Science Assessment System Through Course Task

Got Gas?

Grade Level:
9, 10, 11, 12

Phenomena:
Lactose Intolerance

Science & Engineering Practices:
Analyzing and Interpreting Data
Obtaining, Evaluating and Communicating Information
Constructing Explanations and Designing Solutions

Crosscutting Concepts:
Patterns

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Preparing to implement Through Course Tasks in the Classroom

What is a TCT?

- TCTs are 3-dimensional tasks specifically designed to get evidence of student competency in two dimensions, Science and Engineering Processes (SEPs) and Crosscutting Concepts (CCC), untethered from Performance Expectations (PEs)/standards. Tasks are sense-making experiences.
- Tasks are to be used formatively. The goal is for both students and teachers to understand areas of strength and improvement for the SEP(s) and CCC assessed within the task.

How do I facilitate a Through Course Task (TCT)?

- TCT facilitation is a collaborative process in which teacher teams calibrate understanding of the expectations of the task and refine strategies to be used during task facilitation.

Before the task:

1. Complete the TCT as a learner – compare understanding of task through the lens of success criteria (identified in the task) in order to understand expectations.
   Success criteria include:
   - What is this task designed to get evidence of?
   - What is the task asking the students to do?
   - What might a student response look like?
2. Identify the phenomenon within the task. Consult resources to assure teacher teams have a deep understanding of associated science concepts.
3. Collaborate to generate, review and refine feedback questions during facilitation.
4. Identify potential "trouble spots" and plan for possible misconceptions.

During the task:

5. Collect defensible evidence of each student's competencies in 3-dimensional sense-making for the task.
6. Ask appropriate feedback questions to support student access and engagement with the task in order to elicit accurate evidence of student capacities.

After the task:

7. Reflect on the task as a collaborative team.
8. Review student work samples to identify areas of strength and areas of need.
9. Determine/plan next steps to move 3-D sense making forward through the strengthening of the use of SEPs and CCCs.

Using the materials included in this packet:

- **Task Annotation:**
  - The task annotation is a teacher guide for using the task in the classroom. Additionally, the annotation gives insight into the thinking of developers and the task overall.

    - Each task has science and engineering practices, disciplinary core ideas, and crosscutting concepts designated with both color and text style:
        - **Science and Engineering Practices**
        - *Disciplinary Core Ideas*
        - Crosscutting Concepts
- **Student Task:** The materials to be used by students to complete the TCT.

Got Gas? Task Annotation

After **synthesizing text about** *lactose processing by the human body* and **analyzing and interpreting data** *about the varying blood glucose levels over time for five different patients,* **construct an explanation** *for lactase availability/blood glucose patterns in patients who consume dairy products* based upon patterns in the data and **synthesis from the text**.

Phenomenon within the task
Why do some people suffer from digestive issues after eating dairy, while others do not?

The enzyme lactase breaks down lactose to yield blood glucose. Lactose intolerance may be tested using blood glucose test strips after lactose consumption, which indicate lactose intolerance (low levels of blood glucose) or lactose persistence (high levels of blood glucose). Students need to recognize that lactose intolerant individuals can process some lactose, but not as efficiently as a lactose persistent individual. While the blood glucose test does not directly measure the source of digestive symptoms, they indicate an absence of lactase available to break down the lactose that is then left to be digested by bacteria in the gut (thus producing the uncomfortable gases that are the source of digestive discomfort and the hallmark symptoms of lactose intolerance).

How the phenomenon relates to DCI
LS1.A Structure and Function

- Systems of specialized cells within organisms help them perform the essential functions of life.
- Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.

The feedback mechanism present in this task is the digestion of the sugar lactose by the enzyme lactase. People who lack this enzyme and are unable to completely digest lactose exhibit symptoms due to positive feedback mechanisms.

PS1.B Chemical Reactions

This task is about the role of one particular enzyme, lactase, on the breakdown of the lactose molecule into glucose, whose concentration is then measured in the blood. While not specifically mentioned, students should have a general understanding of chemical reactions.

