Classification systems have changed a lot in recent years thanks to the ability to compare DNA sequences. We'll learn more about taxonomy in Biology 2.*

Five misclassified marvels

Scientists group things into categories to better understand them, but some organisms don't exactly fit! This page is dedicated to five organisms that people often mistake for something else. One is already filled out as an example. Choose 4 more from these lists to fill in the remaining blocks!

Plant or Fungus? *Caloplaca marina (Orange Sea Lichen), Sarcodes sanguina (Snow Flower), Monotropa uniflora (Ghost Pipe), or Clathrus archeri (Octopus Stinkhorn);*

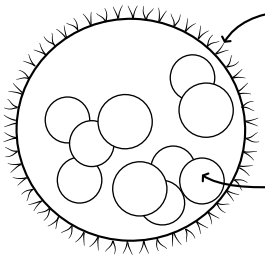
Animal or Plant? *Diploria labyrinthiformis (Brain Coral), Xestospongia muta (Giant barrel sponge), Elysia chlorotica (Emerald Elysia), or Pseudocolochirus violaceus (Sea Apple)*

What in the world? *Caulerpa taxifolia, Acetabularia, and Volvox.*

Volvox!

Volvox barberi

AN ALGAE COLONY MADE OF THOUSANDS OF COOPERATING CELLS!



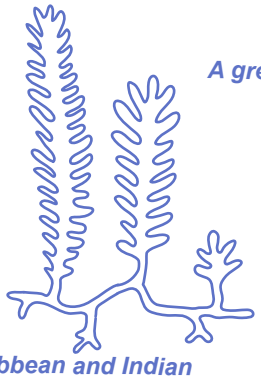
THOUSANDS OF CELLS ARRANGE THEMSELVES SO THAT THEY FORM A SPHERE WITH WITH FLAGELLA FACING OUT.

THE DAUGHTER COLONIES INSIDE HAVE THEIR FLAGELLA FACING TOWARD THE INSIDE AND WILL TURN THEMSELVES INSIDE OUT WHEN THEY GROW UP!

THE FIRST PEOPLE WHO WROTE ABOUT VOLVOX THOUGHT IT WAS A TINY ANIMAL, PERHAPS RELATED TO A JELLYFISH!

Caulerpa taxifolia

The LARGEST known single celled organism!



Can grow more than 30 cm (16 inches) tall!

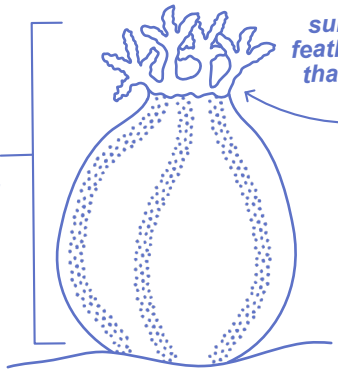
A green seaweed

Is coenocytic (has many nuclei inside one cell)

Native to Caribbean and Indian Ocean. Often considered an invasive species elsewhere.

Psudocolorchirus violaceus

Commonly called "Sea Apple"



Mouth is surrounded by feathery tentacles that gather food

About 20 cm (7 inches) tall.

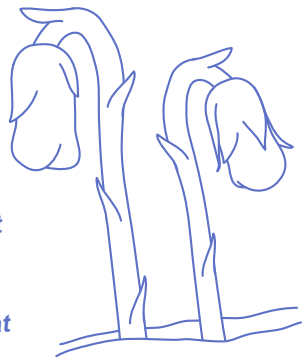
At first glance this looks like a plant, but it can walk slowly on rows of tube feet. Also, if threatened, it can pull in enough seawater to double in size and then escape by floating away on the sea currents!

This animal is closely related to sea cucumbers. It can release a toxin (and it's internal organs!) when stressed.

Monotropa uniflora

Also called Ghost Pipe

This plant is pure white or sometimes pink. It has no chlorophyll and does not perform photosynthesis.

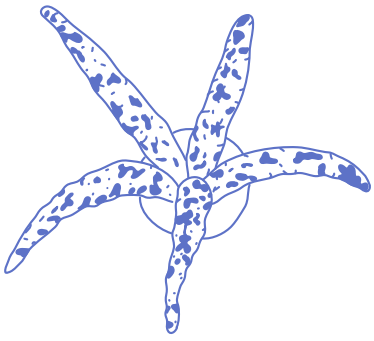


It is a parasite that gets all of it's energy from infecting certain types of fungi that are connected to trees.

