



COURSE 1:

Food Production, Nutrition and Health

HOW THE COOKIE CRUMBLES



**food and
nutrition sciences**

PREPARATION FOR TOMORROW





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Project Overview



CONCEPT/DESCRIPTION

- 1** Students describe the chemistry of baking cookies. Students describe the difference between baking and cooking. Students list the criteria for a cookie.
- 2** Students determine the scope/meaning of the project.
- 3** Students describe the ingredients of sugar cookies. Students describe the baking process for sugar cookies.
- 4** Students use ratios and proportions to adjust recipes for varying numbers of servings.
- 5-7** Students list the ingredients in a sugar cookie by food group. Students characterize each food group (chemical make-up, caloric content, form at room temperature, etc.). Students explain the role of each ingredient in the baking process and how the ingredients change during baking.
- 8-9** Students describe how caloric content of foods is determined. Students compare the caloric content of fat to sugars. Students determine sources of error in an experimental procedure.
- 10** Students determine alternative ingredients for their sugar cookies. Students develop a “new” healthier recipe.



CONCEPT/DESCRIPTION

- 11-12** Students define sensory evaluation. Students develop a sensory evaluation protocol.
- 13** Students perform a paired t-test (or appropriate application). Students interpret statistical results and draw conclusions.
- 14** Students use sensory evaluation protocol in a pilot test. Students perform paired t-test (or appropriate application). Students interpret statistical results and draw conclusions.
- 15** Students bake cookies following a recipe. Students demonstrate food and lab safety protocol.
- 16** Students use a sensory evaluation protocol. Students perform a paired t-test. Students interpret statistical results and draw conclusions.
- 17-19** Students analyze data and draw conclusions.
- 20** Students discuss the results of a paired t-test and their implications. Students make decisions based on the analysis of quantitative data.



Key Question of the Day:

What is the science behind baking cookies?

(Each day the key question should be prominently displayed and used to open the lesson.)



Estimated Time

One 50-minute class period



Learning Objectives

As a result of this lesson, students will be able to:

- Describe the chemistry of baking cookies.
- Describe the difference between baking and cooking.
- List criteria for a cookie.



Required Materials

- Weekly Bell-Work journal – [Appendix 1](#) - One per student
- Daily Exit Ticket – [Appendix 2](#) – One per student
- Computer
- Projector
- Video – Cookie Chemistry
- Cookies (any type – remember to consider food allergies, one per student)
- Ingredients to make cookies (e.g., flour, sugar, salt, butter, vanilla, etc.)
 - ✓ **TEACHER TIP!** For the ingredients, feel free to bring in copies of the food labels if it's too expensive or challenging to bring in the actual products.
- Flip chart paper
- Markers
- Index cards



Bell-Work

(Each day the Bell-Work question should be prominently displayed and used to open the lesson)

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- **“What is your favorite kind of cookie? Why?”**

OPENING

*(Designed to **prepare** students for learning. Students are prepared for learning by activating an **overview** of the **upcoming** learning experience, their **prior knowledge**, and the **necessary vocabulary**.)*

- Read the Bell-Work question and solicit responses from the students.
- Possible responses could range from flavors of cookies, like chocolate chip or oatmeal raisin, to types of cookie textures, such as hard and crunchy or soft and chewy.
- Make a list of the responses on a sheet of flip chart paper.
- Explain that, **“We can all agree that cookies are delicious. The amazing cookies you just described aren’t easy to make. There’s a science to baking the perfect cookie, and we’re going to learn more about that today.”**

MIDDLE

*(Designed to provide a **structure** for learning that actively promotes the **comprehension and retention** of knowledge through the use of **engaging strategies** that acknowledge the brain’s limitations of **capacity and processing**.)*

- Ask the class, **“What’s the meaning of the term bake?”**
- Give students about 30 seconds to try and find the answer.
- Ask volunteers to share their responses.
 - › According to Merriam-Webster, bake means “to make food (such as bread or cake) by preparing a dough, batter, etc., and cooking it in an oven using dry heat.”

- Ask the class, **“How is baking different from cooking?”**
- Divide the class into groups and assign each group a method of cooking – frying, roasting, grilling, boiling, steaming, etc.
- Each group will research their method of cooking and list the characteristics and requirements for that method on a sheet of flip chart paper. At the bottom of the page, students should write one sentence explaining why their method of cooking would not be ideal for making cookies.
- Students will hang their flip charts around the room.
- Take about one-two minutes to have a gallery walk so that students can walk around the room and read all of the posters.
- Bring the class back together and debrief the exercise by having a brief discussion about the difference between cooking and baking.
- Explain that, **“Cooking involves all types of techniques – frying, roasting, grilling, boiling, steaming, etc. These techniques use open flames, water, oil, or steam. Baking is different because it uses dry heat to obtain the desired end result.”**
- Transition by giving each student a cookie. Ask them not to eat it.
- Ask the class to examine the cookie and make a list of all of the ingredients they think are in the cookie.
 - ✓ **TEACHER TIP!** Have the cookie ingredients set up somewhere in the room, but keep them hidden so that the students can’t see them. After students share their responses to this question, reveal the ingredients.
- Ask volunteers to share the ingredients on their lists. Capture the responses on a sheet of flip chart paper.
- Reveal the packages and compare the ingredients to the class list to see if the list was accurate.

Cross out ingredients that aren’t needed and add any ingredients that were left off of the list.

- Explain that the main criteria for making cookies are right there in the list of ingredients. Each ingredient has a purpose. The only other items missing would be the oven and the baking sheet.
 - › Students can eat their cookies.
- Transition by showing the video “Cookie Chemistry” (in the “Video” folder) about the chemistry of baking cookies.
- Ask students to make a list of the key terms they hear as they watch the video. These terms will be added to the word wall.
- Once the video is over, have a brief discussion to debrief the main points.
- Students will work with a partner to create a tip card for baking cookies. Using an index card, students will make a list of the key tips to remember about how cookies are made.
 - › Each student will make their own cards, but they can work with a partner to share and recall information from the video.
- Students will use these cards for the duration of the project.

CLOSING

(Designed to promote the **retention of knowledge** through the use of engaging strategies designed to **rehearse and practice skills** for the purpose of **moving knowledge into long-term memory**.)

- Provide each student with the weekly Exit Ticket handout [Appendix 2](#).
- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: **“What characteristics of a cookie make it unhealthy?”**
- Collect the Exit Tickets as students exit the classroom.



Key Question of the Day:

(Project Roll-out)

Do you understand our project?



Estimated Time

One 50-minute class period



Learning Objectives

As a result of this lesson, students will be able to:

- Describe the purpose of the project.
- List the tasks and products related to the project.
- Describe the project in one sentence.



Required Materials

- Computers
- Internet
- All rubrics – [Appendix 13](#), [14](#), [15](#), [16](#) – One per student
- Engagement Scenario and Essential Question – [Appendix 3](#) – One per student
- Project Management Log – [Appendix 4](#) – One per student
- Post-It notes
- Highlighters
- Cookie dough package or label
- Video – Sesame Street Cookie Monster



Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- *“Is the Cookie Monster setting a bad example? Why or why not?”*

OPENING

5 minutes

- Prompt students with the concern many parents have voiced about the cookie monster as a character on a children’s TV program.
- Read the Bell-Work question and solicit responses from the students.
- Explain that, *“Many parents have voiced their concerns about the Cookie Monster, a character on a popular children’s TV program.”*
- Show the video about the Cookie Monster (in the “Video” folder).
- After the video (about 2 minutes) give students an opportunity to explain their responses to the situation of the angry parents.
- Use these responses to segue to the cookie ingredients and responses to the “unhealthy cookie” question from the previous day. Share some of the responses from the Exit Tickets that were collected yesterday.
 - › Give students an opportunity to ask questions or voice opinions.
- Transition by saying, “This project is going to take us on the journey of discovering how to make a healthy cookie.”

MIDDLE

40 minutes

- ✓ **TEACHER TIP!** Students will create a portfolio at the end of the project (on the last day) where they will compile the bodies of evidence they have created throughout the project. Remind students to save important artifacts as they complete different tasks throughout the project. Feel free to determine the best way for students to create their portfolios based upon your particular situation (e.g., if your school/district has any specific requirements, etc.).
- Show the cookie dough package to the class.

