

TTCD Lesson Plan (29): The Science of Jam

Unit: The Science of Jam	Grade(s): All	Class Size: 1-30	Lesson Duration: 1 hour, 15 minutes	Location(s): Classroom
Topic(s):	Pectin, Sugar, Acidity			
Student Prerequisites:	N/A			
Essential Questions:	What makes jam set? What is pectin? What is the function of pectin in plants and what is its function in jam? How does sugar preserve food?			
Student Objectives:	Students will conduct an experiment to see how jam is made. Students will understand how the components of pectin, sugar, and acid come together to create jam. Students will learn how pectin helps plants strengthen their cell walls.			
Standards:	Supports NGS Standards: 4-LS1-1 From Molecules to Organisms: Structures and Processes Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. Relevant NGS Crosscutting Concepts: <i>Systems and System Models:</i> A system can be described in terms of its components and their interactions. Cultural Standards C.1: Culturally-knowledgeable students are able to actively participate in various cultural environments by: perform[ing] subsistence activities in ways that are appropriate to local cultural traditions.			
Local Context:	Use berries picked from Tyonek with the students during the season, ideally at the beginning of the school year, referencing the TTCD lesson plan on berry picking. Ask: What is your favorite way to eat blueberries? What are the different ways you eat blueberries year-round?			
Vocabulary:	Pectin: water-soluble substances that bind adjacent cell walls in plant tissues and yield a gel which is the basis of fruit jellies. Food preservation: the process of treating food to prevent spoilage and extend its shelf life.			

	Cell wall: The cell wall is the protective, semi-permeable outer layer of a plant cell. A major function of the cell wall is to give the cell strength and structure. Subsistence: the traditional and customary use of wild resources for personal or family use. Scientific Observation: A scientific observation is a sensory experience or recording of data about the natural world. Component: A part of a whole.
Dena'ina language words:	
Materials:	• A two-stove burner or Coleman stove with propane. • Two glass jars for jam. <i>***If using glass jars, remind students that glass can be dangerous. What are some rules we should have in place before we begin? (no running, horseplay, holding jar above head, etc.)</i> • Fruit pectin • 4 lemons • 2 small bags of Sugar • Bread, yogurt, or other base for students to sample the finished jam on. • Paper plates. • A jar of already made jam (just in case!). • Two cutting boards, two knives • Measuring cups • Two wooden spoons • Two small saucepans • Two printed out jam recipes with measurement directions. • Fresh or frozen blueberries (4 cups for 2 classes) • Student's TTCD journal or binder to record observations and predictions • Colored pencils, crayons, writing utensils
Instructor Prep:	Set up Coleman stove/cooking space ahead of time, carefully delineating where it is safe for students to stand during the cooking process.
Introduction:	Hold up a bag of berries and a jar of jam. Ask the class: What's the difference between these two things? Ask, what steps would it take to get from one to the other? On the board, PowerPoint, or chart paper, make a list of the ideas students come up with. Write down sugar, acid, and pectin. Ask students what they think each component does in jam. Sugar: Sugar sweetens jam, it helps it set, and it preserves it by preventing bacterial growth. [For older students: Sugar primarily acts as a preservative by drawing water away from microbes, preventing their growth. Sugar enhances the strength of the gel in jam by attracting some of the water away from the pectin. In the absence of sufficient water, pectin molecules are more likely to unite with each other.]

	Acid: Something that tastes sour. Acid helps balance the sweetness in jam. It also helps the pectin form a gel like consistency For older students: Acid helps to extract the pectin from the fruit during the cooking process. This helps to form a gel. Pectin: Pectin is a naturally occurring substance found in fruits that acts as a gelling agent, giving jam its thick, set consistency. Pectin is found naturally in plants and it performs a similar function in plants as it does in jam, strengthening plant structures and holding them together. For older students: Pectin is a major component of plant cell walls, where it helps cells stick together and hydrates the walls. A cell wall is a rigid or flexible layer that surrounds some types of cells, providing structure, support, and protection. Explain that today we will be conducting an experiment to learn more about the main components of jam, specifically pectin. A component is one part of a larger whole. We will be making one pot of jam using just the natural pectin found in the blueberries and one pot of jam adding fruit pectin. We will compare and contrast the differences between the two jams. Ask the class: Can everyone write down on a piece of paper or in their TTCD notebook what they predict will be the differences between the jam with added pectin and the jam without added pectin?
Activity	1. Divide students into groups of 2. Distribute one cutting board, one knife, measuring cups, a small saucepan, sugar, lemons, a bag of berries, and a recipe sheet to each group. 2. If helpful, assign each student a role: 1. Sugar measurer. 2. Lemon cutter. 3. Lemon squeezer. 4. Pectin measurer 5. Berry measures 6. Someone to walk over the pot containing all of the ingredients to the teacher. 3. Instruct students to stand around the instructor or instructors while the jam begins to heat up. Remind students which jam has added pectin and which jam does not. Students will observe as the berries mix with the sugar, acid and pectin and become a new consistency. This should take 10-15 minutes. <i>If young students are losing interest, you can instruct them to draw a picture of their favorite ways to eat berries or favorite memories from berry picking.</i> 4. When the jam has finished cooking, instruct students to sit down while you walk around with the two pots. Ask students to observe the two pots and right down in their journals the differences they observe. 5. Cut bread or spoon out yogurt onto plates, giving every student a dollop or spread of each type of jam to enjoy.
Wrap-Up:	<i>Evidence of Learning:</i> After everyone is finished eating, check for understanding by answering the following

	questions as a group: 1. What are the main components of jam? 2. What role does pectin play in jam? What role does pectin play in plants? a. For older students, ask: What is the relationship between acid and pectin? What is the relationship between pectin and sugar? 3. What do you think would happen if plants had no pectin inside of them? - Researchers suggest that without pectin, plants would have difficulty maintaining their shape and could easily break or tear apart.
Lesson Adaptations:	If not heating source is available and you have additional time/are at the school all day, have students conduct the same experiment but make jam in a bag, checking back on the jam hours later to monitor if it has set: Jam in a Bag Classroom Cooking
Extensions:	1. Different fruits have different amounts of pectin in them. For example, apples have a lot of pectin and grapes have less. Blueberries have pectin, although they are relatively low in pectin compared to other fruits. Knowing what you know now after this experiment, if you were to make jam at home, would you add pectin or leave it out? What would be another way to add pectin to blueberry jam without having to add liquid/powdered pectin? 2. Have students write a sentence about their observations in their journal or binder. (In the jam with added pectin, I saw... In the jam without added pectin, I saw...What I predicted initially ended up being...) 3. If younger students draw pictures about their favorite ways to eat berries or favorite berry memories, have students go around at the end of the class and share out their drawing with everyone. 4. For older students, watch this crash course video on plant cells: https://www.youtube.com/watch?v=9UvIqAVCoqY&t=176s
Reflections:	How did it go? What did students understand most/least? What could change about instruction or lesson plan?
Resources Used:	Food Corps Program Guide: Let's Jam How to Make the Best Jam According to Science Mad Food Science: Pectin