# Edible Labs

## Biology:

1. Models – Cell or DNA
2. Organelles – Models
3. Organelles – Let Them Eat Pancakes!
4. Mollusk Survey
5. Biome Recipe
6. Mimicry
7. DNA Extraction

## Chemistry:

1. Snickers vs. Three Musketeers
2. Gummy Bear Lab
3. Percentage of Water in Popcorn
4. Bubble Gum Lab
5. Frozen Colloids
6. Frozen Colloids using Vernier Probes
7. What's the Concentration of Kool-Aid?

# Ideas for Food in the Biology Lab

**1. <u>Models</u> - Cell or DNA**

<u>Cells</u> - Have students build models of cells by using different foods to represent the different organelles. The organelles can easily be represented with candy or food.

Have a "Cellular Structure Recognition and Consumption Lab Activity"

*Be sure that all items used are edible or non-toxic*

<u>DNA</u> – have the students use candy to represent the nucleotide components. Gum Drops, Marshmallows, Gummy Life Savers, all work well.

You can even have the students represent the purine and pyrimidine structure of the bases.

**2. <u>Organelles</u> – Models**

Modify the models to only be of a specific organelle.

Have the students each present, then put the organelles together to form a complete cell.

**3. <u>Organelles</u> – Let Them Eat Pancakes!**

Mix pancake batter and make pancakes in the shapes of the organelles. Add food coloring to add variety. Let the students arrange them on their plate as they are arranged in a cell and then eat them.

4. **Mollusk Survey**

After studying Phylum Mollusca, cook different samples of the Mollusks and let the students taste.

Use calamari, clams, oysters, scallops, escargot, etc.

*Have a restaurant deliver if possible*

5. **Biome Recipe**

Have the students research the characteristics of each of the terrestrial biomes. Once they have numbers on the amount of rainfall, average temperature, plants, animals, etc, they can then convert the numbers to put into a recipe format.

*Opportunity for Embedded Math*

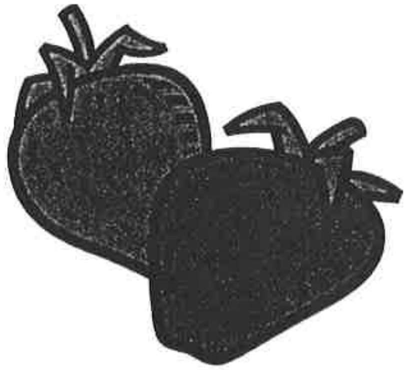
6. **Mimicry**

Use unsweetened and semi-sweet chocolate with powdered sugar. Have the students select and taste.

7. **DNA Extraction**

The polymer of DNA can easily be extracted from many fruits and vegetables.

Use strawberries, bananas, spinach, green beans, etc. DNA can easily be extracted from cells using household chemicals. (Lab Attached)



# Strawberry DNA Extraction

**Background Information:** DNA is found in cells of all living things. DNA is a double stranded macromolecule composed of nucleotide bases pairing Adenine with Thymine and Guanine with Cytosine. DNA can be extracted from cells by a simple technique with household chemicals, enabling students to see the polymer of DNA with the naked eye.

**Purpose:** To extract DNA from the fruit of the strawberry plant.

**Materials/Equipment**

- 1 Heavy duty zip-lock baggie
- 3 to 4 large strawberry pieces
- 1 #2 cone style coffee filter
- Funnel
- 50 or 100 ml beaker
- Test tube
- Graduated cylinder
- Stirrer
- Micro-centrifuge tubes

**Reagents**

- DNA Extraction buffer (one liter: mix 100ml of shampoo (without conditioner), 15g NaCl, and 900ml water)
- Ice-cold 95% alcohol (ethanol / isopropyl)