- Ask students to think back to yesterday’s discussion about the cookie ingredients.
 - › The list of ingredients should still be posted in the room.
- Students should compare the ingredients in the packaged cookie dough to the individual ingredients.
 - › Ask students to determine what is the same and what is different about the ingredients.
- After students share their responses, ask the class which version would be healthier, the prepackaged or the made from scratch.
 - › If they say that the made from scratch cookies seem healthier, ask them to explain why.
 - » *Possible responses may include: packaged cookie dough has extra ingredients that the made from scratch don’t have like additives, etc.*
 - › Then, have them share why they think people would buy the prepackaged cookie dough if it isn’t as healthy.
 - » *Possible responses may include: convenience, they taste better, they come out better compared to homemade, etc.*
- Ask students to turn to their neighbor and discuss the following question, “Why do we need to create a recipe for a healthier cookie?”
 - › This should tie into a brief discussion about health and nutrition.
- Explain that, “We’ve all had sweets, like cookies, that are supposed to be healthy but really don’t taste good at all. The goal of our project will be to beat the odds and create a healthy cookie that tastes great.”
- Provide students with copies of the essential question and project scenario ([Appendix 3](#)).
- Provide students with copies of all rubrics.
- Give each student a Post-It note and a highlighter.
- Students should read the essential question and project scenario.
 - › They should write any questions or reactions to the project on the Post-It note.
 - › They should use the highlighters to highlight any terms or phrases for which they would like more information.
- Students should find a partner and share their Post-It notes and highlighted information with each other to try and answer each other’s questions.
- Bring the class back together. Have a discussion about the project, review the rubrics, and address any questions the students still have.
- Assign project teams. These will be the teams that students work with for the duration of the project.
- Distribute [Appendix 4](#) and have students set up their project management logs, which they will use to document tasks throughout the project.
- Have each team create a name and design a logo/graphic that represents their team. The logo should incorporate their team name and any components of the project they wish to emphasize.
- Teams should share their logos and post them around the room.
 - › If time permits, have a gallery walk so that students can see each other’s logos.

CLOSING

5 minutes

- Provide each student with the weekly Exit Ticket handout [Appendix 2](#).
- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: **“Summarize the project in one sentence.”**
- Collect the Exit Ticket for the day as students leave the classroom.



Key Question of the Day:

How do we make sugar cookies?



Estimated Time

One 50-minute class period



Learning Objectives

As a result of this lesson, students will be able to:

- Describe the ingredients of sugar cookies.
- Describe the baking process for sugar cookies.



Required Materials

- Computers
- Internet
- Cook books



Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- ***“List three key points to remember for conducting reliable research.”***

OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Lead a quick discussion to review how to conduct reliable research and the importance of documenting sources of information.
- Explain that, ***“Our goal today will be to research and select a standard sugar cookie recipe. Keep your notes in your research journal. These notes will form the basis for the research report that each team will write and submit at the end of the project.”***

MIDDLE

40 minutes

- Share Research Journal guidelines:
 - › Date each entry
 - › Take clear notes
 - › Cite references in detail
- Share research report format with the students:
 - › Title Page. Identify the group members, project, dates and timeframe – “How to Bake Healthier Sugar Cookies That are Still Palatable”
 - › Summary or Abstract (Executive Summary)
 - › Nomenclature. Students need to list and define all terms and measurements used in the report.
 - › Introduction. This should include the entire project description.
 - › Theory and Analysis – Why did we do this? Why is this a significant problem?
 - › Experimental Procedures – Sensory Evaluation Design/t-test
 - › Results and Discussion – Data analysis and sources of error. How would you improve the process?
 - › Conclusions and Recommendations
 - › Acknowledgments
 - › Literature Cited
 - › Appendix

- ✓ **TEACHER TIP!** Be sure to remind students that as they are finding information to add to their research journals, they should be dating each entry, taking clear notes, and citing all references in detail.
- Working with their teams, students will use the Internet and cookbooks in the classroom to find a recipe for sugar cookies that makes about a dozen cookies. Students should note all details – ingredients, amounts, temperatures, times, number of cookies, etc.
 - › This should take about 25 minutes (or less).
- All students in the team should agree on one recipe, but they'll all document the information independently in each of their research journals.
 - ✓ **TEACHER TIP!** Make clear that for the original recipe that students can find/bring their own - if they have a family favorite, or they find one online or in a cookbook, they can use that. It will give a little more ownership for the original recipe cookie.
- Remind them to include the source for where the recipe was found.
- Students should write a couple of sentences to explain why this was the selected recipe.
- Once each team is finished, transition by providing each team with a problem:
 - › Part of a recipe calls for $\frac{1}{4}$ cup warm water, $1\frac{1}{2}$ cups lukewarm milk, 1 tsp of salt, and $\frac{1}{3}$ cup shortening. This recipe prepares enough for 18 portions. How much should the amount of each ingredient be changed if we prepared enough for 36 portions? How much should the amount of each ingredient be changed if we prepared enough for 27 portions? Show work and explain why you did what you did.
 - › Students will turn this prior to leaving.
 - ✓ **TEACHER TIP!** This will be the ratio pre-test to assess the level where students are with this type of math. Use this to gauge how to proceed with teaching the math portion of the project.

CLOSING

5 minutes

- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: ***“What aspect of baking the cookies are you most excited about? Why?”***
- Collect the Exit Ticket for the day as students leave the classroom.



Key Question of the Day:

How do we adapt recipes for varying numbers of servings?



Estimated Time

One 50-minute class period



Learning Objectives

As a result of this lesson, students will be able to:

- Use ratio and proportion to adjust recipes for varying numbers of servings.



Required Materials

- Recipe – [Appendix 5](#) – One per student



Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- *“How many cookies does your recipe make? What would you have to do to double the number of cookies the recipe makes?”*

OPENING

10 minutes

- Read the Bell-Work question and solicit responses from the students.
- Use this opportunity to answer any questions and to review how to calculate ratios.
- Return problems from previous day with any notes or comments.
- Allow students to review these notes and their work. Students should correct any mistakes they made.
- Students should meet with their team to discuss.
- Have a volunteer from each team share their strategies for solving the math problem.

MIDDLE

35 minutes

- Explain that, *“This type of problem is termed a ratio and proportion problem. When two ratios are equal, the expression becomes a ratio and proportion. When changing the recipes, we want the ratios of ingredients to be the same, but the amounts will change.”*
- Share this example:
 - › If one recipe serves 12 people, then we must add ingredients in order to serve 24 people. However, the ratio (the relationships among ingredients) of ingredients must stay the same, otherwise the flavor will change.
- Walk the class through this example:
 - › If a class has 30 students and 30 desks, the ratio of students to desks is 30/30. This expression could be reduced to 1/1 (this could also be written 1:1 or 1 to 1).

- › If we add ten students to the class, then we must add desks in the same ratio, 1:1. A way to approach the problem is to set up the two ratios as equal, since we want the ratios to remain the same.
- › 30 students/30 desks = 40 students/ x desks
- › Since the ratios are equal, if we cross multiply, those products will be equal.

$$\frac{30 \text{ Students}}{30 \text{ Desks}} = \frac{40 \text{ Students}}{x \text{ Desks}}$$

$\frac{30 \text{ Students}}{30 \text{ Desks}} \times \frac{40 \text{ Students}}{x \text{ Desks}}$
Cross Multiply

30 students x "x" desks = 40 students x 30 desks

$$x \text{ desks} = \frac{40 \text{ students} \times 30 \text{ desks}}{30 \text{ students}}$$

$$x \text{ desks} = \frac{120 \text{ desks}}{30} = 40 \text{ desks}$$

Thus $\frac{30 \text{ students}}{30 \text{ desks}} = \frac{40 \text{ students}}{40 \text{ desks}}$

- Practice together as a class by working the first problem for the class (on board or projected):
 - › 90 grams butter/18 portions = x grams/ 36 portions
 - › 3 grams/18 portions = x grams/36 portions
 - › 15 mL/18 portions = x mL/36 portions
- Provide opportunities for questions and discussion.
 - ✓ **TEACHER TIP!** Have students practice calculating the ratios with the recipes they found earlier within their teams.
 - › Have at least one team share their work.
 - › Provide time for questions or discussion.
- Explain that, ***“When we adjust recipes for baking, we use the simple ratio method you’ve already used to adjust the amount of flour in the recipe but we adjust all of the other ingredients based on their relationship with the flour. Once we’ve adjusted the flour to double a recipe, we have to adjust all of the other ingredients using the ratio***

$$\frac{\text{Original amount ingredient}}{\text{Original amount flour}} \times \frac{x}{\text{New amount flour}}$$

and solve for x where x = the new amount of the ingredient. Cross multiply

$$\frac{\text{original recipe butter}}{\text{original recipe flour}} \times \frac{x}{\text{twice the original recipe flour}}$$

and solve for x where x = the amount of butter in the scaled up recipe.”

- Distribute a clean copy of the original recipe ([Appendix 5](#)) to each student.
- Students will go through the recipe for the original cookie and calculate the amount of each ingredient needed for the new recipe using the ratio method.
- Assign some students different amounts of cookies to make so that you have several examples to work through on the board when students finish.
- Monitor progress and address issues as they arise.
- Have students post a few on the board when they finish and check them as a class.

CLOSING

5 minutes

- Provide each student with the weekly Exit Ticket handout [Appendix 2](#).
- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: ***“Why would a cook or baker need to know how to adjust recipes? How do you think these skills will help in our project?”***
- Collect the Exit Ticket for the day as students leave the classroom.



Key Question of the Day:

Why do sugar cookies have the ingredients they have?



Estimated Time

One 50-minute class period



Learning Objectives

As a result of this lesson, students will be able to:

- List the ingredients in a sugar cookie by food group.
- Characterize each food group (chemical make-up, caloric content, form at room temperature, etc.)
- Explain the role of each ingredient in the baking process.
- Explain how the ingredients change during baking.