What information/data will students use within this task?

Students are provided with informational text that explains the role of the enzyme lactase in converting lactose into glucose. From the text, students are expected to acquire an understanding that in a typical patient who consumes lactose/dairy, the enzyme lactase breaks lactose down into glucose. As a result, one's blood-glucose levels should rise after consuming lactose. In a patient who suffers from lactose intolerance, there is a reduction in, or absence of, the conversion of lactose to glucose, and therefore, diminished or no rise in blood-glucose levels.

Students are also provided sample blood glucose test results for five patients in both graph and table format. Students are expected to apply the understanding that blood glucose concentration is the amount of sugar that's been absorbed into the bloodstream, and thus, after drinking milk (or ingesting some form of lactose) blood glucose level is an indicator of the ability to convert lactose to glucose. This understanding is needed in order from them to be able to analyze the data.

Ideas for setting up the task with students

While not explicitly necessary, students should have a working understanding of how enzymes work in the digestive process in order to help in identifying the importance of the relationship between the enzyme lactase and the blood glucose concentrations.

A video describing how enzymes work may be viewed at: https://www.youtube.com/watch?v=UVeoXYJlBtI

A video explaining lactose intolerance may be viewed at: http://www.hhmi.org/biointeractive/making-fittest-got-lactase-co-evolution-genes-and-culture

Intent of the Task for Assessment

The intent of the task is to elicit evidence of student ability to analyze features of models, then identify which model would be most useful to explain the needs of plants. Evidence gathered will include student ability to analyze and compare the features of the given models, as well as their ability to make a claim that is supported with evidence.

Success Criteria

Evidence of Learning Desired based on Progression from Appendices

Analyzing & Interpreting Data

- Analyze and interpret data to provide evidence for phenomena. (MS grade band)

Obtaining, Evaluating, and Communicating Information

- Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the world. (MS grade band)

Constructing Explanations and Designing Solutions

- Apply scientific ideas, principles and/or evidence to provide an explanation of a phenomenon.

Patterns

- Empirical evidence is needed to identify patterns

Success Criteria

- Student explains the relationship between lactase availability and blood glucose levels after ingesting dairy products consistent with the information from the text.
- Student explains the implications of the patterns in the blood glucose data relative to lactose intolerance and lactose persistence for the patients named consistent with the information from the text.

Possible Student Responses

- If blood glucose levels increase after drinking milk, then this means that the enzyme lactase is present. Lactase converts lactose into glucose, which is why glucose levels increase.

- When the blood glucose levels increase, lactase is available to breakdown lactose into glucose. If the concentrations do not, then lactose is not digested as there is no additional sugar measured in the blood. Jazmine is lactose persistent because her blood glucose levels increase within the first 15 minutes of drinking milk. Josef, however, is lactose intolerant because his blood glucose levels remain the same. Taylor had a slight increase in levels after about 30 minutes, but quickly decreased to normal levels. Since his levels were not as high as Jazmine's and Dillon's, this suggests that Taylor is lactose intolerant.

Other information teacher teams might find useful when preparing to use this task in the TCT process

By comparing and contrasting Taylor's data with the other patients' data sets, students should identify some efficacy in Taylor's lactase as a causal factor for his unique trend in blood glucose levels. It is possible students may indicate other reasons for his data (e.g. contaminated sample, faulty test strips, failure to test at appropriate time intervals, etc.); this is fine as long as the students acknowledge a diagnosis of intolerance based upon the data given. A strong argument would include a suggestion to retest.

Teachers may wish to use the resources found in the "Ideas for Setting up the Task" section. These will provide students some background knowledge so that they may better understand the results they are analyzing.

Extensions and/or other uses after the task is implemented

If resources and time permit, students may gain first- hand experience with the enzyme lactase though this lab: http://www.hhmi.org/biointeractive/milk-how-sweet-it. Students could then compare their experimental data with the patients' results, where discussions about experimental design (such as those mentioned above) could be further discussed.