**Procedure**

- Place strawberries in a zip-lock baggie
- Gently smash strawberries for 2 to 3 minutes (be careful not to tear the bag)
- Add 10 ml extraction buffer to the bag
- Mash and mix for 1 to 2 minutes
- Filter through coffee filter in a funnel into graduated cylinder
- Carefully remove coffee filter out of funnel; gently squeeze the strawberry juice from the filter into the cylinder. (squeeze only liquid, no chunks)
- Pour filtrate (strawberry juice) into test tube
- Slowly add 4 full droppers of ice-cold alcohol into the tube
- At the interface, you will see the DNA precipitate out of solution and float.
- Use the stirrer to gather the DNA and remove
- Place into the micro-centrifuge tube provided

Name: ____________________

# DNA Extraction Questions

1. What is DNA?

2. What is the function of DNA?

3. Where is DNA found within a cell?

4. Does DNA have the same basic structure for all organisms?

5. What are the three basic steps for DNA extraction?

6. What was the reason for smashing the strawberries?

7. In order to study human genes, DNA must be extracted from human tissue. Would you expect the method of DNA extraction we used for the strawberries be the same for human DNA? Explain.

8. Describe the appearance of the final product.

9. What was the purpose of the DNA extraction buffer?

10. Draw a diagram of DNA structure. (Include six nucleotide sequences)

# SNICKERS VS. THREE MUSKETEERS LAB

One floats and one sinks…..can you make the prediction?

**Teacher Information:**

The students will need to have some basic concepts of density and calculating both volume and mass before attempting this laboratory investigation. The students will also need to know the density of water. This lab will also reinforce the concepts of measuring accurately and significant digits. I have used various sizes of candy bars, but the students prefer the "fun size." I purchase enough candy for the groups to enjoy a set of candy bars each and another set for the actual calculations.

**Materials Needed:**

- Snickers
- Three Musketeers
- Ruler
- String
- Balance

**Procedure:**

1. Gather all of the materials listed above.
2. Unwrap each of the candy bars and weigh them on the balance. Record your data in the table.
3. Carefully measure the candy bars by wrapping the string around each one and using the ruler to get an accurate measurement of length, width and height. Record your data in the table provided.
4. Calculate the density of each candy bar using the correct number of significant digits.
5. Predict whether the candy bars will sink or float.

**Names –** ______________________ ______________________

**Date -** ______________________ **Period -** ______________

# SNICKERS VS. THREE MUSKETEERS LAB
## Data Table

Mass in grams of each candy bar: Snickers - ____________________

Three Musketeers - ______________

| Length, Width, and Height of each | Snickers | Three Musketeers |
|---|---|---|
| Length: | _________cm | __________cm |
| Width: | _________cm | __________cm |
| Height: | _________cm | __________cm |

| Volume of each candy bar: | Snickers | Three Musketeers |
|---|---|---|
| | _________$cm^3$ | __________$cm^3$ |

| Density of each candy bar: | Snickers | Three Musketeers |
|---|---|---|
| | _______$g/cm^3$ | __________$g/cm^3$ |

Which candy bar is denser than water?

Which candy bar will float? Briefly explain.

# *Gummy Bear Lab*

Name ______________________________

**Hypothesis: What do you think will happen to a gummy bear when you put it in water over night?**

**Part A:** Choose one gummy bear from the container on your table. Use the equipment available to measure your gummy bear and record the data in the chart for Day 1.

**Measurements:**

- The length of your gummy bear should be measured from the top of its head to the bottom of its feet to the nearest tenth of a centimeter.
- Measure the width at the widest point across the back of the bear to the nearest tenth of a centimeter.
- Measure the thickness from the front to the back at the thickest point to the nearest tenth of a centimeter.
- Calculate the volume by multiplying the length, width, and thickness. Round to the nearest hundredth.
- Measure the mass using a triple-beam balance or other scale to the nearest tenth of a gram.
- Calculate the density by dividing the mass by the volume. Round answer to the nearest hundredth.

**Part B:** Put the bear in a cup labeled with your name and class period. Add 50 ml of water to the cup and allow it to sit overnight. On Day 2, remove the gummy bear from the cup of water and use a towel to dry it off to prevent it from dripping all over the place. Repeat the measurements from Part A and record your data in the correct portion of the chart. Determine the amount of change for each measurement and record in the chart.