Required Materials

- Internet
- Computers
- Flip charts
- Markers
- Purpose of Ingredients – [Appendix 6](#) – One per student



Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- **“What role do ingredients play in a recipe?”**

OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Possible responses may include:
 - › To make the food taste good
 - › To give it a specific texture or flavor
 - › To make it nutritious
- Explain that, **“To help us determine what we can change about our cookie recipes to make them healthier, we are going to investigate the ingredients of sugar cookies, what these ingredients provide, and how they change during the baking process.”**

MIDDLE

40 minutes

- Ask the class to, **“Think back to the video we watched about the science of baking. You probably recall the video discussing the importance of the chemical reactions that occur during the baking process. Well, without heat and water, those reactions won’t happen and you’ll be left with a pile of dough. The ratios of ingredients play a role in this too, because if you add too much or too little of certain ingredients, you won’t get the desired result, meaning the cookie may not have the right flavor or texture consistency. Let’s start by examining the scientific role of ingredients in baking.”**
- Divide the class into the following teams:
 - › Strengthens or Toughens
 - › Weakens or Tenderizes
 - › Moistens
 - › Dries
 - › Leavens

- On a sheet of flip chart paper, create a master matrix template that looks like this (add additional spaces since there will be more than 3 ingredients):

INGREDIENT	STRENGTHENS OR TOUGHENS	WEAKENS OR TENDERIZES	MOISTENS	DRIES	LEAVENS

- Each team will research their ingredient role and when they find the answers, they will come to the master matrix, list the ingredient and place an “X” in the column for the role, like in this example:

INGREDIENT	STRENGTHENS OR TOUGHENS	WEAKENS OR TENDERIZES	MOISTENS	DRIES	LEAVENS
Eggs	X				

- Some ingredients will have more than one role, like eggs (which also weakens or tenderizes, moistens, and leavens), and the students will hopefully find this information to be able to complete the matrix.

✓ **TEACHER TIP!** See a complete list in [Appendix 6](#) so that you can help fill in any blanks if students don’t find all of the answers.

- Once the table is complete, bring the class together and have a brief discussion about the findings and what the information means in terms of baking cookies.
- Fill in any missing information on the table that the students didn’t find.
- Ask the class, **“So, why do recipes call for specific ingredients in specific amounts?”**
 - Ask volunteers to share their responses.
- Next, ask the class, **“What happens to these ingredients during the baking process?”**

- Each team should research the ingredients that they found for their category on the matrix. So, for example, if the category is “Strengthens or Toughens” and eggs and flour are under that category, those are the ingredients they should research.
- Give each team a clean sheet of flip chart paper and a marker. Teams will document their responses on the flip charts and hang them in the room near the matrix poster.
- Once everyone has found the answers, bring the class together and have a volunteer from each team share their findings.
- Explain that the class will be using this information to help with tomorrow’s tasks.

CLOSING

5 minutes

- Provide each student with the weekly Exit Ticket handout [Appendix 2](#).
- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: **“List two new facts you learned about the role of ingredients in a recipe.”**
- Collect the Exit Ticket for the day as students leave the classroom.



Key Question of the Day:

(Continuation of Day 5)

Why do sugar cookies have the ingredients they have?



Estimated Time

One 50-minute class period



Learning Objectives

As a result of this lesson, students will be able to:

- List the ingredients in a sugar cookie by food group.
- Characterize each food group (chemical make-up, caloric content, form at room temperature, etc.)
- Explain the role of each ingredient in the baking process.
- Explain how the ingredients change during baking.



Required Materials

- Internet
- Computers
- PowerPoint (or other presentation software)
- Flip charts
- Markers



Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- ***“What is the nutritional role of the ingredients in your cookie recipe?”***

OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Explain that, ***“Now that we know the scientific role of each ingredient, we’re going to explore the nutritional role of the ingredients.”***

MIDDLE

40 minutes

- The task for each team will be to use their identified sugar cookie recipe to determine the following:
 - › The food groups involved in the recipe
 - › Relative caloric content (Cal/gram)
 - › Nutritional facts about each food group and the pros/cons of the ingredients
 - › Percentages of each food group in the recipe
 - › Purpose of each ingredient (use the information found the previous day)
 - › Changes that occur in each ingredient during the baking process (use the information found the previous day)
- Remember, our ultimate goal to make a healthier sugar cookie, so the goal it to understand why they are made like they are.
- Students will document this information in their research journals.
- Students should work in their project teams to locate, arrange, and analyze the information.
 - › In their teams, students can determine how to divide the tasks.
- After completing the research students will organize the data/information into a presentation to share with the other teams.
 - › Students may use a PowerPoint format (or some other electronic format that’s compatible with the available technology) or posters.
 - › Limit your sharing presentation to no longer than 5 minutes.

- The goal of team sharing is to ensure that research was complete and to ensure that all information is accurate. In a positive research institution, the culture is both sharing and competitive.

✓ **TEACHER TIP!** Remind students that if they have found any information on recipe substitutes through their research, they shouldn't share that information with the class since that will come up later in the project and should be kept confidential.

CLOSING

5 minutes

- Provide each student with the weekly Exit Ticket handout [Appendix 2](#).
- Students will turn in their Exit Ticket for that day. They will respond to the following prompt:
“What is the healthiest ingredient in your cookie? The least healthy? Why?”
- Collect the Exit Ticket for the day as students leave the classroom.



Key Question of the Day:

(Continuation of Day 6)

Why do sugar cookies have the ingredients they have?



Estimated Time

One 50-minute class period



Learning Objectives

As a result of this lesson, students will be able to:

- List the ingredients in a sugar cookie by food group.
- Characterize each food group (chemical make-up, caloric content, form at room temperature, etc.)
- Explain the role of each ingredient in the baking process.
- Explain how the ingredients change during baking.



Required Materials

- Internet
- Computers
- PowerPoint (or other presentation software)
- Flip charts
- Markers
- Cookie Ingredients
- Presentation Rubric – [Appendix 7](#) – One per team



Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- **“What are the characteristics of an engaging presentation?”**

OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Review the characteristics of an engaging presentation.
- Use this opportunity to also review the characteristics of a good audience.

MIDDLE

40 minutes

- Give the class a bit of time to meet with their teams and add any finishing touches to their presentations.
- Each team will give their presentations.
- During the presentations, students in the audience should take notes in their research journals.
- Feel free to use the rubric ([Appendix 7](#)) to score the presentations.
- Debrief the presentations by having a discussion with the class to review the importance of the cookie ingredients.

CLOSING

5 minutes

- Provide each student with the weekly Exit Ticket handout [Appendix 2](#).
- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: **“What is the most interesting fact you learned about the cookie ingredients?”**
- Collect the Exit Ticket for the day as students leave the classroom.



Key Question of the Day:

Which contains more calories – fats or sugars?



Estimated Time

Three 50-minute class periods



Learning Objectives

As a result of this lesson, students will be able to:

- Describe how caloric content of foods is determined.
- Compare the caloric content of fat to sugars.
- Determine sources of error in an experimental procedure.



Required Materials

- Calorie Lab – [Appendix 8](#) – One per student
- Lab materials for each team:
 - › Peanuts
 - › Sugar candy or sugar cube (marshmallows work well too)
 - › Water
 - › Test tube
 - › Clamp
 - › Stand
 - › Paper clip
 - › Electronic balance
 - › Thermometer
 - › Bunsen burner (if you don't have a Bunsen burner, matches or a lighter will work)



Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- *“What are calories? Why should we pay attention to the number of calories we consume?”*

OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- A calorie is a unit of energy in food.
- Explain that, *“Today we will investigate the caloric content of fats and sugars in order to gauge why both can be a concern in our diets.”*

MIDDLE

40 minutes

- Use [Appendix 8](#) as a handout for the activity.
- If lab safety has not been addressed in previous activities, this would be a good time to review key safety rules.
- Review the activity with the students indicating that their procedure must be approved and that they have two days to complete the lab procedure and complete their report.
- The key question students will be answering in the lab is, *“Which contains more calories, fat or sugar (carbohydrates)? How much energy is stored in a peanut and in sugar?”*
- Once the students are in their teams, give them time to review the “Discussion” section of [Appendix 8](#). Then, bring the class back together and quickly discuss the key points.
- Have the lab materials out and ready for students to bring back to their tables.
- Review the instructions on [Appendix 8](#).
- Ensure that students have time to put away their materials before the end of class.

CLOSING

5 minutes

- Provide each student with the weekly Exit Ticket handout [Appendix 2](#).
- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: ***“What do you have left to do for the lab? What data do you still need to collect?”***
- Collect the Exit Ticket for the day as students leave the classroom.



Key Question of the Day:

(Continuation of Day 8)

Which contains more calories – fats or sugars?



Estimated Time

One 50-minute class period



Learning Objectives

As a result of this lesson, students will be able to:

- Describe how caloric content of foods is determined.
- Compare the caloric content of fat to sugars.
- Determine sources of error in an experimental procedure.



Required Materials

- Calorie Lab – [Appendix 8](#) – One per student
- Lab materials for each team:
 - › Peanuts
 - › Sugar candy or sugar cube (marshmallows work well too)
 - › Water
 - › Test tube
 - › Clamp
 - › Stand
 - › Paper clip
 - › Electronic balance
 - › Thermometer
 - › Bunsen burner (if you don't have a Bunsen burner, matches or a lighter will work)



Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- *“How do we know how many calories are in food?”*

OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Conduct a quick status check and remind students of time limitations.

