INTRODUCTION TO BIOLOGY KIT

KT-BIOLINT

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INTRODUCTION

From vast mountain forests to the tiniest cells in a petri dish, the study of biology is wonderful and amazing! This guide and activities will take you on a journey through biology – the study of life – where you'll learn about microorganisms, cells, DNA, genetics, animals, plants, and more.

These activities are designed for scientists age 12 and up. Younger students can enjoy experimenting with parental assistance. Use this kit only under adult supervision, and carefully follow all safety precautions.

Kit Contents

This kit contains the following items:

- Assorted Gummy Bears
- 7 Clear Plastic Cups
- 2 Sheets Drawing Paper
- Isopropyl Alcohol, 30 mL
- Dish Detergent, 10 mL
- 6" Bamboo Skewer
- Test Tube Rack
- 2 Large Test Tubes
- 1 Size 0 Stopper
- 12 White Chenille Stems
- Beads - Red, Blue, Green & Yellow
- 24 Plastic Chips
- Blood Type Testing Kit
- Prepared Nutrient Agar, 125 mL
- Permanent Marker
- 6 Petri Dishes
- 4 Zip Lock Bags
- 1 mL Pipet
- Sheep Heart Dissection Kit
- 8 Sterile Swabs (4 packs of 2)
- Vinyl Apron
- 1 ft Parafilm
- 4 pair Nitrile Gloves
- 10 pack of Filter Paper
- Safety Glasses, Adult Size
- Dry Protist Culture
- 12 Microscope Slides
- Yeast Packet
- 5 Medium Balloons
- Funnel
- UV Flashlight
- Plastic Stir Rod
- 10 mL graduated cylinder

In addition, you will need the following household items:

- Salt
- Sugar
- Tap Water
- Spring Water
- 4 Slices of Bread
- Spinach leaves
- Scissors
- Ruler
- 3x AAA Batteries
- Measuring spoons (1/4 tsp to 1 tbsp)
- Tape
- Microwave
- Stovetop (to boil water)
- 400x - 1000x Microscope (recommended but required only for Activity 10)

ACTIVITY #2 – DNA MODEL

FROM THE KIT: 8 – 12 pipe cleaners, beads, 2 sheets of paper and permanent marker.
YOU PROVIDE: Scissors and tape (any type of tape will work).

NOTE: You will use this DNA model later. Be sure to keep the finished product.

1. Separate the beads by color. Label the beads with the permanent marker as follows:

Blue	Red	Green	Yellow
			
"A" for adenine	"T" for thymine	"C" for cytosine	"G" for guanine

2. Cut 3 – 4 pipe cleaners into two-inch pieces for the ladder rungs (make 21 total pieces).
3. Use the rungs and the remaining pipe cleaners to build the following DNA sequence:

C	A	C	G	T	G	G	A	C	T	G	A	G	G	A	C	T	C	C	T	C
G	T	G	C	A	C	C	T	G	A	C	T	C	C	T	G	A	G	G	A	G

4. To do so, thread a pair of nucleotide bases on each rung according to the order shown above. Remember A (blue) can only pair with T (red) and C (green) with G (yellow).
5. Lay each of the base pairs on the table in the order shown above making sure to keep the top and bottom in order.
6. Continue creating the nucleotide bases until you've completed all 21 pairs.
7. To make the sides of the ladder, twist the ends of 2 pipe cleaners together to make a longer strand (overlap by about 1 inch to make a strong connection). Repeat with another 2 pipe cleaners for the other side.
8. Attach the base pair rungs to the sides of the ladder by twisting the ends securely around the longer backbone pipe cleaners. Space your rungs about 1 inch apart. Be sure to attach them in the order shown.
9. While attaching the rungs, keep the ladder as parallel as possible. If you run out of space, add another 2 long pipe cleaners to the end and continue.
10. Tape the two sheets of paper together on the shorter end to make a single long sheet of paper.
11. Tape one end of the completed DNA model to the end of the long sheet of paper.
12. Gently twist the ladder until it forms a double helix. Tape the other end of the helix down to the opposite end of the paper (see an example on the next page).
13. Congratulations you've made a model of part of a human gene – one that you'll learn more about later!

Classification Systems

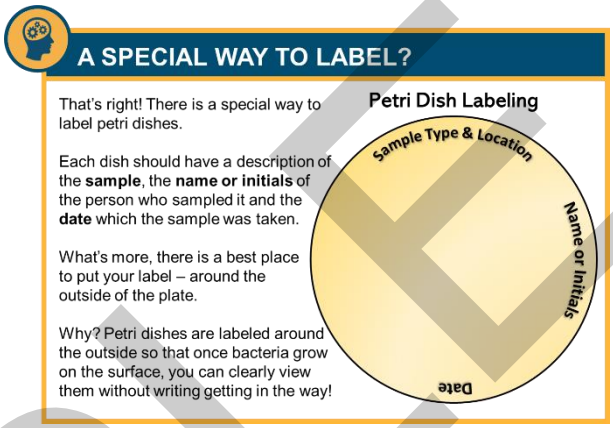
Careful observation and organization are crucial to creating a well-informed view of the natural world. In biology, all living things have been organized into a classification system that is often generally referred to as (unsurprisingly) the Classification of Living Things. This field of study is called **Taxonomy**.