**Experiment Data:**

| Day | Bear Color | Length | Width | Thickness | Volume | Mass | Density |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| Amount of change | | | | | | | |

**Questions:**

1. Was your hypothesis correct? Why or why not?

2. Which change is greater - volume or mass? Explain.

3. Was there a change in density? Why?

4. How do your results compare to those of your classmates?

*T. Trimpe 2002* ***http://sciencespot.net/***

**Teacher Notes:**
This lab worksheet was created based on a gummy bear lab I found on the internet; however, the website with the original lab is no longer available. I use the lab during my Metric Mania unit when we are studying volume and mass. I did find another gummy bear lab that explores diffusion with gummy bears and describes the lab in terms of polymers. Go to http://www.psrc.usm.edu/macrog/proposal/dreyfus/outcome/gelatin/bearlab.html to view this lab and get ideas for extension lessons.

**Materials - Each student will need:**
1 gummy bear (may want extra for the students to eat after they have completed the lab)
1 small cup of water (4 oz.)
Measuring tools - metric ruler and scale
Calculator (optional)
1 worksheet

**NOTE**: I have had good luck with Brachs brand of gummy bears, but be sure to test your gummy bears before trying the lab with your students. Some gummy bears do not absorb water well as others. If you find some that don't work for the lab, save them for treats after the lab!

**Extra time?**
Challenge your students to create an experiment with gummy bears. My students have asked if they will "grow" larger if left for another day. Others wondered if the temperature of the water had an effect on the rate of absorption. Some students wanted to experiment with colored water and other liquids to see what would happen to the gummy bears. Buy some extra and experiment!

# PERCENTAGE OF WATER IN POPCORN

How much water is in a kernel of popcorn?

**Teacher Information:**

The students will need to have a basic understanding of how to calculate percentage composition before completing this lab. The lab will reinforce the concepts of significant digits and the law of conservation of matter. You can provide the students with microwavable popcorn or you may ask them to bring their own and therefore get various types of popcorn and vary the results.

**Materials Needed:**

Microwavable Popcorn
Balance
Microwaves

**Procedure:**

1. Remove the popcorn from the plastic wrapper.
2. Use the balance to determine the mass of the bag of the unpopped microwavable popcorn. Record the mass in the data table.
3. Place the bag in the microwave and allow the kernels to pop.
4. Open the bag and allow the steam to escape. Be careful when opening the bag to avoid contact with the steam.
5. After the bag has cooled, find the mass of the popped bag of popcorn. Record the mass in the data table.
6. Calculate the difference between the original mass and the final mass after it was popped.
7. Calculate the percentage composition of water in the popcorn using the following formula:

$$\text{Percentage composition} = \frac{\text{Mass of water lost}}{\text{Mass of unpopped popcorn}} \times 100$$

# BUBBLE GUM LAB

How much sugar is in gum?

**Teacher Information:**

The students will need to have a basic understanding of how to calculate percentage composition before completing this lab. The lab will reinforce the concepts of significant digits and the law of conservation of matter. You can provide the students with various types of gum or you may ask them to bring their own and therefore vary the results. I typically add a "ringer" by putting in some sugar free gum in order to skew the results and cause the students to question what happened to their results.

**Materials Needed:**

Various types of gum
Balance

**Procedure:**

1. Obtain gum from your teacher for both you and your partner. Do not unwrap the gum yet. Record the name and flavor of the gum on the data sheet.

2. While still wrapped, measure the total mass of ALL gum in your lab group and record the data on the data sheet.

3. Without touching the gum, remove the wrapper and begin to chew. You will continue to chew for 15 minutes. You've wanted to chew gum all year... here is your chance. Save the wrapper for later measurements.

4. While chewing the gum, measure the total mass of all gum wrappers in your group.

5. Calculate the average mass of one piece of wrapped gum and the average mass of one gum wrapper. Record your results.

6. Calculate the average mass of one piece of gum and record in your data table.

7. After 15 minutes of chewing, the gum will have lost most of its sweetener and flavoring. Remove the gum from your mouth and place it back on its own gum wrapper. Measure the TOTAL mass of all gum from your group. Record the results in your data table.