MIDDLE

40 minutes

40 minutes

- Give students the rest of the class period to finish their experiments and data collection.
- Once the labs are finished, students should put their supplies away and focus on the write-up of the research report.
- Debrief the lab by bringing the class together and have each team share a 30-second summary of their research design and findings.

CLOSING

5 minutes

- Provide each student with the weekly Exit Ticket handout [Appendix 2](#).
- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: *“What have you learned about nutrients in food, such as fat and sugar?”*
- Collect the Exit Ticket for the day as students leave the classroom.



Key Question of the Day:

How can we make our cookies healthier?



Estimated Time

One 50-minute class period



Learning Objectives

As a result of this lesson, students will be able to:

- Determine alternative ingredients for their sugar cookies.
- Develop a “new” healthier recipe.



Required Materials

- Internet access
- Computers



Bell-Work

- Provide students with the weekly Bell-Work sheet (Appendix 1)
- “How can you make a healthier sugar cookie?”

OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Possible responses may include:
 - › Substitute an ingredient such as butter, change white flour to wheat flour, etc.
 - › Add something “healthy” like dried fruit or nuts
 - › Substitute oil for applesauce or mashed banana
- **“Today, our goal is to find a way to change your cookie recipe to make it healthier.”**

MIDDLE

40 minutes

- ✓ **TEACHER TIP!** Their key here is that we are asking students to “change” the recipe. This means they have the freedom to substitute ingredients, add ingredients, or even take out ingredients (which wouldn’t be recommended). But, based upon the research that has been done to this point, students should have a solid understanding of the role of cookie ingredients and why they are used, so that information should help in their research specifically for ingredients to substitute, like substituting applesauce for oil. While students are working on their research, walk around the room to see if they need any help making the connections between what they’ve learned and the goal for today. A simple conversation can help steer them through this thought process without you specifically giving all of the information away.
- ✓ **TEACHER TIP!** Providing a budget to the students, or limitations on the ingredients list, is perfectly acceptable. Suggestions for this may include: must be available at the local grocery store, recipe must be under \$25, each ingredient must cost less than \$5, etc.

✓ **TEACHER TIP!** When baking day arrives, feel free to expand to allow for multiple trials (see Teacher Tip! On day 15). It's up to you if you want to put restrictions on the # of ingredients that the students are allowed to change in each "trial" recipe. Ex: groups can change 1 ingredient per trial, or up to 3 ingredients per trial, etc. Advantages to that are less time spent, less chance for massive failure and lower cost of ingredients, but the disadvantages can include less exploration, less data from sensory evaluations, and healthier cookies that are very similar to each other even with multiple groups.

» *Another way to handle this could be "assigning" each group of students to change one particular type of ingredient. Draw from a hat or randomly assign: Group A changes the sugar/sweetener, Group B changes the flour, Group C changes the oil/butter, etc.*

✓ **TEACHER TIP!** Make clear that for the original recipe that students can find/bring their own - if they have a family favorite, or they find one online or in a cookbook, they can use that. It will give a little more ownership for the original recipe cookie.

- Students can make more than one change to the recipe. However, for each change they make, they need to research the nutritional value of the changed ingredient and explain why their team decided to make that change. If they are adding an ingredient, they must include how much of the ingredient is being added. For example, if they decide to add raisings, how many raisins (e.g., 1 tablespoon, ½ cup, etc.).
 - › This could be done in a table format if it's easier to organize the information.
- All of this data should be recorded in their research journals.
- By the end of the class period, each team should have a healthier cookie recipe.

CLOSING

5 minutes

- Provide each student with the weekly Exit Ticket handout [Appendix 2](#).
- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: **"How did you change your recipe and why?"**
- Collect the Exit Ticket for the day as students leave the classroom.



Key Question of the Day:

What is a sensory evaluation?



Estimated Time

One 50-minute class period



Learning Objectives

As a result of this lesson, students will be able to:

- Define sensory evaluation.
- Develop a sensory evaluation protocol.



Required Materials

- Internet access
- Rulers
- Markers
- Flip charts
- Computer with Excel (or other data organization program) for each group
- Food service gloves
- Paper plates – Two per student
- Crackers
- A commercial cookie and its healthy alternative



Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- *“What attributes do you look for in the perfect cookie (e.g., taste, texture, etc.)?”*

OPENING

5 minutes

- ✓ **TEACHER TIP!** Before class, prepare plates for a sensory evaluation. Each student will receive two plates, one labeled “A” (or some other labeling system you’ve devised) the other labeled “B.” Put the alternative cookies on plates labeled “A” and the original recipe on plates labeled “B.” How you label the plates and which goes on each does not matter as long as it is consistent. Be sure to keep track of this so you don’t forget, and keep the answers hidden from the students. The cookies can be any type of variation, regular Oreo’s and reduced fat Oreo’s, for example. Other variations could be fat free, store brand, sugar free, etc. the combination doesn’t matter as long as a control (the name brand original version) is used. The goal is to identify differences in the cookies. For a first-time sensory evaluation, Oreo’s are a great cookie to use because the differences between reduced fat and regular are very easy to detect. The filling in the regular will be a different color and texture from the reduced fat, and the cookies are a noticeably different color.
- Read the Bell-Work question and solicit responses from the students.
- Create a class list of cookie attributes on a sheet of flip chart paper: likes, dislikes, what would make the cookie better? Possible responses may include:
 - › Crunchy
 - › Chewy
 - › Soft
 - › Cake-like
 - › Sweet
- Give each team a sheet of flip chart paper and a marker. Ask students to organize the list into categories.

- Students post their lists around the room and view each other’s posts.
- Explain that, “Depending on the food item, there are specific attributes the food should have in order for it to be palatable and desired by consumers.”
- Share the definition of palatable.
 - › According to Merriam-Webster, palatable means “agreeable to the palate or taste.”
- Explain that, “Today we are going to learn the fundamentals of sensory evaluation, which we’ll use later in the project to evaluate your new cookie recipes.”
- › Taste and Sound – Take a small bite of one cookie. Observe the flavor, texture, and listen for the sound of the cookie as you bite into it and chew it. When you’re done with the first sample, take a bite of a cracker to cleanse your palate. Then, repeat with the second sample.
- › When they are finished with all of these steps, they can eat the cookies.
- As you go through each step of the sensory evaluation, have students write down their reactions at each phase in their research journals.
- After they have tested each sample, ask them to share their thoughts about each stage and the differences they noticed. Then, ask them to share what they think is different about the cookies and reveal the answers.

MIDDLE

40 minutes

- Explain the components of a sensory evaluation.
 - › According to the Institute of Food Technologists, a sensory evaluation is “A scientific discipline used to evoke, measure, analyze, and interpret those responses to products that are perceived by the senses of sight, smell, touch, taste and hearing. In a food company, sensory scientists work closely with product developers to understand what consumers like and why, and if consumers can tell a difference when they change a product (e.g., substitute an ingredient).”
- Give each student the two cookie samples and some crackers.
- Walk students through the steps of conducting a sensory evaluation:
 - › Eyes – Start by looking at the cookies. Compare each cookie. What are the physical differences, if any?
 - › Nose – Smell the cookies. Can you smell any differences? If so, what smells different?
 - › Touch – Touch the cookies. Do they feel different? If it’s an Oreo, for example, touch the cream filling in each cookie. Do they feel different? Break the cookies. Are there differences in the texture?
- Transition by explaining that students just completed a discrimination test, which answers the question, “Which one is different.” This type of test can also be done with three samples, and that would be called a triangle test, where two samples would be the same and one would be different.
- Students will now research different sensory evaluation tools.
 - ✓ **TEACHER TIP!** Other methods of sensory evaluation include (but don’t reveal these to the students, this is just for your information as students conduct their research):
 - › If you are trying to determine how products are different, if they are different, a descriptive analysis test is done. While this test is time consuming, it results in a lot of data. The panelists will use a t-test to determine if means are statistically different. We’ll be learning more about that later.

- › If you are trying to determine the acceptability of a product, if one is preferred over the other, use an affective/hedonic test (also known as consumer acceptance test). This will help developers understand if people like the product, but it may be difficult to get a representative sample.
- Based on their research, students will develop a sensory evaluation instrument to use when they test their own cookies. This instrument must utilize a measurement scale that will provide quantitative (numeric) data that students can analyze.
 - ✓ **TEACHER TIP!** The PowerPoint “Sensory Evaluation” (in the “Additional Resources” folder) is an additional resource to help students through this process. Have students work in their teams to develop the instrument and then create them as Word Documents (or other electronic format that compatible with available technology).
 - ✓ **TEACHER TIP!** Depending upon how long it takes to get through the sensory evaluation, the research part could either start in this class period and carry over to the next day, or it could be introduced and start the next day.
- Directions for developing the instrument:
 - › List all important characteristics of the cookie that you want the participants to evaluate (since each team knows what they’ll be changing about their cookies, this list should be easy to make)
 - › Narrow the list to the 5 most important items
 - › Develop a scale to measure each characteristic from one extreme to another
 - » *For example, chewiness goes from too chewy to too crunchy.*
 - › Draw a 10cm line and place the extremes at either end of the line
 - › Repeat for all characteristics

CLOSING

5 minutes

- Provide each student with the weekly Exit Ticket handout [Appendix 2](#).
- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: **“Why do we conduct sensory evaluations?”**
- Collect the Exit Ticket for the day as students leave the classroom.