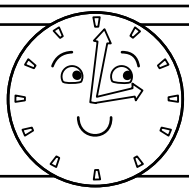
Clathrus archeri

Devil's Fingers or Octopus stinkhorn

This fungus has red "fingers" speckled with black that emerge from a white knob or "egg."



The fungus smells like rotting flesh, which attracts flies. The flies then spread the spores of the fungus to other places.



Quiz Time!

ANSWER THE QUESTIONS TO SEE WHAT YOU LEARNED ABOUT CELLULAR LIFE!

1 Which of these is the best simple definition for the word homeostasis?

- **A.** The ability to regulate internal conditions.
- B. The ability to use energy.
- C. The ability to reproduce.
- D. The ability to respond to a stimulus.

2 What are two characteristics of living things?

Growth, homeostasis, metabolism, made of cells, r esponds to stimuli, reproduction

_____, _____

3 When did humans invent a microscope that can see structures inside a cell that are smaller then the wavelength of light (< 500 nanometers)?

- A. 1665
- B. 1850
- **C.** 1903
- D. 1951

The invention of the ultramicroscope in 1903 allowed scientists to observe particles this small. Richard Zsigmondy, the inventor of the ultramicroscope, later won a Nobel Prize for his research in chemistry.

4 No cell is large enough to be viewed without the help of a microscope.

- A. True
- **B.** False

While most are too small, many can be seen! (egg, certain amoebas and algae, Caulerpa taxifolia and acetabularia)

5 Which type of cell has a nucleus?

- A. Prokaryotic
- **B.** Eukaryotic

6 Fungi are plants, but plants are not fungi.

- A. True
- **B.** False

7 Which domains of life have both single-celled and multi-celled organisms?

- A. Only protists
- B. Archaea and eubacteria
- **C.** Fungi and protists
- D. Only archaea
- E. Only fungi

8 Which of the following are prokaryotic?

- **A.** Bacteria and archaea
- B. Fungi, animals, and plants

9 Protists are which type of cell?

- A. Prokaryotic
- **B.** Eukaryotic

10 A cell can only have one nucleus.

- A. True
- **B.** False

There are many types of multinucleate cells (cells with more than one nucleus) such as muscle cells and the large single-celled Caulerpa taxifolia

11 The average prokaryotic cell is _____ than the average eukaryotic cell.

- A. 2 to 5 times smaller
- **B.** 20 to 100 times smaller
- C. More than 1,000 times smaller

12 Which organelle is responsible for making proteins in the cell?

- A. Mitochondria
- **B.** Ribosome
- C. Plasma membrane
- D. Endoplasmic reticulum

13 Which of the following are made of cells?

- **A.** Wood
- B. Plastic
- **C.** Tomato
- D. Polyester fabric

Plastic and polyester are polymer most often made from petroleum. Although petroleum and other fossil fuels originally came from living things, they have changed through intense pressure and long amounts of time and have no cellular structures remaining.

14 Which organelle uses oxygen and sugar to create energy for the cell?

- **A.** Mitochondria
- B. Chloroplast
- C. Nucleus
- D. Flagella

15 Which of the following statements is true?

- **A.** Some living things are too small to see.
- B. Animals are made of prokaryotic cells.
- C. Fungi contain chloroplasts.
- D. Every cell has a nucleus.

16 Which organelle is only found in plants or protists?

- **A.** Chloroplasts
- B. Mitochondria

17 Eukaryotic cells are bigger than prokaryotic cells.

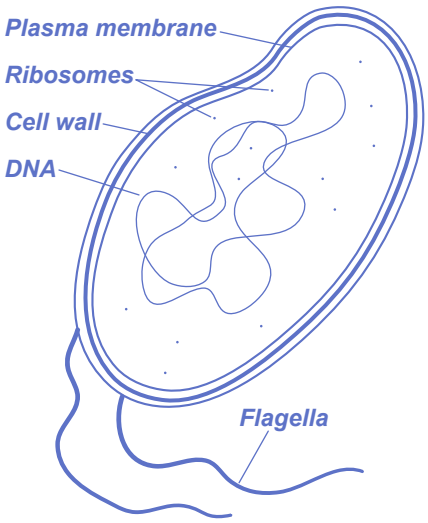
- **A.** True
- B. False

In general, this is true! The average eukaryotic cell is between 10-100 times larger than the average prokaryotic cell. But there are exceptions to every rule. The smallest eukaryotic cell is Ostreococcus, an algae 0.8 micrometers in diameter. The largest prokaryotic cell ever discovered is Thiomargarita namibiensis, which is 100-300 micrometers in diameter. So either answer can be considered correct depending on how you interpret the statement.