**Names -** ______________________ ______________________

**Date -** ______________________ **Period –** ______________

# BUBBLE GUM LAB

## Data Table

**Before chewing:**

Name of gum ______________________

Flavor of gum ______________________

Number of group members ______________________

Total mass of wrapped gum ______________________g

Total mass of gum wrappers ______________________g

Average mass of gum + wrapper ______________________g

Average mass of gum wrapper ______________________g

Average mass of one piece of gum ______________________g

**After chewing:**

Total mass of gum + wrapper ______________________g

Total mass of gum ______________________g

Average mass of 1 piece of chewed gum ______________________g

Average mass of sweetener in 1 piece of gum ______________________g

Percentage of sweetener in gum ______________________%

# BUBBLE GUM LAB
## Mathematics Clue Sheet

**Before chewing:**

Average mass of gum + wrapper → Take the total mass of wrapped gum and divide by the number of group members.

Average mass of one piece of gum → Subtract average mass of gum wrappers from average mass of gum + wrapper.

**After chewing:**

Total mass of gum → Total mass of chewed gum + wrapper – total mass of gum wrappers.

Average mass of one piece of chewed gum→ Divide total mass of gum by number in group.

Average mass of sweetener in one piece of gum→ Subtract the average mass of chewed gum – average mass of one piece of gum.

# FROZEN COLLOIDS

Can you make and eat a frozen colloid in lab?

**Teacher Information:**

The students will need to know about freezing point depression, molality, moles and graphing before beginning this activity. The students will also need to complete the Pre-lab questions before beginning the laboratory investigation.
I typically mix the ice cream mixture prior to the lab. The recipe that I use is:

1 Gallon of milk
1 Cup of sugar
1 Tbsp. of vanilla
1 Can sweetened condensed milk

Each batch of ice cream mixture will serve about 25 students. I also provide toppings for the ice cream for the students to make ice cream sundaes while completing their lab reports. The students always enjoy chocolate and strawberry syrup, sprinkles, whipped topping and cherries.

**Materials Needed:**

1 cup of ice cream mixture / student
1 quart-size freezer bag
1 gallon-size freezer bag
Crushed ice – several cups / group
Sodium chloride – approximately ½ cup / group
Lab Thermometer
Plastic Spoons
Plastic Cups
Balance
Stop Watch
Graph Paper

**Procedure:**

1. Obtain two freezer bags, one quart and one gallon.

2. Pour the ice cream mixture into the quart freezer bag and completely seal the bag. Remove as much air as possible from the bag.

3. Place several cups of crushed ice (about 400 grams) into the large bag and weigh the ice on the balance. Place the quart size bag with the ice cream mixture inside the gallon bag with the ice.

4. Measure the mass of about ½ cup of salt (about 80 grams) on a balance and record it. Pour the salt over the ice in the gallon bag. Immediately take a temperature reading.

5. Begin to knead the small bag inside the gallon bag to expose it to the cold temperature of the ice-salt mixture. Take a temperature reading every minute of the salt-water slurry. DO NOT place the thermometer inside the ice cream mixture bag.

6. Continue to measure the temperature of the salt-water slurry for a few minutes, while kneading the bags. You will need to switch partners to prevent over-exposure to the cold temperature. The temperature should continue to go down. If the temperature starts to increase, you have begun the melting process.

7. After about 5 minutes, check the mixture to see if it has frozen. If not, continue to knead the bag. If the mixture has frozen, remove the inner bag and ENJOY the produce of your reaction. The consistency will be similar to soft-serve ice cream.