Key Question of the Day:

(Continuation of Day 11)
What is a sensory evaluation?



Estimated Time

One 50-minute class period



Learning Objectives

As a result of this lesson, students will be able to:

- Define sensory evaluation.
- Develop a sensory evaluation protocol.



Required Materials

- Internet access
- Rulers
- Markers
- Flip charts
- Computer with Excel (or other data organization program) for each group
- Food service gloves
- Paper plates – two per student
- Crackers
- A commercial cookie and its healthy alternative



Bell-Work

- Provide students with the weekly Bell-Work sheet – [Appendix 1](#)
- “What questions do you have about the research you’re doing on sensory evaluation instruments?”

OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Use this opportunity to answer questions and assess progress.

MIDDLE

40 minutes

- Students will continue their research and development of sensory evaluation tools. After students complete their research and develop an instrument, compile a master file with the instruments from each team.
- Review the instruments as a class, compare similarities and differences, and create one instrument based on the contributions from each team. This final result will be the instrument that’s used for each team to test their cookies.
- By creating a class instrument, there will be some consistency in the results of the sensory evaluations for the different cookies.
 - ✓ **TEACHER TIP!** Keep in mind that when it’s time to bake the cookies and do the sensory evaluations, you’ll have to bake a batch of cookies using the original, unaltered sugar cookie recipe, which will serve as the control. So, participants will be conducting a discrimination test to determine what’s different about the cookies and which one they like better.

CLOSING

5 minutes

- Provide each student with the weekly Exit Ticket handout [Appendix 2](#).
- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: “**How do you know our instrument will give us good data?**”
- Collect the Exit Ticket for the day as students leave the classroom.



Key Question of the Day:

What statistical concepts are needed for analyzing a sensory evaluation?



Estimated Time

One 50-minute class period



Learning Objectives

As a result of this lesson, students will be able to:

- Perform a paired t-test (or appropriate application).
- Interpret statistical results and draw conclusions.



Required Materials

- Math Lesson – [Appendix 9](#) – One per student
- Math Pre-Test – [Appendix 10](#) – One per student
- Traditional Math Problems – [Appendix 11](#) – One per student



Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- **“What are statistics?”**

OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Share the definition of statistics:
 - › According to Merriam-Webster, statistics is “a branch of mathematics dealing with the collection, analysis, interpretation, and presentation of masses of numerical data.”
- Explain that, **“Today, we are going to explore statistical concepts that will help us understand how to analyze the data from our sensory evaluations.”**

MIDDLE

40 minutes

- Give each student a copy of [Appendix 10](#).
- Give students about 10-15 minutes to complete the pre-test.
- Collect the pre-tests and review them while students work on the next exercise ([Appendix 11](#)).
- Students will work in pairs to complete this exercise.
 - › If they work in teams of 4 for their main project teams, they could split into teams of 2 for this exercise.
- Students will have the rest of the class period to complete the exercise.
- If students finish before the end of the class period, bring the class back together for a review discussion.

CLOSING*5 minutes*

- Provide each student with the weekly Exit Ticket handout [Appendix 2](#).
- Students will turn in their Exit Ticket for that day. They will respond to the following prompt:
“What are two new statistics concepts you learned?”
- Collect the Exit Ticket for the day as students leave the classroom.
- Give students [Appendix 10](#) for homework.



Key Question of the Day:

How do we determine which cookies people prefer?



Estimated Time

One 50-minute class period



Learning Objectives

As a result of this lesson, students will be able to:

- Use a sensory evaluation protocol in a pilot test.
- Perform a paired t-test (or appropriate application).
- Interpret statistical results and draw conclusions.



Required Materials

- Rulers
- A computer with Excel for each group
- Food service gloves
- Paper plates – Two per student
- Same cookies as used on the previous day
- Crackers
- Sensory Evaluation Presentation – “Additional Resources” folder



Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- **“Summarize the process of a sensory evaluation?”**

OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Use this opportunity to review the process of conducting a sensory evaluation.
- Explain that, **“Today we will perform a pilot test of our sensory evaluation using the same commercial cookies.”**

MIDDLE

40 minutes

- Take a few minutes to review the homework.
- Answer any questions and review the answers with the class.
- Collect their papers at the end of the review.
- Transition to the Sensory Evaluation Presentation (in the “Additional Resources” folder) and review the key points about creating a hypothesis, data collection, and analysis.
- Distribute the cookies and crackers to the students.
- In their teams, students will conduct the sensory evaluation, collect and analyze the data.
- Each team should write a summary of their findings.
- If time permits, bring the class together and discuss the results of the pilot test.
 - ✓ **TEACHER TIP!** At this point, you should begin planning for the sensory evaluation when the cookies are baked. You’ll need to find a guest to join the sensory evaluation panel. The guest could be a baker or someone from the food industry who would be willing to participate. You’ll also need to determine who will participate

in the panel and where on campus it will take place. One option is to do it during lunch, where faculty and staff could come to the cafeteria to participate. Or, participants can just come to your classroom. Be ready by Day Sixteen.

CLOSING

5 minutes

- Provide each student with the weekly Exit Ticket handout [Appendix 2](#).
- Students will turn in their Exit Ticket for that day. They will respond to the following prompt:
“What will you do differently when you conduct the sensory evaluation again? What changes will you make?”
- Collect the Exit Ticket for the day as students leave the classroom.



Key Question of the Day:

How do we bake cookies?



Estimated Time

One 50-minute class period



Learning Objectives

As a result of this lesson, students will be able to:

- Bake cookies following a recipe.
- Demonstrate food and lab safety protocol.



Required Materials

- Cooking lab/supplies
 - ✓ **TEACHER TIP!** If a cooking lab is not available, cookies could be baked using toaster ovens.
- All cookie ingredients for each team



Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- **“What food safety rules will you follow today?”**

OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Have a discussion about food safety protocol as students are sharing their responses.
- Remind students of the key rules and procedures to follow when working in a kitchen and preparing food.
- Explain that, **“Today, we will be baking our modified cookie recipes along with a batch of the original cookie recipe.”**

MIDDLE

40 minutes

- Use the entire class period for baking the cookies.
 - ✓ **TEACHER TIP!** If you want to allow more days for baking, such as allowing 3 trials to get the “ideal” healthier cookie, then do so. Or allow students to bake at home, if time is tight, if they want to do multiple trials. This does take more time but might allow for more investigation for the students and deeper discussion of what healthier/alternative ingredients will do to the original cookie. Remember: each trial **MUST** have a sensory evaluation!

CLOSING

5 minutes

- Provide each student with the weekly Exit Ticket handout [Appendix 2](#).
- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: **“How do you think your cookies turned out?”**
- Collect the Exit Ticket for the day as students leave the classroom.



Key Question of the Day:

Which cookie do people prefer?



Estimated Time

One 50-minute class period



Learning Objectives

As a result of this lesson, students will be able to:

- Use a sensory evaluation protocol.
- Perform a paired t-test.
- Interpret statistical results and draw conclusions.



Required Materials

- Food service gloves
- Paper plates – Two per student
- Baked cookies – Original recipe and modified recipe
- Guest speaker (Baker or other food industry representative)
- Sensory evaluation instrument – [Appendix 12](#) – One per participant



Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- ***“How will we know if the cookies are different?”***

OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Explain that, ***“Today, is the day the panel will test our cookies!”***

MIDDLE

40 minutes

- As participants come to conduct the sensory evaluation, give them a copy of [Appendix 12](#) to record their data.
- Since there will be a number of cookies to sample depending on the number of teams, as the teacher, you can determine who will sample which cookies. Obviously, there won't be enough for everyone to sample every cookie. They will just need one cookie of the original recipe and one modified cookie.
- Be sure the participants don't have any food allergies.
- As participants finish, collect their handouts.

CLOSING

5 minutes

- Provide each student with the weekly Exit Ticket handout [Appendix 2](#).
- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: ***“Why do we need to collect a lot of data? Why can't we just ask a few people?”***
- Collect the Exit Ticket for the day as students leave the classroom.



Key Question of the Day:

What does our data indicate?



Estimated Time

One 50-minute class period



Learning Objectives

As a result of this lesson, students will be able to:

- Analyze data and draw conclusions.



Required Materials

- Computer
- Spreadsheet (MS Excel or similar program that is available)



Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- “What must be included in your presentation? List the information required.”***

OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Remind students that they are preparing a report and presentation.
- Re-acquaint them with the research report elements and the rubrics for the report and the presentation that were presented earlier in the project.
- Explain that, ***“Today is a time to review your notes, organize your data and begin writing your report.”***

MIDDLE

40 minutes

- Students will have the rest of the class period to work in their teams to develop their research reports and presentations.
- Since all of the records were kept in their research journals, at this point, it will be a matter of compiling and organizing the information into the report format.
- In their teams, students can determine who will work on which parts.
- Visit with each team and answer any questions.

