## “Cell-f” Understanding

**Summary:**   
 Students will be making a model of an animal cell by using a bouncy ball (that they will create themselves) to represent the cytoplasm and craft string, small beads, candies, and cake/cookie decorating supplies to represent the organelles: nucleus, mitochondria, vacuole, golgi body, ribosomes, and endoplasmic reticulum. The cells will then be combined to make tissues, then organs, then organ systems, and finally an organism to help students understand cells and their levels of organization.  
  
**Subject:**

* Science: Differentiate between structures and function in plant and animal cell organelles, including cell membrane, cell wall, nucleus, cytoplasm, mitochondrion, chloroplast, & vacuole

**Grade Level:**

* Target Grade: 7
* Upper Bound: 6
* Lower Bound: 8

**Time Required:** 1 full period + the beginning of the following period for discussion.

**Activity Team/Group Size:** individuals or groups of 2 students.

**Materials:**

* Cornstarch
* Borax—found in the laundry section of the grocery store.
* Clear school gel (not washable)—should be available at craft stores, but if you cannot find it Amazon.com has ColorSplash!® Clear Glue (128-oz. for $8.50).
* Warm water
* Craft sticks (to stir the mixture)
* Measuring spoons
* Two plastic cups for mixing
* Marker
* Stopwatch
* Ziploc sandwich bag (1 bag per pair; get the 7X8 inch bags)
* Ziploc freezer bag (1-quart or 1-gallon depending)
* Ziploc Big Bag (or 1 or 2 gallon bag depending)
* Metric ruler
* Assortment of craft string, small beads, candies, and cake/cookie decorating supplies (sprinkles) to represent the organelles: nucleus, mitochondria, vacuole, golgi body, ribosomes, endoplasmic reticulum
* Address labels or some other small label (optional, for labeling the Ziploc bags)
* Safety goggles, gloves, and aprons for all students
* Bouncy Ball Cell Key
* Cells and Levels of Organization Directions

**Expendable Activity Cost Per Group [in dollars]:** $5

**Learning Objectives:**

* Students will be able to recognize organelles in an animal cell. Building models helps students visualize the organization of organelles within a cell.
* Students will understand the levels of organization from a cell to an organism.

**Lesson Introduction / Motivation:**   
 This lesson is intended to 1) reinforce the levels of organization and 2) help the students review the organelles in an animal cell and visualize their organization within the cell. Before beginning the activity, you may discuss with the students what they think the inside of a cell looks like. You may then introduce this activity by explaining that scientists often build models to represent things that cannot be viewed directly (for example, a globe). So, today as scientists, they will build models of cells that they could use to teach others about the inside of a cell. They will also model the levels of organization.

**Lesson Plan:**

Day 1:  
 Hand out to each student the *Bouncy Ball Cell Key* and the *Cells and Levels of Organization Directions*. Go over the directions with the students, and be sure to emphasize that the students must follow lab safety procedures and wear the provided protective equipments (goggles, gloves, and aprons/coats). Also stress that it is important to read and follow the directions *exactly*. Allow each row/table of students to go gather their materials. Supervise the students as they carry out the directions for the project (see the Directions sheet at the bottom of this document).

After the students have completed their cells, regroup as a class. Pair the students (or groups) together, so that now each group has at least 2 cells in it. Allow the students to grade each other’s bouncy ball cells. If any of the organelles are missing or are incorrectly keyed the students will lose points. While the students are correcting, hand out a small Ziploc bag. Have each group make a “Tissue” bag and place their cells inside of it. Lead the class as a group explaining the levels of organization. Next, tissues work together to form organs. Combine two “Tissue” groups together to make an “Organ” bag. Assign each group an organ names to write on their bag: heart, blood, lungs, trachea, stomach, intestines, thyroid gland, adrenal gland, hair, skin, skeletal muscle, smooth muscle, brain, nerves, prostate, mammary glands, bones, joints, kidneys, or bladder. Collect these “Organ” bags at the end of the period.

Day 2:   
 At the end of the day, separate the “Organ” bags into the following organ systems: circulatory (heart, blood), respiratory (lungs, trachea), digestive (stomach, intestines), endocrine (thyroid gland, adrenal gland), integumentary (hair, skin), muscular (skeletal muscle, smooth muscle), nervous (brain, nerves), reproductive (prostate, mammary glands), skeletal (bones, joints), and excretory (kidneys, bladder). Put these into the largest Ziploc bags and label them accordingly.

Draw a larger-than-life outline of a human (or some other organism) on a large sheet of white paper. Make this outline as big as possible. Before the next class day, put the outline on one of the walls or a bulletin board in your classroom, making sure to securely attach it on all sides and throughout the paper. If necessary, attach the outline to a large piece of cardboard, then attach or lean this against the wall. Attach all of the organ system bags in the interior of the outline with their names facing outward. You can use staples, duct tape, or anything that will make the bags stay on the paper.

At the beginning of class review what they had done the day before and continue the discussion by explaining to them how different organs make up organ systems, and that the organ systems put together creates an organism. It may help them to understand how the complexity of each level increases by pointing out that each level that they made (from cells to organism) involved an increasing number of students. Since you have labeled the organ systems on the organism this activity is an appropriate introduction to the different organ systems.  
  
**Assessment:**

Students should be able to easily grade each others’ cells. The cells should have 6 organelles inside (no more, no less) and the key should be complete and match what is in the cell.