Names – ______________________ ______________________

Date - ______________________ Period - ______________

# FROZEN COLLOIDS LAB
## Data Table

| Time: Minutes | Temperature: °C |
|---|---|
| 0 minute | ________ |
| 1 minute | ________ |
| 2 minutes | ________ |
| 3 minutes | ________ |
| 4 minutes | ________ |
| 5 minutes | ________ |
| 6 minutes | ________ |
| 7 minutes | ________ |
| 8 minutes | ________ |
| 9 minutes | ________ |
| 10 minutes | ________ |

**Questions:**

1. Plot a graph of temperatures vs. time on a sheet of graph paper using the data from the table above.

2. Why do the temperatures go below 0°C, the official freezing point of water?

3. Explain the term "freezing point depression." How does it relate to your graph?

4. How does freezing point depression relate to the changes that took place in each of your freezer bags?

Mass of ice: ____________________ g ____________________ kg

Mass of salt: ____________________ g Moles of salt: __________ mol

Molality of salt-ice mixture: ______________________________ m

Theoretical freezing point depression:

$\Delta T_f = \frac{-1.86\ ^\circ C}{m}(\ m) =$ _________________________ ˚C

Measured freezing point depression: _________________________

Is your measured freezing point higher or lower than your theoretical freezing point? Why?

# FROZEN COLLOIDS
## Using Vernier Software

Can you make and eat a frozen colloid in lab?

**Teacher Information:**

The students will need to know about freezing point depression, molality, moles and graphing before beginning this activity. The students will also need to complete the Pre-lab questions before beginning the laboratory investigation.
I typically mix the ice cream mixture prior to the lab. The recipe that I use is:

1 Gallon of milk
1 Cup of sugar
1 Tbsp. of vanilla
1 Can sweetened condensed milk

Each batch of ice cream mixture will serve about 25 students. I also provide toppings for the ice cream for the students to make ice cream sundaes while completing their lab reports. The students always enjoy chocolate and strawberry syrup, sprinkles, whipped topping and cherries.

**Materials Needed:**

1 cup of ice cream mixture / student
1 quart-size freezer bag
1 gallon-size freezer bag
Crushed ice – several cups / group
Sodium chloride – approximately ½ cup / group
Plastic Spoons
Plastic Cups
Balance
Vernier Temperature Probe
Vernier Quest or Mini Quest
Computer

**Procedure:**

1. Obtain two freezer bags, one quart and one gallon.

2. Pour the ice cream mixture into the quart freezer bag and completely seal the bag. Remove as much air as possible from the bag.

3. Place several cups of crushed ice (about 400 grams) into the large bag and weigh the ice on the balance. Place the quart size bag with the ice cream mixture inside the gallon bag with the ice.

4. Measure the mass of about ½ cup of salt (about 80 grams) on a balance and record it. Pour the salt over the ice in the gallon bag. Immediately take a temperature reading.

5. Begin to knead the small bag inside the gallon bag to expose it to the cold temperature of the ice-salt mixture. Take a temperature reading every minute of the salt-water slurry. DO NOT place the temperature probe inside the ice cream mixture bag.

6. Continue to measure the temperature of the salt-water slurry for a few seconds, while kneading the bags. You will need to switch partners to prevent over-exposure to the cold temperature. The temperature should continue to go down. If the temperature starts to increase, you have begun the melting process.

7. After about 4 minutes, check the mixture to see if it has frozen. If not, continue to knead the bag. If the mixture has frozen, remove the inner bag and ENJOY the produce of your reaction. The consistency will be similar to soft-serve ice cream.

Names – ______________________ ______________________

Date - ______________________ Period - ______________

# FROZEN COLLOIDS LAB
## Data Table

| Time: Minutes | Temperature: °C |
|---|---|
| 0 second | ________ |
| 10 second | ________ |
| 20 seconds | ________ |
| 30 seconds | ________ |
| 40seconds | ________ |
| 50 seconds | ________ |
| 60 seconds | ________ |
| 70 seconds | ________ |
| 80 seconds | ________ |
| 90 seconds | ________ |
| 100 seconds | ________ |
| 110 seconds | ________ |
| 120 seconds | ________ |
| 130 seconds | ________ |
| 140 seconds | ________ |
| 150 seconds | ________ |
| 160 seconds | ________ |
| 170 seconds | ________ |
| 180 seconds | ________ |
| 190 seconds | ________ |
| 200 seconds | ________ |
| 210 seconds | ________ |
| 220 seconds | ________ |
| 230 seconds | ________ |
| 240 seconds | ________ |

**Questions:**

1. Print a graph of temperatures vs. time with the Logger Pro. If there are two groups using the Vernier Mini-Quest, print two graphs and highlight your group's data.