CLOSING

5 minutes

- Provide each student with the weekly Exit Ticket handout [Appendix 2](#).
- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: ***“What does your team still need to accomplish?”***
- Collect the Exit Ticket for the day as students leave the classroom.



Key Question of the Day:

(Continuation of Day 17)
What does our data indicate?



Estimated Time

One 50-minute class period



Learning Objectives

As a result of this lesson, students will be able to:

- Analyze data and draw conclusions.



Required Materials

- Computer
- Spreadsheet (MS Excel or similar program that is available)



Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- “What questions do you have about your research reports?”**

OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Answer any questions students have about their projects.

MIDDLE

40 minutes

- Students will have the rest of the class period to work in their teams to develop their research reports and presentations.
- Continue to visit with the teams to answer any questions.

CLOSING

5 minutes

- Provide each student with the weekly Exit Ticket handout [Appendix 2](#).
- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: **“What does your team still need to accomplish?”**
- Collect the Exit Ticket for the day as students leave the classroom.



Key Question of the Day:

(Continuation of Day 18)
What does our data indicate?



Estimated Time

One 50-minute class period



Learning Objectives

As a result of this lesson, students will be able to:

- Analyze data and draw conclusions.



Required Materials

- Computer
- Spreadsheet (MS Excel or similar program that is available)



Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- “List the objectives for your presentation tomorrow.”***

OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Answer any questions students have about their projects.

MIDDLE

40 minutes

- This is the last day students will have to work in their teams to develop their research reports and presentations.
- Continue to visit with the teams to answer any questions.
- If students need additional time to finish their work, this can be done for homework.

CLOSING

5 minutes

- Provide each student with the weekly Exit Ticket handout [Appendix 2](#).
- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: ***“Are you ready for your presentations?”***
- Collect the Exit Ticket for the day as students leave the classroom.



Key Question of the Day:

Do the healthy alternative cookies taste differently than the original recipe?



Estimated Time

One 50-minute class period



Learning Objectives

As a result of this lesson, students will be able to:

- Discuss the results of a paired t-test and their implications.
- Make decisions based on the analysis of quantitative data.



Required Materials

- Projector
- Computers
- Project Presentation Audience Feedback Form – [Appendix 13](#) – One per student per presentation
- Self-Reflection Form – [Appendix 14](#) – One per student
- Collaboration Rubric – [Appendix 15](#) – One for the teacher
- Project Rubric – [Appendix 16](#) – One per team
- Guest speaker (Bakery reps, parents, faculty, administration, etc.)



Bell-Work

- Provide students with the weekly Bell-Work sheet (Appendix 1)
- *“What are we looking and listening for in your classmates’ presentations today?”*

OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Have students discuss the essential pieces of the presentations to clarify expectations and develop focus.
- After the discussion, allow each group a few minutes to review their presentations and make final edits.
- When you call time, each group must have their presentation to you (emailed or on disk) before the presentations begin (so that students are focused on their classmates’ presentations not their own).
- Welcome guests to the presentation.

MIDDLE

40 minutes

- Each team will deliver their presentations.
- Each student should complete a rubric for each presentation.
- Allow a few minutes for a question answer session following the presentations.
- Students will complete the self-reflection form ([Appendix 14](#)).

- Students collect their evidence for this project and add it to their portfolio with their captions and descriptions for each item.

ITEM	DESCRIPTION

CLOSING

5 minutes

- Provide each student with the weekly Exit Ticket handout [Appendix 2](#).
- Students will turn in their Exit Ticket for that day. They will respond to the following prompt:
“What changes made a healthier cookie that people actually wanted to eat?”
- Collect the Exit Ticket for the day as students leave the classroom.

Daily Bell-Work Journal

MONDAY

DATE _____

TUESDAY

DATE _____

WEDNESDAY

DATE _____

THURSDAY

DATE _____

FRIDAY

DATE _____

Daily Exit Tickets



DAY EXIT TICKET Name: (First, Last) _____
Date: _____ Period: _____
Topic:



Continue your answer on the back if necessary

DAY EXIT TICKET Name: (First, Last) _____
Date: _____ Period: _____
Topic:



Continue your answer on the back if necessary

DAY EXIT TICKET Name: (First, Last) _____
Date: _____ Period: _____
Topic:



Continue your answer on the back if necessary

DAY EXIT TICKET Name: (First, Last) _____
Date: _____ Period: _____
Topic:



Continue your answer on the back if necessary

DAY EXIT TICKET Name: (First, Last) _____
Date: _____ Period: _____
Topic:



Continue your answer on the back if necessary

Essential Question:

Can we bake a healthier sugar cookie that tastes like the original recipe?

Engagement Scenario:

With obesity rates in the United States among the highest in the world, increasing from 13% in 1962 to 35.7% in 2010¹, the head of baking at the _____ Foods Company has decided to offer a new version of the company's best-selling sugar cookie using a healthier recipe. To accomplish this, the company has decided to hold a competition among teams of its bakers to determine which new recipe will be accepted and marketed.

Your team is to develop a new recipe while trying to maintain the desirable qualities of the current popular cookie. You are also responsible for designing a new package for the cookies – one that will help maintain the current sales level of the cookie. Develop a package on which all claims meet FDA standards. You will also design a food label that meets FDA standards.

A very important component of the competition is a sensory evaluation to determine if your new cookie tastes good enough to market. Your team will design and conduct a sensory evaluation as well.

To accomplish your task, you and your team will research the roles different ingredients play in cookie recipes and what can be done to make a cookie healthier. In addition, you will research the regulations regarding food labels and attributes of quality, marketing-friendly packaging. In order to judge the palatability of the new cookie, you will need to research how to design a sensory evaluation and quantify and analyze the results. You will keep your research notes, plans, and sensory test results in a research notebook.

After researching on-line resources and other informational texts on healthier recipes and sensory evaluation, and after participating in enabling activities in class, write a report to the officials of your company that compares the new cookies to the original cookies and argues for the inclusion of the new, healthier cookie in the company's product line. Be sure to support your position with evidence from the texts and results from the sensory evaluation. You will research via the internet and will organize and treat data using an MS Excel spreadsheet with appropriate mathematical procedures. You will investigate how to experimentally determine caloric content of foods and calculate experimental error.

A presentation, based upon your report, will be presented to bakers and marketing officials in a format of your design. You will need to include data from the sensory evaluation and other supporting evidence from your research.

<http://www.reuters.com/news/pictures/slideshow?articleId=USRTXT3DK#a=1> - Reuters.com

Project Management Log: Team Tasks

Project Name _____

Team Members _____

TASK	WHO IS RESPONSIBLE	DUE DATE	STATUS	DONE

Original Sugar Cookies

From *On Cooking: A Textbook of Culinary Fundamentals*

Yield: 24 cookies

Method: cut-out cookie

All-purpose Flour	360g
Baking Powder	10ml
Ground Mace	1ml
Unsalted Butter, Softened	120g
Granulated Sugar	240g
Vanilla Extract	5ml
Egg	1

1. Stir together the flour, baking powder, and mace. Set aside.
2. Cream the butter and sugar until light and fluffy. Blend in the vanilla. Add the egg and beat again until fluffy. Gradually add the flour mixture, beating until well combined.
3. Wrap the dough in plastic wrap and refrigerate until firm, approximately 1-2 hours.
4. Work with half the dough at a time, keeping the remainder refrigerated. On a lightly floured board, roll out the dough to a thickness of approximately 1/8 inch. Cut as desired with cookie cutters and transfer to lightly greased baking sheets.
5. Bake at 325oF until golden brown, approximately 10-12 minutes. Let stand for 1 minute then transfer to wire racks to cool.

Approximate values per cookie: **Calories** 90, **Total fat** 3g, **Saturated fat** 1.5g, **Cholesterol** 15mg, **Sodium** 0g, **Total carbohydrates** 14g, **Protein** 1g.

Purpose of Ingredients

INGREDIENT	STRENGTHENS OR TOUGHENS	WEAKENS OR TENDERIZES	MOISTENS	DRIES	LEAVENS
BUTTER		X			
SHORTENING		X			
COCOA BUTTER		X			
COCOA POWDER				X	
FLOUR	X			X	
STARCHES (POTATO, CORN, TAPIOCA, ETC.)				X	
EGGS	X	X	X		X
SUGAR		X	X		
OIL		X	X		
SYRUPS (MAPLE, CORN, MOLASSES, HONEY, ETC.)		X	X		
DAIRY (LIQUID MILKS, CREAMS, YOGURTS)			X		
DRY MILKS				X	
BAKING SODA					X
BAKING POWDER					X
YEAST					X
AIR					X
WATER			X		X
FLAVORINGS					

Cookie Ingredients Presentation Rubric

Name _____ Date _____ Class Period _____

Total Score _____

CATEGORY	30 POINTS	20 POINTS	UNSATISFACTORY OR NO ATTEMPT MADE (0)
Addressed key concepts in the presentation	All six of the key concepts were addressed in the presentation in.	Four of the six key concepts were addressed in the presentation.	Three or fewer key concepts were addressed in the presentation.
Facts are included and referenced from reliable sources	Ten or more facts are included with citations listed from reliable sources.	Five to nine facts are included with citations listed from reliable sources.	Facts are omitted and/or a majority of sites are not reliable.
Grammar, punctuation and fluidity	Written with fluid tone, correct grammar and punctuation.	Minor grammar or punctuation errors exist in the paper.	There are significant grammar and/or punctuation errors in the paper.
Presentation	Confidently delivers the entire presentation with appropriate visual aids.	Delivers portions of the presentation with incomplete visual aids.	Does not deliver the presentation or create visual aids.