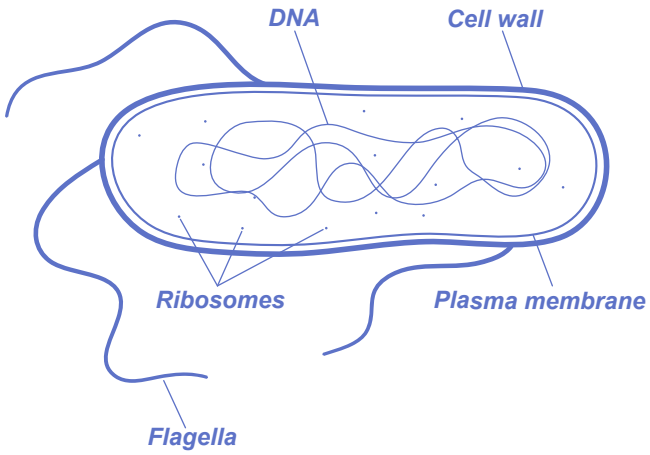
18 Which of these is the best simple definition for the word metabolism?

A. The ability to regulate internal conditions
B. The ability to use energy
C. The ability to reproduce
D. The ability to respond to a stimulus

19 Draw a simple bacterial cell. Label the plasma membrane, cell wall, DNA, ribosomes, and flagella.

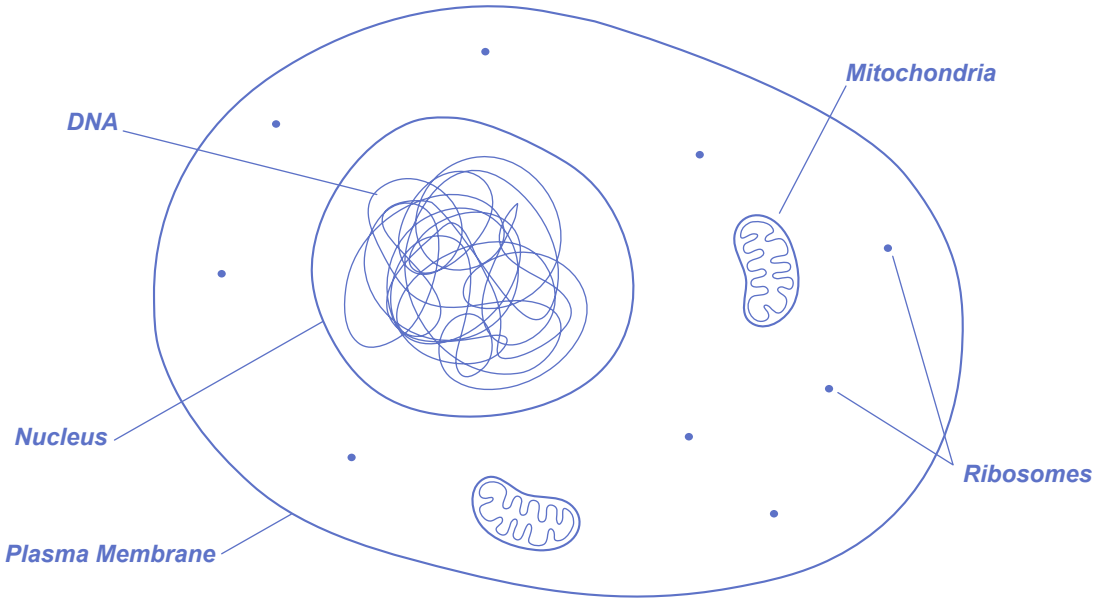


You could draw a GRAM POSITIVE bacterium which has an inner membrane, thin cell wall, and then an outer membrane



You could draw a GRAM NEGATIVE bacterium which has an inner membrane and thick cell wall (no outer membrane). Either choice is just fine!