2. Why do the temperatures go below 0°C, the official freezing point of water?

3. Explain the term "freezing point depression." How does it relate to your graph?

4. How does freezing point depression relate to the changes that took place in each of your freezer bags?

Mass of ice: ______________________ g ______________________ kg

Mass of salt: ______________________ g Moles of salt: __________ mol

Molality of salt-ice mixture: ______________________________________ m

Theoretical freezing point depression:

$\Delta T_f = \frac{(-1.86\ ^\circ C)}{m}(\ m) =$ ______________________________ °C

Measured freezing point depression: ____________________________

Is your measured freezing point higher or lower than your theoretical freezing point? Why?

# What's the Concentration of Kool-Aid???

**Problem:** Can you determine the concentration (molarity) of properly made Kool-Aid? We will be making 4 different concentrations of Kool-Aid. You will taste the Kool-Aid solutions you make to determine how you like your Kool-Aid.

**Materials:**

- Kool-Aid Powder
- Spoons
- Water
- Triple Beam Balance
- Plastic cups
- Ruler

**Procedure:**

1. Calculate how much solid Kool-Aid you will need to make 0.2 L of each solution. **(Hint 1: Kool-Aid is mostly sugar ($C_{12}H_{22}O_{11}$), so you can assume that the "molar mass" of Kool-Aid is the same as the molar mass of sugar.) (Hint 2: "What you know" is the volume – 0.2 L)** Show all of your calculations below. *Circle or box the answer for each part.*

The "molar mass" of Kool-Aid:

Mass of Kool-Aid needed for 0.1 M solution:

Mass of Kool-Aid needed for 0.4 M solution:

Mass of Kool-Aid needed for 0.7 M solution:

Mass of Kool-Aid needed for 1.0 M solution:

2. Mark the 0.2 L mark on a plastic cup by measuring 6.0 cm from the bottom of the cup and drawing a line. (Usually we would use more accurate measuring techniques, but we can't drink out of lab equipment.)

3. Mass out the correct amount of solid Kool-Aid in each cup by putting your cup on the balance, setting the mass to zero, and putting the correct mass of Kool-Aid in the cup.

4. Add water to the cup until you have 0.1 L of solution (fill it up to the line you drew). Stir with a spoon.

5. Observe and taste the solutions you have made. You can have one "designated taster" or you can pour a little into separate cups for each group member to taste. Record how each solution looked, smelled, and tasted. **Rate the taste of the solution on a scale of 1 to 5.** (*5 being the best*)

| Concentration | Color | Smell | Taste | Rating (circle one) |
|---|---|---|---|---|
| 0.1 M | | | | 1 2 3 4 5 |
| 0.4 M | | | | 1 2 3 4 5 |
| 0.7 M | | | | 1 2 3 4 5 |
| 1.0 M | | | | 1 2 3 4 5 |

6. Compare the solutions, and decide which one is closest to the correct concentration. If you have extra time, you can try to make one more solution with the exactly perfect concentration based upon your observations.

7. Dump leftovers in the sink and throw away used cups.

**Conclusion:**

1. Which concentration that you tested was closest to the ideal concentration of Kool-Aid? What was wrong with each of the other solutions that you made?

2. How is taste related to concentration? Why are they related in this way?

3. Calculate the molarity of Kool-Aid as prepared using the directions on the back of the container. (Add 88 grams {3/4 cup} of Kool-Aid powder to 1 quart of water.) {*1 quart = 946.35 mL*}

4. If you mixed three Dixie cups contents together containing 0.05 L of 1 M Kool-Aid, 0.05 L of 2.5 M Kool-Aid, and 0.05 L of 0.5 M Kool-Aid, what would the molarity be of the resulting solution? SHOW YOUR WORK!!!