Calorie Lab Activity

Key Question:

Which contains more calories, fat or sugar (carbohydrates)? How much energy is stored in a peanut and in sugar?

Discussion:

Food Calories. The calorie (energy) content of food is of obvious interest. It is known that the metabolism (breakdown, digestion) of food produces carbon dioxide (CO₂). In general, the reaction that occurs in metabolism of food is given by the following (unbalanced) equation:



However, this is the same equation used for the burning (combustion) of a substance. It can be shown that the energy released from metabolism should be equivalent to the energy released from combustion. Again, generally speaking, the more energy stored within our food, the more of it will be converted into fat and stored by the body if we don't "burn" it off.

Measuring calories. In order to determine the heat (caloric) content of a food, scientists simply burn it and measure the amount of heat (calories) given off. The measure is usually given in terms of calories per gram. For example, if 5 grams of a burning food gave off 100 calories it be said to give off 100 calories per 5 grams, or 100 calories/5 grams, or 20 calories/gram.

Scientists conduct this process in a chamber called a bomb calorimeter. (Calorimeter means to measure calories, or heat.) For our purposes, will use a test tube filled with water. The water is used to absorb the heat given off by a burning piece of food, in this case a peanut and a piece of sugar. (Even though the peanut is not pure fat, it is predominantly fat.)

Comparative data. Since we know it takes one calorie of heat to raise the temperature of 1 gram of water 1 degree Celsius, it is easy to determine the amount of heat given off by the peanut. The only problem, since we are not using a bomb calorimeter, is that we will lose some heat. However, if we burn both items in the same manner, we will get good comparison data, not necessarily correct data.

Units of Measurement. A nutritional calorie (Calorie) is the same as 1000 calories (1 kilocalorie) of energy. A calorie is defined as the amount of heat gained or lost when one gram of water changes temperature by 1 C. (This measurement is termed the specific heat, since it is specific to water. Every substance has its own specific heat and this is one way to identify a substance.) The approach we will take will be to burn a peanut underneath a container of water. If the amount of water is known and the change in water temperature is known, the amount of heat gained by the water in calories can be determined.

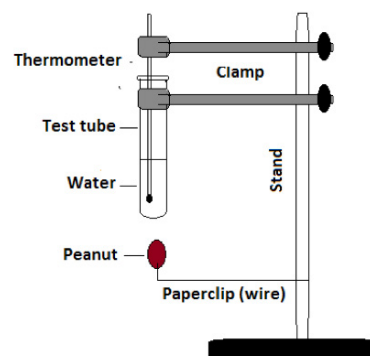
Assumptions:

- All of the heat given off by burning the peanut is absorbed by the water (not really true)
- The water will not lose any heat to its surroundings (not really true)
- Only that part of the peanut that burns will be used to determine calorie content

Set-up/Design:

The flame from the burning peanut must be in contact with test tube. Peanuts, water, test tube, clamp, stand, a paper clip and an electronic balance will be provided. Use the thermometer to measure the temperature of the water before and after heating.

Here is a suggested set-up.



Measurements:

The researcher must know --

- The mass of the peanut and the mass of the water.
- The original and final temperature of the water. “ ΔT ”
- The final mass of the peanut (after cooling).

Data:

Set up a data table to collect your data. Be sure that all pertinent data is collected. If there is a question regarding some data, collect it. It might be useful.

Procedure:

Write up a procedure as to how to collect the data. Keep it brief. The teacher will review it and approve it. (This should go into your research journal along with the data and calculations.)

Calculations:

Remember, we must know how much heat was given off by the portion of the peanut that burned. We assume that all of this heat is absorbed by the water in the test tube.

- Heat gained by the water = “ ΔT ” of H₂O x g H₂O.
- Energy given off by peanut (per g) = Heat gained by water / (initial mass – final mass of the peanut)
- Find the “official” caloric content of a peanut (per g) and calculate your error.

Next Step:

Repeat with sugar. A piece of sugar candy or a sugar cube will work.

Summary/Write-up:

Submit your procedure, data table, and calculations.

Account for your sources of error. How could some of the error have been prevented?

According to your experimental result, which food contains the most calories?

Math Lesson

During this Collaborative Activity, you and your partner will engage in a Card Sort, aimed at identifying and practicing statistical concepts within the context of a Food Sensory Evaluation. Begin by reading the scenario and reviewing the sample data provided. As necessary, research math textbooks and/or websites to re-familiarize yourselves with the statistics concepts necessary for completing this activity.

Card Set A: Statistics Concept

Card Set B: Definition or Explanation of Statistics Concept

Card Set C: Application within Scenario Context

Scenario:

Thirty students at Elmwood Elementary school recently participated in a food sensory survey given by the school district's nutrition program. They were provided with samples of both a popular chocolate sandwich cookie and a low-fat version of the same. The students were asked to rate each of the sample cookies using "overall taste" as the descriptive criteria.

Each participating student provided his/her ranking of each of the cookies on a form similar to the one shown here:

COOKIE A OR COOKIE B									
Disliked Taste Very Much			Liked Taste Very Much						
1	2	3	4	5	6	7	8	9	10
Student #	Cookie A	Cookie B	Student #	Cookie A	Cookie B	Student #	Cookie A	Cookie B	Student #
1	7	6	16	7	7	17	8	9	18
2	6	6	19	8	5	20	7	6	21
3	3	5	22	10	6	23	8	5	24
4	4	1	25	8	5	26	7	6	27
5	9	8	28	5	3	29	8	8	30
6	7	4		8	8		9	6	
7	10	10		7	6		10	8	
8	9	6		6	5		8	9	
9	5	7		9	8		5	6	
10	6	6		5	5		8	9	
11	8	9		8	8		5	6	
12	9	6		8	9		10	8	
13	10	9		5	6		4	5	
14	9	9		10	8				
15	8	7		4	5				


CARD SET A

Null Hypothesis	Alternate Hypothesis	Mean
Standard Deviation	T-Test	P-value
Inferential Statistics	Normal Curve	Sample
Population	Confidence Interval	Mean Difference

CARD SET B

<p>Typically corresponds to a general or default position. For example, it might state that there is no relationship between two measured phenomena or that a potential treatment has no effect.</p>	<p>In statistical hypothesis testing, this and the null hypothesis are the two rival hypotheses which are compared by a statistical hypothesis test.</p>	<p>The sum of all the values in a set divided by the number of values in the set. It is a measure of central tendency for the set of data.</p>
<p>A number that indicates the spread or variability in a set of data.</p>	<p>A statistical test involving means of normal populations with unknown standard deviations; small samples are used, based on a variable t equal to the difference between the mean of the sample and the mean of the population divided by a result obtained by dividing the standard deviation of the sample by the square root of the number of individuals in the sample.</p>	<p>The probability of obtaining a test statistic at least as extreme as the one that was actually observed, assuming that the null hypothesis is true. One often "rejects the null hypothesis" when this value is less than the significance level which is often 0.05 or 0.01.</p>
<p>The treatment of a small sample of data that allows one to infer or draw conclusions about a total population from which the sample is taken.</p>	<p>The graph of a frequency distribution for a set of ideal data. Most of the values in the set cluster around the midpoint. The curve is symmetric about its central value and has the shape of a bell: it's often referred to as a bell-shaped curve.</p>	<p>A group of people or objects selected from a population. You can make predictions or draw conclusions about the entire population based on this selected data.</p>
<p>A complete set of people or things being studied.</p>	<p>An interval about the sample mean in which you can be $p\%$ confident that the population mean lies.</p>	<p>The average of the differences found among the responses by each subject in the sample.</p>

CARD SET C

<p>There is no difference in overall taste between the popular chocolate sandwich cookie and the low-fat version of the same cookie.</p>	<p>There is a difference in overall taste between the popular chocolate sandwich cookie and the low-fat version of the same cookie.</p>	<p>Cookie A: $\bar{X} = 7.3$</p> <p>Cookie B: $\bar{X} = 6.6$</p>
<p>Cookie A: $\sigma = 1.9$</p> <p>Cookie B: $\sigma = 2.0$</p>	<p>T = mean difference divided by the (standard deviation of difference / square root of 30 the number of samples)</p> <p>T = 2.39</p>	
<p>Using the data obtained from the 30 students at Elmwood Elementary to draw conclusions about the taste preferences of all students in the entire school.</p>		<p>The 30 students selected to participate in the sensory test.</p>
<p>All of the students in the entire school.</p>	<p>Tells you the significance of the difference between the two cookies. Usually this value is benchmarked at either 0.05 or 0.01.</p>	<p>Cookie A – Cookie B</p> <p>$\bar{X} = 0.7$</p>

Mathematics Pre-Lesson Assessment

Scenario:

In response to public outcry for healthier cookie options, Scrumptious Cookie Company has created a healthier version of its signature cookie, “The Crumbler.” As a sensory specialist, you have been contracted to design and conduct a test to determine if consumers detect a significant difference in the original vs. the healthier version of “The Crumbler” or have a preference for one cookie versus the other. You decide to conduct a sensory evaluation using as your subjects, 50 students from a local high school.