20 Draw a simple animal cell. Label the plasma membrane, DNA, ribosomes, mitochondria, and nucleus.

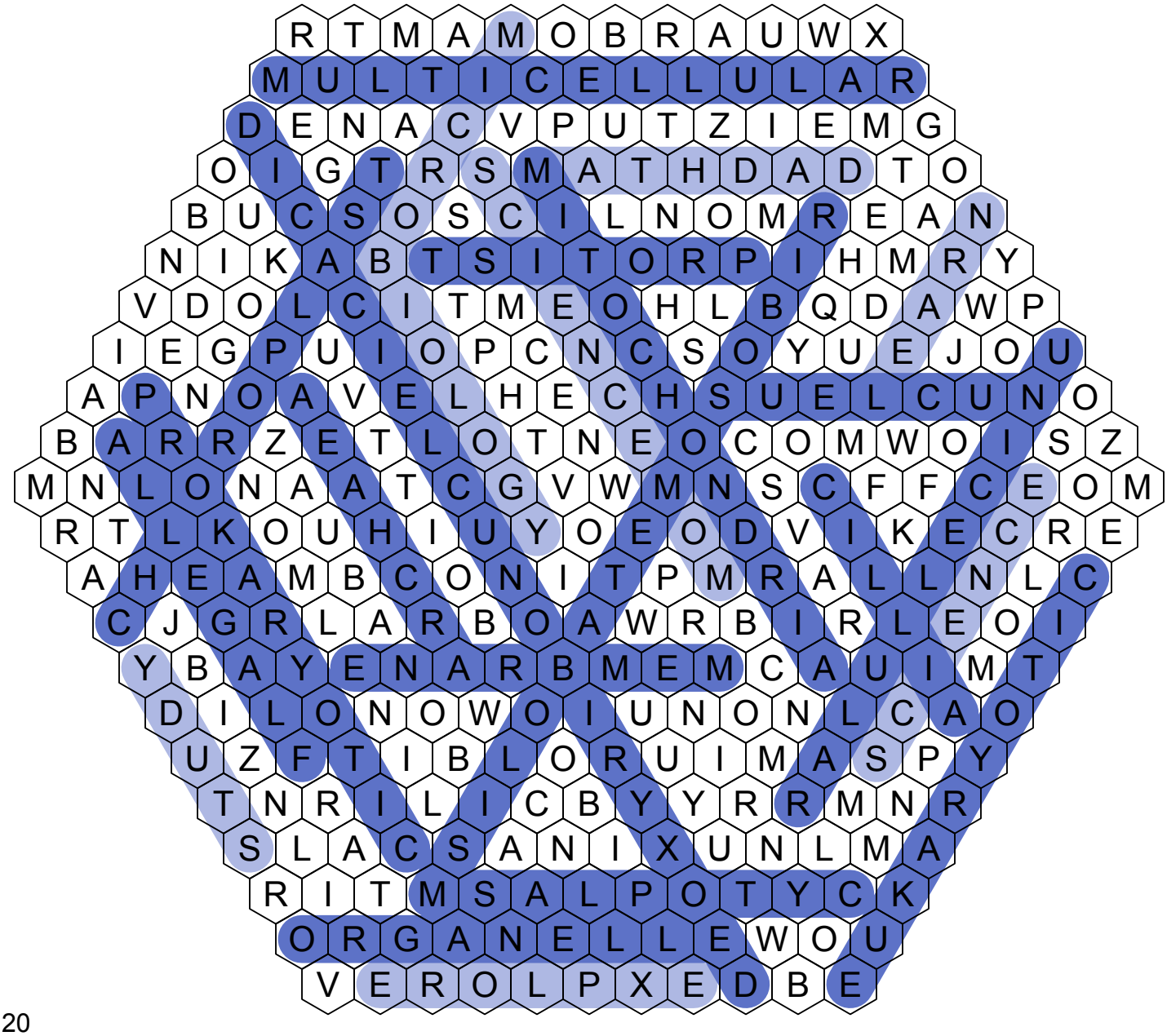


The drawing doesn't need to be fancy or contain more than the 5 items on the list. The goal is to demonstrate a basic understanding of the key cell parts covered in class.