Through Course Task – Got Gas?

Lactose Intolerance

Taylor was so embarrassed! About an hour after chowing down on pizza and a milkshake with a group of friends, his stomach suddenly started rumbling, and he started farting. Then Taylor's stomach began to ache and he had to run to the restroom every few minutes. Taylor didn't know what was happening. He became concerned that he is lactose intolerant.

Background Information

What Is Lactose Intolerance?

Lactose intolerance is the inability to digest a sugar called lactose that is found in milk and dairy products. Normally when a person eats something containing lactose, an enzyme in the small intestine called lactase breaks down lactose into simpler sugar forms called glucose and galactose. These simple sugars are then easily absorbed into the bloodstream and turned into energy — fuel for our bodies. People with lactose intolerance do not produce enough of the lactase enzyme to break down lactose. Instead, undigested lactose sits in the gut and gets broken down by bacteria, causing gas, bloating, stomach cramps and diarrhea.

Lactose intolerance is fairly common. It seems to affect guys and girls equally. Little kids are less likely to have lactose intolerance. But many people eventually become lactose intolerant in adulthood — some while they are still teens. Some health care providers view lactose intolerance as a normal human condition and therefore don't really consider it a disease.

Who Gets Lactose Intolerance?

A person may be or may become lactose intolerant for different reasons:

- Ethnic background. People of Asian, African, Native American and Hispanic backgrounds are more likely to develop lactose intolerance at a young age.
- Other problems with the digestive tract. People who have inflammation of their upper small intestine, such as celiac or Crohn's disease, have a reduced level of the lactase enzyme.
- Medicines. Certain antibiotics can trigger temporary lactose intolerance by interfering with the intestine's ability to produce the lactase enzyme.
- Infection. After a bout of infectious diarrhea, some kids can develop a temporary lactose intolerance that usually improves after a few days or weeks.
- Age. As people get older, their bodies usually stop producing the lactase enzyme, and most people will naturally become lactose intolerant over time.

What Happens When Someone Has It?

People with lactose intolerance may have a variety of symptoms. It all depends on how much dairy or how many milk-containing foods the person eats and how little lactase the body produces.

Usually within 30 minutes to 2 hours after eating, someone with lactose intolerance will experience nausea, stomach cramps, bloating, gas and diarrhea. This can be unpleasant, not to mention embarrassing if you're at school or out with friends.

Because many people may think they're lactose intolerant when they really aren't, it helps to see a doctor who can diagnose the condition correctly and advise you on ways to manage it.

Read the following article related to Living with Lactose Intolerance. Think about how dairy products are a necessary part of our daily nutritional needs and how individuals with lactose intolerance can ensure that they are getting needed calcium.

Lactose usually can be easily managed if you're in tune with your body. Everyone's different, but most people with lactose intolerance can eat a small amount of dairy. The trick is to eat dairy products in combination with other foods that don't contain lactose and not to eat too much dairy at once. It can also help to keep a food diary to learn which foods your body can or can't tolerate.

Dairy foods are the best source of calcium, a mineral that's important for bone growth. Because growing teens need about 1,300 milligrams (mg) of calcium each day, experts recommend that even teens who have lactose intolerance continue to include some dairy in their diet.

Foods like cheese or yogurt may be easier to digest than milk, so try a cup of yogurt for dessert or add a piece of cheese to your sandwich. Lactose-free milk is also a great way to get calcium in your diet without the problems that can come with lactose.

Taking a lactase enzyme supplement might help, too. Taking this before eating foods that contain dairy will help the body digest the lactose sugar in dairy so you don't develop the symptoms of lactose intolerance, like pain, cramping, bloating, gas and diarrhea.

Teens with the most severe symptoms of lactose intolerance might have to avoid all dairy products. It's extra important that these teens find other good calcium sources, so talking to a registered dietitian is a good idea. Dietitians are trained in nutrition and they can help people who are lactose intolerant come up with eating alternatives and develop a well-balanced diet that provides lots of calcium for developing strong bones.