Based on the scenario above, answer the following questions:

1. State a possible null hypothesis for the sensory evaluation above.

2. State a possible alternate hypothesis for the sensory evaluation above.

The principal offers you the following locations within the school to conduct your sensory evaluation:

- a. The cafeteria area next to the kitchen where the cooks are preparing the daily lunch.
- b. The commons area of the school where random amounts of people flow through at any given time.
- c. A quiet area in the Media Center with limited traffic.

Which of the three locations above would you select and why? (Explain why the other two locations would be less suitable.)

Given the following results of a Food Sensory Evaluation, answer the statistics questions that follow:

Participant #	Cookie A	Cookie B	Participant #	Cookie A	Cookie B
1	3	6	6	7	7
2	6	5	7	9	7
3	5	4	8	8	6
4	3	4	9	5	7
5	8	9	10	6	9

1. What is the mean difference between the two cookies? Show how you arrived at your answer.

2. What is the standard deviation of the differences between the two cookies? Show how you arrived at your answer.

3. Would a paired t-test be an appropriate statistical measure for use in this scenario? Defend your answer.

Sample Traditional Math Problems

1. You are working on a budget for your home expenses. One of the expenses is the monthly electric bill. You have the statements from the previous 12 months, as shown below.

January	\$131
February	\$128
March	\$110
April	\$94
May	\$93
June	\$78
July	\$86
August	\$99
September	\$73
October	\$94
November	\$108
December	\$117

- a. Compute the mean and standard deviation of the costs.
 b. Would it be reasonable to use the mean of the above data to budget the monthly electricity cost for the next year? Explain your answer.
2. A researcher hypothesizes that electrical stimulation will result in a decrease in food intake (in this case, chocolate chips) in rats. Rats undergo surgery where an electrode is implanted. Following a ten day recovery period, rats are tested for the number of chocolate chips consumed during a 10 minute period of time both with and without electrical stimulation. Compute the appropriate t-test for the data provided below.

Stimulation	No Stimulation
12	8
7	7
3	4
11	14
8	6
5	7
14	12
7	5
9	5
<u>10</u>	<u>8</u>
Mean =	Mean =
Standard Deviation =	Standard Deviation =

- a. What would be the null hypothesis in this study?
 - b. What would be the alternate hypothesis?
 - c. What probability level did you choose and why?

3. You have obtained the number of years of education from one random sample of 38 police officers from City A and the number of years of education from a second random sample of 30 police officers from City B. The average years of education for the sample from City A is 15 years with a standard deviation of 2 years. The average years of education for the sample from City B is 14 years with a standard deviation of 2.5 years. Is there a statistically significant difference between the education levels of police officers in City A and City B?
 - a. State your null hypothesis.
 - b. State your alternate hypothesis.
 - c. Is there a statistically significant difference? Show your work.

Sensory Evaluation Instrument

Download: Appendix 12 Sensory Evaluation Instrument and edit in Microsoft Excel

Participant	Example	Item 1	Item 2	Item 3	Item 4	Item 5
Original 1	1.8					
Healthy 1	0.7					
Difference 1	1.1					
Original 2	5.6					
Healthy 2	4.8					
Difference 2	0.8					
Original 3	2.9					
Healthy 3	3.6					
Difference 3	-0.7					
Original 4	6.5					
Healthy 4	7.8					
Difference 4	-1.3					
Original 5	4.5					
Healthy 5	5					
Difference 5	-0.5					
Original 6	6.5					
Healthy 6	8					
Difference 6	-1.5					
Original 7	9					
Healthy 7	8.6					
Difference 7	0.4					
Original 8	5.8					
Healthy 8	6.3					
Difference 8	-0.5					
Original 9	7.5					
Healthy 9	4.6					
Difference 9	2.9					

Project Presentation Audience Feedback

Student Team _____

Project Name _____ Date _____

Thank you for attending our project presentations and taking the time to write thoughtful answers to the following questions:

1. What did you learn from this presentation, or what did it make you think about?

2. What did you like about this presentation?

3. Do you have any questions about the topic or about how the project was done?

4. Any other comments about this presentation?

Self-Reflection on Project Work

Think about what you did in this project and how well the project went. Write your comments in the right column.

Student Name:	
Project Name:	
Driving Question:	
List the major steps of the project:	
ABOUT YOURSELF:	
What is the most important thing you learned in this project:	
What do you wish you had spent more time on or done differently:	
What part of the project did you do your best work on:	
ABOUT THE PROJECT:	
What was the most enjoyable part of this project:	
What was the least enjoyable part of this project:	
How could your teacher(s) change this project to make it better next time:	



Collaboration Rubric

	BELOW STANDARD	APPROACHING STANDARD	AT STANDARD	ABOVE STANDARD
RESPONSIBILITY FOR ONESELF	<ul style="list-style-type: none"> is not prepared and ready to work with the team does not do project tasks does not complete tasks on time does not use feedback from others to improve his/her work 	<ul style="list-style-type: none"> is sometimes prepared and ready to work with the team does some project tasks, but needs to be reminded competes some tasks on time sometimes uses feedback from others 	<ul style="list-style-type: none"> is prepared and ready to work with the team; is available for meetings and uses the team's communication system does what he or she is supposed to do without having to be reminded completes tasks on time uses feedback from others to improve his or her work 	<p><i>In addition to At Standard criteria:</i></p> <ul style="list-style-type: none"> does more than what he or she has to do asks for additional feedback to improve his or her work, beyond what everyone has been given
HELPING THE TEAM	<ul style="list-style-type: none"> does not help the team solve problems; may cause problems does not share ideas with other team members does not give useful feedback to others does not offer to help others 	<ul style="list-style-type: none"> cooperates with the team but does not actively help it makes some effort to share ideas with the team sometimes gives useful feedback to others sometimes offers to help others 	<ul style="list-style-type: none"> helps the team solve problems, manage conflicts, and stay focused and organized shares ideas that help the team improve its work gives useful feedback (specific and supportive) to others so they can improve their work offers to help others do their work if they need it 	<p><i>In addition to At Standard criteria:</i></p> <ul style="list-style-type: none"> steps in to help the team when another member is absent encourages others to share ideas, helps to make them clear, and connects them to the team's work notices if a team member does not understand something and takes action to help
RESPECT FOR OTHERS	<ul style="list-style-type: none"> does not pay attention to what teammates are talking about does not show respect for teammates (may interrupt, ignore ideas, hurt feelings) 	<ul style="list-style-type: none"> usually listens to teammates, but not always is polite and kind to teammates most of the time, but not always 	<ul style="list-style-type: none"> listens carefully to teammates is polite and kind to teammates 	<p><i>In addition to At Standard criteria:</i></p> <ul style="list-style-type: none"> encourages the team to be respectful to each other recognizes everyone's strengths and encourages the team to use them

Project Rubric

CATEGORY	EXCELLENT (15)	PROFICIENT (10)	SATISFACTORY (5)	UNSATISFACTORY OR NO ATTEMPT MADE (0)
ORGANIZATION	Includes all of the project components in an organized manner.	Missing one project component but somewhat organized.	Missing two project components and content is somewhat unorganized.	Missing three or more project components and content is unorganized.
CONTENT KNOWLEDGE	Detailed explanation of the topic. Explains the key components of the topic and can support findings with background information.	Contains a good description of the fundamentals of the topic and can somewhat support the findings with a little background information.	General to vague description of the fundamentals of the topic and has difficulty supporting the findings with background information.	Missing information regarding the description of the fundamentals of the topic, and unable to support the findings with background information.
COMPLETENESS	Project components are complete and demonstrate strong depth and breadth.	Project components are mostly complete, only moderately lacking in depth and/or breadth.	Project components are generally incomplete and lack in depth and/or breadth.	Some project components are incomplete and others completely lack depth and breadth.
SYNTHESIS	Responses are well organized, cohesive, and team components flow as a whole.	Responses are somewhat organized, cohesive, and team components sometimes lack flow as a whole.	Responses are lacking organization and cohesion and/or team components do not flow as a whole.	Responses are poorly organized, not cohesive, and the team components fail to create a whole coherent response.
REFERENCES	Thorough reference list included. References are in proper APA form and all inclusive of the citations in project.	References are missing one or two pieces of information.	References are included but not in proper form. Three or more references that are cited are missing.	No reference list included.
MECHANICS	No capitalization, spelling, punctuation or grammatical errors.	2 or less capitalization, spelling, punctuation or grammatical errors.	3-5 capitalization, spelling, punctuation or grammatical errors.	6+ capitalization, spelling, punctuation or grammatical errors.
VISUAL	Visual aids are neat, creative, and easy to follow.	Visual aids are somewhat neat, creative, and easy to follow.	Visual aids are somewhat messy, lacking creativity, and not as easy to follow.	Visual aids are messy, not creative, and difficult to follow.