**Lesson Scaling:**

This activity is designed so that individual students may make their own cell or work in groups of 2 (no larger). For large classes, you can combine several groups together to make the “Tissue” and “Organ” bags (so that there will be more than 2 cells in a “Tissue” bag and more than 2 tissues in an “Organ” bag).

**Safety Issues:**

Make sure students are all wearing aprons, safety gloves, and safety goggles when they are mixing the bouncy ball solution. Closely monitor students as they are creating their bouncy ball.

**Troubleshooting Tips:**

You may want to create your own bouncy ball at least a day before the lesson to anticipate any problems the students may have when they are creating their own. For example, the coloring in some of the candies and cake decorating items may run into the bouncy ball material.

**Multimedia Support and Attachments:**

* <http://web.jjay.cuny.edu/~acarpi/NSC/14-anatomy.htm> - a very helpful site on Organ systems

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E-mail to [ljohnson@cvm.tamu.edu](mailto:ljohnson@cvm.tamu.edu)  
Please include the title of the lesson, whether you are a teacher, resident scientist or college faculty and what grade you used it for.

**Teacher’s Comments:**

Cells & Levels of Organization: Directions Sheet

Materials:

* Cornstarch
* Borax
* Clear school gel (not washable)—white glue will make white balls, so you won’t be able to see the organelles in the cells.
* Warm water
* Craft sticks (to stir the mixture)
* Measuring spoons
* Two plastic cups for mixing
* Marker
* Stopwatch
* Ziploc sandwich bag (1 bag/2 groups)
* Ziploc freezer bag (1-quart or 1-gallon)
* Metric ruler
* Assortment of craft string, small beads, candies, and cake/cookie decorating supplies (sprinkles) to represent the organelles: nucleus, mitochondria, vacuole, golgi body, ribosomes, endoplasmic reticulum
* A label

Before you start:

We will be making a model of an animal cell. It will be a “Bouncing Ball Cell”. The ball will represent the cytoplasm—the jellylike material outside the cell nucleus in which the organelles are located. The organelles will be represented by craft string, small beads, candies, and cake/cookie decorating supplies. Before you begin making your bouncing ball, you need to choose 6 different items (from the materials provided to you) that you think best represent the organelles: nucleus, mitochondria, vacuole, golgi body, ribosomes, endoplasmic reticulum. Fill out the key to help you identify what the organelles are inside of the cell once it is made.

Part 1:

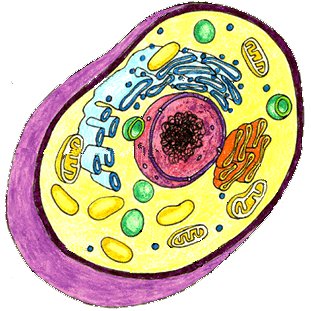
1. Label one cup “Borax Solution” and the other cup “Cytoplasm Mixture”
2. Pour 4 tablespoons of warm water in the “Borax” container.
3. Measure 1 teaspoon borax powder and add it to the “Borax” container. Stir the borax and water together.
4. Pour 2 tablespoon of glue into the “Cytoplasm” container.
5. Set your stop watch for 15 seconds. Add 1 teaspoon of the borax solution from the “Borax” container and 2 tablespoon of cornstarch. DO NOT STIR!!!!!!!!!! Start your stop watch.
6. Once the 15 seconds is up, stir the ingredients together until they are completely mixed.
7. The mixture will thicken and become impossible to stir. Take the mixture out of the cup to mold with your hands. Spread the mixture out a little bit in the palms of your hands. Place the “organelles” on it and fold the mixture around the organelles. Continue to knead the “cell” until it begins to solidify and becomes less sticky.

(**STOP!!!!!!** and wait for further instructions from your teacher) Part 2:

1. Now, we will model the levels of organization. Place your “cell”, along with another person’s “cell” in a Ziploc bag. Cells are organized into tissues. So, label your Ziploc bag “Tissue”.
2. Find two other “Tissues” and put all three tissue bags into a larger Ziploc bag. Tissues are organized into organs, so label the big bag “Organ”.
3. Give your “Organs” bag to me (the teacher!). I will assign your Organ a name, and write it on the big Ziploc bag. Make sure that every member of your Organ group turns in their Bouncy Ball Cell Key with their name on it.
4. Get excited for what your cells look like tomorrow!

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| --- | --- |
| **Name** | **What I’m using in my Cell** |
| **Nucleus** - Controls the production of protein. Contains DNA and so determines the cell's characteristics |  |
| **Mitochondria** - the main power generator, converting oxygen and nutrients into energy |  |
| **Vacuole** - A large space filled with a watery fluid containing sugar and salts |  |
| **Golgi body** - the distribution and shipping department for the cell's chemical products. |  |
| **Ribosomes** - tiny organelles made of about 60 percent RNA and 40 percent protein |  |
| **Endoplasmic reticulum** - The endoplasmic reticulum is a network of sacs that makes, processes, and transports chemical compounds for use inside and outside of the cell. |  |

Fill out the key to help you identify what the organelles are inside of the cell once it is made. Paste the item that you have chosen to represent each organelle into the blank space next to that organelle in the key.



**Vacuole**

**Nucleus**

**Ribosomes**

**Endoplasmic Reticulum**

**Golgi body**

**Mitochondria**