Have you ever heard humans called *Homo sapiens*? That is our classification. We humans are referred to in scientific language by our genus (*Homo*) and species (*sapiens*). Why the capitalization and italics? Taxonomy in biology has a set of rules like these to help everyone around the world refer to organisms in the same way. Ever heard of the bacteria *E. coli* – sometimes found in food, causing food poisoning? This organism belongs to the genus *Escherichia* and the species *coli*.

The biological classification system begins by separating all living things into 5 large groups called kingdoms. These kingdoms include: Animalia (Animals), Plantae (Plants), Fungi, Protista (Protists) and Monera (Eubacteria and Archaebacteria).

ACTIVITY #8 – BACTERIA SHAPES AND SIZES, OH MY!

FROM THE KIT: 4 sterile swabs, 4 prepared nutrient agar plates, gloves and parafilm.
YOU PROVIDE: Boiled water.

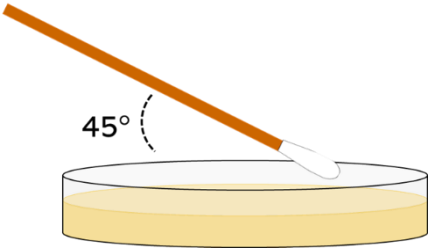


Prepare:

1. If needed, remove the agar plates from the fridge and let warm to room temperature.
2. Keeping the agar plates closed, label the bottom of one plate each with the following labels (you'll add more detail later):
    - Hand
    - Household Surface
    - Common Surface
    - "Gross" Surface
3. Bring a pot of water to a rolling boil for 1-3 minutes. Keep water warm, not boiling.
4. Put on your gloves.

Phase 1: Inoculate the plates with samples of various surfaces.

1. Carefully open and remove a single sterile swab. Dip the swab in the boiled water to moisten (note: you aren't sterilizing the swab just getting it moist to improve sampling).
2. Let cool (do not blow on the swab!).
3. Rub the swab over the palm of one hand, in between your fingers and around your nails.
4. With the agar plate face up, remove the cover of the dish, hold the swab at an approximately 45° angle and lightly streak the swab across the surface in a zig-zag pattern. Twist the swab as you do to maximize transfer of the sample to the plate.



5. Cover the dish immediately.
6. Using new sterile swabs, repeat Steps 1 – 4 to make the following cultures:
    - A **household surface** (table, counter top, cabinet handle or similar)
    - A **commonly used surface** (cell phone, computer keyboard, a door knob or similar)
    - A **"gross" surface** (bottom of a shoe, kitchen sink, floor or similar)
7. With the plate is closed, add detail to the label on the bottom of the plates. Indicate the following information:
    - Where you got the sample ("Kitchen Table")
    - The date ("02/02/2020")
    - Your name or initials ("XYZ")

Phase 2: Seal and incubate.

8. Seal the dishes to prevent evaporation using the supplied laboratory film (Parafilm). Use the Parafilm as follows:

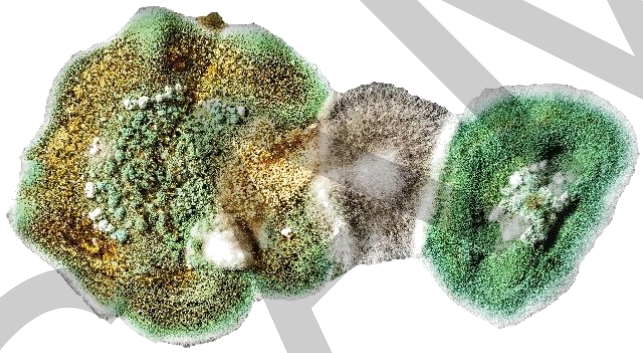
Use a microscope!
You've just cultured bacteria isolated from surfaces on and around you. Once colonies have formed on an agar plate, use a toothpick or swab to remove a small amount of the colony and place it on a slide. Add a tiny drop of water and a cover slip.

View bacteria using a 1000x oil immersion objective and coverslip (not available with all microscopes). Take care not to touch the bacterial sample. Clean any contaminated surfaces with bleach or 70% isopropyl alcohol. After disinfection, dispose of in a plastic bag.

