Lactase Lab

Part B: Video Worksheet

Enzyme Research in Canadian Laboratories
In groups of two, discuss the role of enzymes in food and medicines. While watching the following videos with your partner, take turns asking and answering the questions. Possible questions to discuss:

1. Which enzymes are at work in your body right now? What do they do? How do they work?

2. Watch four (4) videos from the following website:
   Http://glyconetlactaselab.weebly.com
   Answer the following questions – think/pair/share

Video clip #1 - Farah Choudhary, Lab Technician

1. What is the focus of Farah's research?

2. What is the ultimate goal of her project?

3. Why use bacterial enzymes to modify the cells? Why not mammalian cells?

Video clip #2: Dr. Lisa Willis, Post-doctoral Fellow

1. According to Lisa, what does the attachment of polysialic acid to the cell surface allow certain cells to do?

2. What does polysialic acid attachment allow cancer cells to do? How does Lisa's research address the problem?

Video clip #3: Alison Mark, Co-op Student

1. What does the enzyme that Alison is working on do?

2. Why is Alison trying to find a heat stable protein?

Video clip #4: Ray Martinez-Rodriguez - Summer student

1. What does the enzyme that Ray works with do?

2. What are two problems with this protein (enzyme)?

3. Ray describes how a His-tag can help fix one of the two problems mentioned above.

4. Immobilized lactase in a calcium alginate gel and pouring milk through it to break down the lactase is a similar idea to the IMAC mentioned above. How are they similar and how are they different?

Homework: HHMI (Howard Hughes Medical Institute) Video Clips
Watch the following video clips and answer the questions.

Video clip: Lactose Digestion in Infants – animation (53 seconds)
https://www.biointeractive.org/classroom-resources/lactose-digestion-infants

1. Why do babies have the gene to make the lactase enzyme?

Video clip: Natural Selection of Lactose Tolerance - animation (46 seconds)
https://www.biointeractive.org/classroom-resources/natural-selection-lactose-tolerance

1. Why is it biologically "expensive" for people to have this enzyme as an adult?

2. How is the lactase gene selected for?

Regulation of the Lactase Gene – PowerPoint (includes 2 minute video by Dr. Sarah Tishkoff) https://www.biointeractive.org/classroom-resources/regulation-lactase-gene

1. What is lactase persistence?

2. What does lactase do?

Got Lactase? The Co-evolution of Genes and Culture *(15 minute video with interactive multiple choice questions)*
https://www.biointeractive.org/classroom-resources/interactive-assessment-got-lactase-coevolution-genes-and-culture

1. What happens if a lactose intolerant adult drinks milk?

2. What percentage of the world's population is lactose tolerant?

3. In which regions of the world do people have the highest levels of lactase persistence?

4. In which regions of the world do they have the lowest levels of this mutation?

5. What did researchers find out about the mutations in Europe vs. the mutation in Eastern African countries?

6. How long ago did the pastoralists in Europe and Eastern Africa start using milk in their diet?

7. How does milk consumption promote an evolutionary advantage to those who are lactase persistent?

Student Lab Worksheet

Grade: 12	**Subject:** Biology	**Unit:** Biotechnology

Title: Lab Investigation - Investigate factors that affect the efficiency of creating lactose-free milk by using the enzyme lactase

Initiating and planning your experiment

1. Watch your teacher demonstrate how to create lactose-free milk by breaking down the lactose with the enzyme lactase.
2. Brainstorm variables (with your partner) needed to change the procedure to make a more efficient method (below).
3. Select one variable to change (independent variable). The rest of the variables are to be controlled (unchanged). Do not change more than one variable at a time.
4. Think of at least two different variables to measure (dependent variable). Remember: measurability is key!

State six different *independent (manipulated)* variables that you considered for your experiment.	State two different *dependent (measured)* variables that you considered for your experiment.
1. 2. 3. 4. 5. 6.	1. 2.

Of the above variables, <u>circle or highlight</u> the independent variable you chose to manipulate and the dependent variable you chose to measure.

Develop a central research question/hypothesis in the space below.

If I change _____(independent variable), then the _____ (dependent variable) will be changed by _____.

Ask your teacher to sign that he/she approves your research question _____ 

Materials:

For each student group:

- Sieve (one per group)
- Lactase solution
- Sodium alginate gel solution
- Syringe (10 mL for creating the spheres)
- Syringe and a variety of syringe volumes so that they can vary the column width (25 mL, 50 mL, etc.)
- Test tubes with stoppers (a variety of sizes)
- Spoon or scoopula
- Retort stand and clamp
- Milk (30 mL per group)
- Thin tubing (optional) to attach to the bottom of the syringe
- Glucose strips (5-8 per group)

Safety: Lactaid, milk, calcium chloride and sodium alginate are edible (these substances are used in molecular gastronomy). Calcium chloride is classified as green (general use). Safety goggles are not required, although teachers can ask students to wear them (good practice). Do not eat or drink materials in the lab, regardless of their everyday use (milk).

Procedure:

You have seen your teacher demonstrate how to make the gel spheres, place them in the syringe, pour the milk through and test the resulting milk for the presence of glucose.
His/her procedure is listed below. Your challenge is to find a different (better) method of making lactose-free milk.

1. *Obtain the materials listed above.*
2. *Mix the sodium alginate and the lactase solution in a 3:1 ratio in a beaker.*
3. *Draw gel mixture into a syringe.*
4. *Place some calcium chloride solution into a beaker, 2 inches deep. Slowly and carefully, drop the sodium alginate/lactase gel into the calcium chloride. It will make spheres. Let sit for at least 2 minutes.*

5. *Rinse the spheres with distilled water, using the sieve.*
6. *Using a spoon, place spheres into the large syringe (25 mL). Students will have to decide how much they are going to use in the planning stages. For the purposes of the demonstration, 20 mL can be used. Space needs to be left at the top to pour the milk in.*
7. *Clamp the sphere filled syringe onto the retort stand. Place a test tube directly underneath. One may decide to attach tubing to the end of the syringe to direct the flow of milk.*
8. *Pour the milk through the column. Once all of the milk has passed through, test it with the glucose strip, following the directions on the label. Record your observations. You may get a negative glucose reading on the first pass.*
9. *Pour through the milk at least three times. You should be able to see the glucose strip show a positive result on the second try. It is too time consuming to demonstrate three passes through the column so just guide the students to not become discouraged when it takes more than one pass.*

Analysis:

Conclusion: