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| **Title** | *Changing the Way Food is Viewed* |
| **Introduction** | *Private label products are everywhere within the retail market. Most people throughout the nation buy store-brand items instead of name brand simply to save money while grocery shopping not even realizing that most of the brands are produced within the same plant. The goal for the producer is to create a quality product at a lower cost, which is what happens at Bay Valley Foods in Faison, NC. It is the leading pickle and pepper supplier within the United States as well as the top retail market private label pickle packer. Additionally, they produce a broad range of other shelf stable foods for retail distribution as well as “Food Away From Home” items for use in restaurants.*  *Within this unit, students will be applying mathematical concepts within the eighth grade curriculum to the production and packaging of pickles. The lessons within the unit will address concepts relating to volumes as they relate to real-life experiences within a pickle plant. Students will be deducing volumes of three-dimensional figures and applying these concepts in order to figure out cost analyses within the business.* |
| **Real Science Application** | *At Bay Valley Foods they have Quality Assurance labs established to ensure that food products produced are safe to eat while providing the consumer with the best possible quality product. There are specifications developed by the corporate office’s research and development team, the customer specifications, as well as FDA regulations that have to adhere to. Within this facility quality assurance technicians collect samples from each line every 45 minutes to evaluate the closure seal of the containers, the amount and weight of pickles, volume of brine in comparison to volume of the cucumbers, percentage of defected products, in addition to the amount of sugar, vinegar, salt, pH, and calcium chloride within the sample. The pH level is a critical food safety point that determines whether the food is safe to consume.*  *Also, within the Brine Tank Yard this is where the cucumbers are stored in salt tanks to process until they are needed for production. These tanks are monitored within Quality Assurance labs to ensure that they maintain a certain salometer readings measuring salt content, monitor pH levels, and lactic acid in order to ensure that the fermentation process is progressing properly. They also maintain a wastewater treatment process in which the waste from the plant is pumped into ponds that undergo screening and irrigation processes in order to clean the water before releasing it back into the environment.* |
| **Curriculum Alignment** | Grade 8 Mathematics Common Core Standards  **8.G.9 -** Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems. |
| **Learning Outcomes** | *Participants will solve real-world problems involving volume of cylinders and spheres.*  *Participants will convert between units of capacity.*  *Participants will compute mathematically to solve real-world problems.* |
| **Time Required and Location** | *7-8 days - 60 minute class period to complete all of the activities.*  *1-2 day for Introduction and Activity 1: Capacity of Brine Yard Tanks*  *3-4 days for Activity 2: How many pickles are in the jar?*  *2 days for Activity 3: Case Up* |

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| **Materials Needed** | *Facilitator List*   * *Computer* * *3 different size jars of whole pickles – You may need more depending on class size at least one per group.*   *Participant List*   * *Participant worksheets (1 per participant) – attached* * *1 metric ruler per group of 4-5 students* * *Calculator – 1 per person* |
| **Safety** | *Students will be monitored closely while working with glass jars in order to determine their volume to deter breakage. I would have only one student within the group to be responsible for handling the jar at a time.* |
| **Participant Prior Knowledge** | *Students should be able to measure using a ruler, perform unit conversions, and calculate volume of cylinders, rectangular prisms, and spheres as well as surface area for rectangular prisms.* |
| **Facilitator Preparations** | * *Have groups of 4-5 students established based on ability-group heterogeneously* * *Gather different sizes of pickle jars.* |
| **Activities** | ***Lesson 1 - Capacity of Brine Yard Tanks***  *Engage - Show a video of the operation of a brine yard and pickle plant. (Mount Olive Pickle Company Video Tour -* [www.eagle**video**.com/mp4/**pickles**.htm](http://www.eaglevideo.com/mp4/pickles.htm)) *Provide explanations regarding the use of brine tanks usage and the process in which the cucumbers are tanked for storing in order to process at a later date. For example, when the demand for a certain size of cucumber or product is not needed then they can be stored within the tanks within a solution in order to preserve them for later usage.*  *Explore - Provide students with dimensions of the tanks and necessary unit conversions information since they will have to convert cubic feet to gallons for the brine solution and then gallons to bushels for the amount of cucumbers. Have them discuss in groups ways in which to determine the capacity of the tanks and the contents to fill the tanks of cucumbers within the brine solution. (See Capacity of Brine Yard Tanks attachment)*  *Explain - Groups should report out their findings for whole class discussion before completing the handout. This discussion should probably be informal in order scaffold the learning and establish prior knowledge.*  *Elaborate - Based on explanations, focus on the concept of volume and that the tanks have already been cushioned with a certain amount of brine in order to deter breakage of the cucumbers when they are dumped into the tanks so that needs to be taken into consideration when determining the total capacity within the tank. Students will determine the quantity of brine and cucumbers needed to fill an individual tank, and then determine the amount needed for the entire tank yard. They will then look into the cost associated within the tank storage aspect of the business. (See Capacity of Brine Yard Tanks attachment)*  *Evaluate - Within groups the students will collaborate in order to determine the amount of cucumbers and brine needed within the tanks by determining the volume of the cucumbers and brine needed. (See Capacity of Brine Yard Tanks attachment)*  ***Lesson 2: How many pickles are in the jar?***  *Engage - Have at least 3 different size jars of whole pickles (one per group) for students to estimate the number of pickles within the jar without actually counting them? Provide rulers for measurements. Students should describe their strategy without opening the jar and one person within the group will need to report out to class for discussion. Discuss the answers in terms of the jar size as well as the size of the pickle based on student response. Students may try counting the pickles or use the information concerning serving size on the label. (See How many pickles are in the jar attachment)*  *Explore - With 5 different size jars of whole pickles (one per group) have students brainstorm ideas about how to calculate the space occupied by the pickles within their groups. Provide rulers to use if they decide to use but they still cannot open the jar yet. See if they can determine that they are looking for volume and how to find it. Discuss the shape of pickles in terms of cylinders, spheres, and hemi-spheres and volume formulas of spheres and cylinders.*  *Explain - Have students explain their theory from the exploration activity within their groups and share with the whole class. This discussion should probably be informal in order scaffold the learning and establish prior knowledge. This will hopefully lead into the concept of volume and that if you can determine the volume of one pickle and the jar that you should be able to find out how many pickles will fit into the jar.*  *Elaborate - You want them to determine that they do not need to measure each pickle to find all volumes to combine together but that they could find the volume of jar and one pickle then count the number of pickles to find their total volume for pickles then determine the difference. If the students didn’t generate this idea previously, then you may have to go into the concept that volume measures capacity, which is how much the jar can hold and that the pickles are consuming that space within the jar. (See How many pickles are in the jar attachment)*  *Evaluate - Have each group to determine the volumes for the jars and pickles in order to determine the number of pickles within the jar. Then determine how many pickles are actually in the jar and explain why their results were different. (See How many pickles are in the jar attachment)*  ***Lesson 3 – Case Up***  *Engage - Ask students how they think that pickles jars are packaged for shipping? Allow them to have a whole group discussion of various ways to package the jars of various sizes in 6 or 12 pack cases. Depending on the ability levels within your class you may want to modify this to only 12 pack cases. Lead the discussion with the following questions. “How many rows of jars can there be within the cases?” – 1 row of 6 or 12 jars, 2 rows of 3 or 4 jars, etc. “How do we determine the dimensions of the cases using our jar dimensions?” (See Case Up attachment)*  *Explore - Out of the 5 different sizes of jars allow them to use one of the samples from the previous activity to determine the dimensions of the cases. They need to make to determine which case up design they feel would be the best choice and justify their response.*  *Explain – In groups students will examine the various case designs to determine if the jars will fit within the boxes by their volumes to validate that the box size will work. Once they have determined if the jars fit then they will find the cardboard box cost per case to determine which design is the most cost effective. (See Case Up attachment)*  *Elaborate - Provide students with an order of pickle jars in which they need to determine the most cost effective way to package the jars within their designs. They will need to apply the cost per box and number of cases needed to find the total cost of the box order. Once they have completed for each design. (See Case Up attachment)*  *Evaluate - Through the analysis of case design the students will determine the cheapest box design and then determine the final price for an entire order for the customer based on the various expenses related to the order, including the pickled products, overhead costs, and materials. (See Case Up attachment)* |
| **Assessment** | *Knowledge of mathematical concepts will be assessed by informal assessments (listening to whole class discussion and facilitation of group collaboration) and by completion of lesson activities (to be attached).*  *Activity 1 - Within the groups the students will produce tank capacities based on the amount of cucumbers and brine needed within a tank yard by determining the volume of the cucumbers and brine needed.*  *Activity 2 - Have each group to determine the volumes for the jars and pickles in order to determine the number of pickles within the jar. Then determine how many pickles are actually in the jar and explain why their results were different.*  *Activity 3 – Students are going to examine the costs related to casing up pickle jars and how volume and surface areas affect the box size then determine how to price a pickle order based on material costs.*  *Answer Keys have been attached with reasonable solutions even though the dimensions of pickles and jar with vary. The students worksheets will be collected and graded to determine the students knowledge of the material.* |

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| **Critical Vocabulary** | *Volume – The amount of space that a substance or object occupies, or that is enclosed within a three-dimensional object. (Specifically need volume formulas for cylinders, rectangular prisms, and spheres.)*  *Surface area – The total area of the surface of a three-dimensional object.* |
| **Community Engagement** | *Upon completion of the project, the students could investigate other food production industries within their community. Our county is agriculturally rich, ranging from wineries and other produce farms to large pork and poultry operations. The students can organize an agricultural awareness night. The focus of the event could target food safety and procedures, as well as real-world mathematical and scientific applications implemented within the industry. The students would need to create letters to local agricultural businesses and farms inviting them to the event. The students would also need to create a plan to promote the event within the community in order to encourage attendance for the event.* |
| **Extension Activities** | *Students could replicate the procedures within the Quality and Assurance Labs at Bay Valley Foods within their science class. Grants could be written to purchase the items needed to perform the fermentation process that cucumbers undergo when becoming pickles. The students could test the pH, lactic acid, and salinity levels of various pickle brines solutions.* |
| **Supplemental Information** | *How to Make Pickles Commercially -* [*www.madehow.com/Volume-4/****Pickle****.html*](http://www.madehow.com/Volume-4/Pickle.html)  *Mount Olive Pickle Company Video Tour -* [www.eagle**video**.com/mp4/**pickles**.htm](http://www.eaglevideo.com/mp4/pickles.htm)  *Bay Valley Foods -* [*http://www.bayvalleyfoods.com*](http://www.bayvalleyfoods.com) |
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