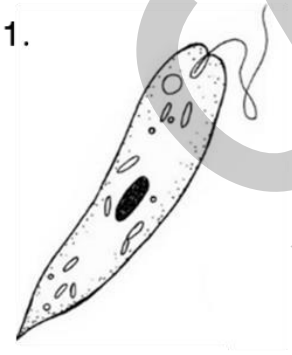
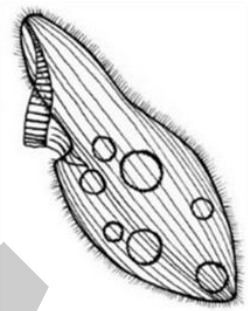
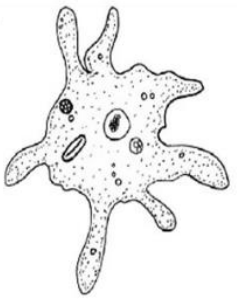
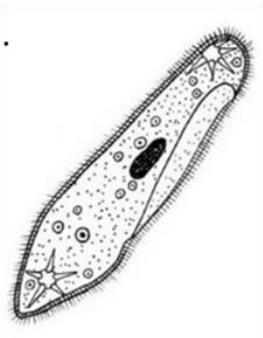
What happened?

There are microorganisms like bacteria, viruses and molds all around you. When placed on agar in the petri dishes, some of these organisms begin to grow. The diversity of these organisms is not only visible on the microscopic scale, but also at the macroscale in the shape of their colonies (the morphology). Colony morphology is used to characterize microorganisms and can help to identify what is growing during microbiology experiments. Imagine you want to grow an organism that typically has a round form, flat elevation and even margin. However, this time all that is growing on your petri dish is something with an irregular form, flat elevation and curled margin. Is it the same thing? Probably not. Study of colony morphology is a great way to learn more about microorganisms and aid in experimentation.

Did you see anything like this? Really fuzzy, dark in color (blue, black or green) that grew quickly across the plate?



This is fungus (or mold), not bacteria. There are fungal spores floating all around us and it's really common to find them growing on agar plates. You'll learn more about mold in later activities.

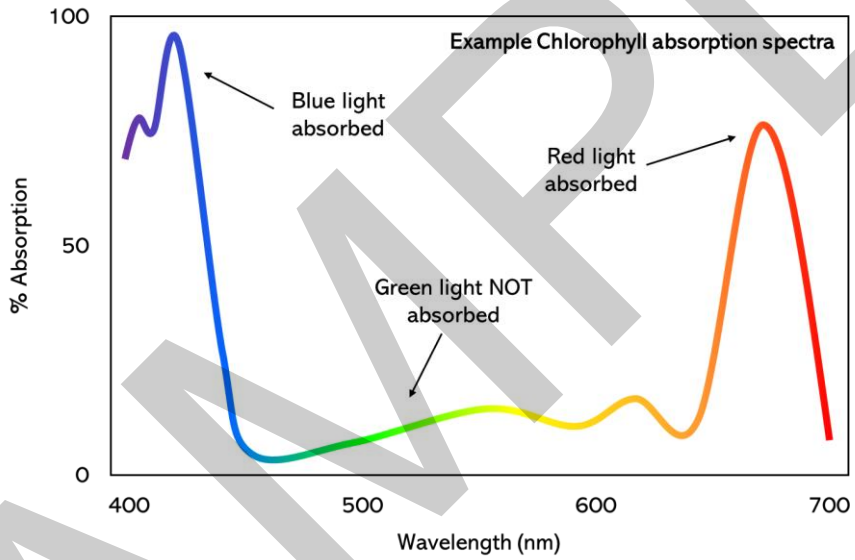
1. 	2. 	3. 	4. 	5. 
Color: Green	Color: No Color	Color: No Color	Color: No Color	Color: No Color
Identification:	Identification:	Identification:	Identification:	Identification:

Answers: 1. Euglena, 2. Vorticella, 3. Blepharisma, 4. Amoeba and 5. Paramecium.

14. Bring the solution into a dark room and shine the UV light on the tube (DO NOT look directly into the UV light).
15. Examine and record the color of the solution under the UV light in the space above.

What happened?

When mixed with alcohol, the chlorophyll in the green leaves was extracted into the solution. The solution should have turned green. This green color is due to the chlorophyll itself which absorbs red and blue light better than green. The absorption spectrum for chlorophyll is shown below. Notice that at around 400 nm (the wavelength of purple/blue light), there is near complete absorption. The same is true at around 675 – 700 nm (the wavelength of orange/red light). However, at 500 nm (the wavelength of green light) there is almost zero absorption and nearly complete reflection. This reflection means that the green light bounces off the chlorophyll (found in leaves) to your eye, making them look green.



During photosynthesis in a living plant, that absorbed light becomes usable energy within the cell. However, the extracted chlorophyll in the tube cannot "pass" the energy in the same way. The red light that was absorbed is instead emitted in a process called fluorescence. As such, the chlorophyll should appear red (or reddish purple) under UV light as the energy is released.