Cellular Word Search

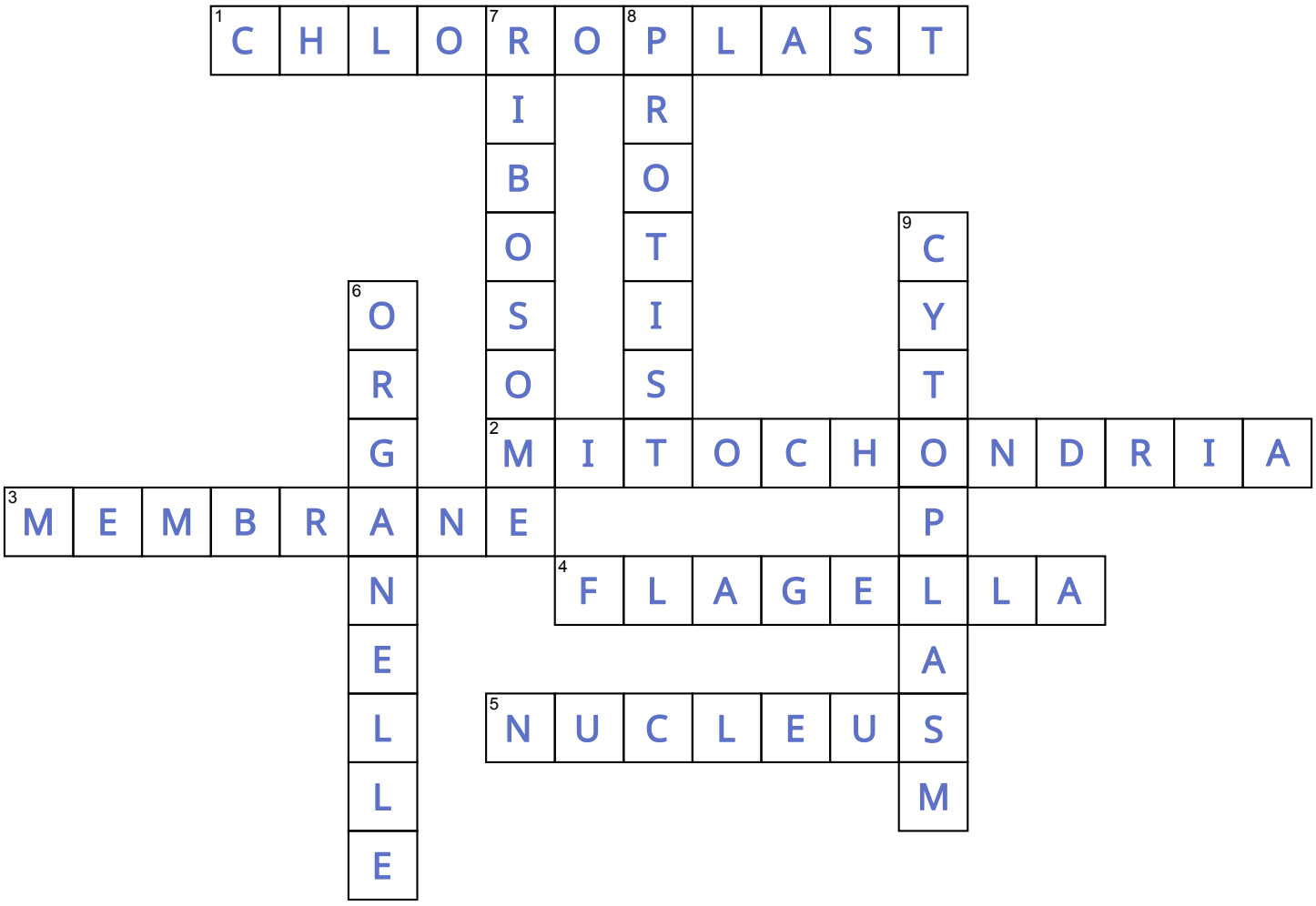
There are a lot of new words to learn when studying biology. Repetition is the best way to learn them, and word games can be part of that! Find each of the hidden words in the word-search. The words can run in any direction: horizontal or diagonal, and the letters might go left to right or right to left!

METABOLISM	NUCLEUS	MULTICELLULAR
MEMBRANE	CHLOROPLAST	EUKARYOTIC
RIBOSOME	FLAGELLA	PROTIST
MITOCHONDRIA	ARCHAEA	CILLIA
DEOXYRIBONUCLEIC ACID	PROKARYOTIC	ORGANELLE
CYTOPLASM	UNICELLULAR	



Biology Crossword

Use the clues below to fill in the crossword puzzle.



Horizontal Words

1. The organelle that performs photosynthesis.
2. The 'powerhouse' of the cell.
3. Keeps the cell intact by surrounding the cell.
4. A tail that some cells use to travel through fluid.
5. The central feature of most plant, fungus, or animal cells.

Vertical Words

6. A structure within a living cell.
7. Organelles that assist the function of DNA, very common throughout the cell.
8. An organism that is eukaryotic but not a fungus, animal, or plant.
9. Contains all of the organelles.