(Full article accessible from http://kidshealth.org/en/teens/lactose-intolerance.html)

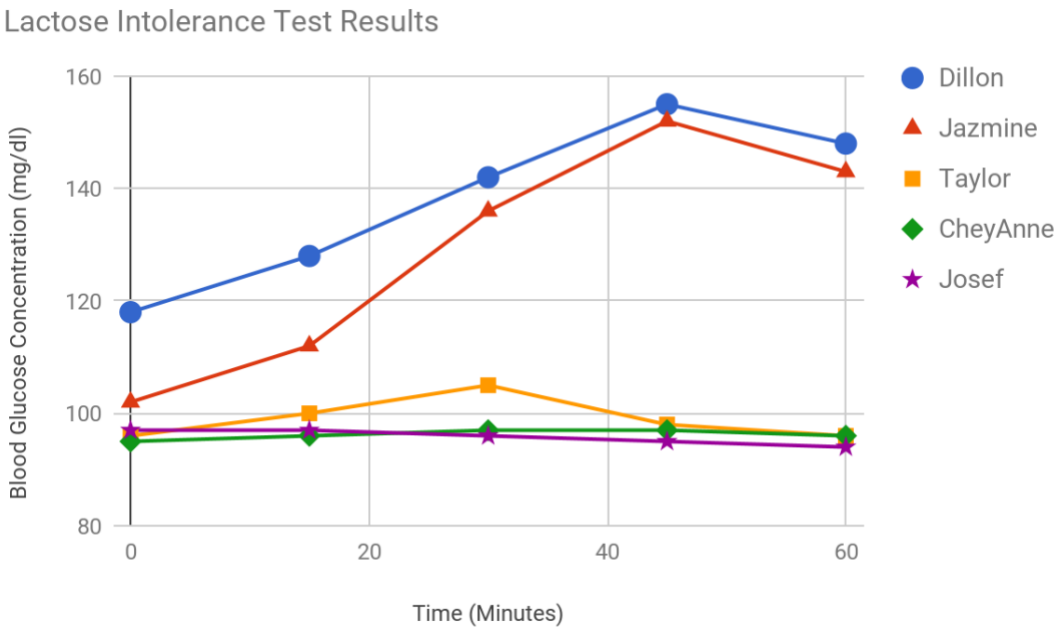
Further Information

Milk contains a sugar called lactose which normally is broken down by an enzyme called lactase into simpler sugar forms of glucose and galactose when ingested. These simple sugars are then released into the bloodstream to be used as energy for our bodies. A person who is lactose persistent has no issues with digesting lactose while an individual with lactose intolerance lacks the enzyme lactase that is necessary to digest lactose.

Some ethnic groups are more likely to be affected than others because their diets traditionally include fewer dairy products. Almost all Asians and Native Americans are lactose intolerant, and up to 80% of African Americans and Hispanic Americans also have symptoms of lactose intolerance. Their ancestors did not eat dairy foods, so their bodies were not prepared to digest dairy, and they passed these genes on from generation to generation.

Test Results

Taylor went to his doctor who tested him for lactose intolerance. The doctor had him drink 50g of milk and then used test strips to check his blood glucose levels, which were measured at 15 minute intervals for one hour. His results are given below alongside data from four other teenaged patients.



Blood Glucose Concentration Readings

	0 min	15 min	30 min	45 min	60 min
Dillon	118	128	142	155	148
Jazmine	102	112	136	152	143
Taylor	96	100	105	98	96
CheyAnne	95	96	97	97	96
Josef	97	97	96	95	94

Task

A. Explain the relationship between lactase availability and blood glucose levels after consumption of dairy products.

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B. Construct an explanation for the glucose patterns seen in Jazmine's, Taylor's and Josef's rates based on possible lactase availability, identifying each as either lactose intolerant or lactose persistent.

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