Human Performance and Medicine

Cupcake Wars: A Battle of Production

Grade Level(s): 3rd

Academic Content Areas: Science, Technology, Engineering, Math, and Social Studies

Topics: Economics; Science and Technology; Scientific Inquiry; Scientific Ways of Knowing; Patterns, Functions, and Algebra and Data Analysis; and Measurement

 Recommended area of co-teaching for an AFRL Engineer or Scientist

Main Problem / Essential Question

How do you produce a cost-effective, quality product in a timely manner?

Summary

In this activity, the students will explore and understand the assembly line process by engineering a cupcake decorating assembly and packaging line. By setting up an organized, well-thought out assembly line, students will learn how time, cost, and quality can be affected. Certain aspects of the assembly line will be explored, such as increasing production of the process and how that affects the quality of the product. Students explore the field of manufacturing/industrial engineering as they design and redesign a more efficient system to mass produce a decorated and packaged product. The students will explore different areas of social studies, economics and scientific processes.

Big Ideas / Focus

Some of the greatest challenges in our American industry base have been quality, cost, and on-time delivery in manufacturing. This will continue to be a great factor in manufacturing competitiveness for future business and production.

The design, development, and production of cupcakes will outline three key aspects of manufacturing: quality, cost, and on-time delivery. This will foster an understanding that a product has to have repeatability in the manufacturing process and that a company has to have a reliable process to produce repeatable results.

Prerequisite Knowledge

Before starting this lesson, students should have an understanding of basic economics including familiarity with the economic concepts of product, productivity, consumer and producer.

Standards Connections

Content Area: Social Studies

Economics

Students use economic reasoning skills and knowledge of major economic concepts, issues and systems in order to make informed choices as producers, consumers, savers, investors, workers and citizens in an interdependent world.

Grade 3: Benchmark A: Explain the opportunity costs involved in the allocation of scarce productive resources.	1. Define opportunity cost and give an example of the opportunity cost of a personal decision.
Grade 3: Benchmark B: Explain why entrepreneurship, capital goods, technology, specialization and division of labor are important in the production of goods and services.	2. Identify people who purchase goods and services as consumers and people who make goods or provide services as producers. 3. Categorize economic activities as examples of production or consumption.

Content Area: Science

Science and Technology

Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition, they should develop the processes to solve problems and understand that problems may be solved in several ways.

Grade 3: Benchmark A: Describe how technology affects human life.	1. Describe how technology can extend human abilities (e.g., to move things and to extend senses). 2. Describe ways that using technology can have helpful and/or harmful results. 3. Investigate ways that the results of technology may affect the individual, family and community.

Grade 3: Benchmark B: Describe and illustrate the design process.	4. Use a simple design process to solve a problem (e.g., identify a problem, identify possible solutions and design a solution). 5. Describe possible solutions to a design problem (e.g., how to hold down paper in the wind).

Scientific Inquiry

Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and to gather and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

Grade 3: Benchmark A: Use appropriate instruments safely to observe, measure and collect data when conducting a scientific investigation.	1. Select the appropriate tools and use relevant safety procedures to measure and record length and weight in metric and English units.
Grade 3: Benchmark B: Organize and evaluate observations, measurements and other data to formulate inferences and conclusions.	2. Discuss observations and measurements made by other people. 3. Read and interpret simple tables and graphs produced by self/others. 5. Record and organize observations (e.g., journals, charts and tables).
Grade 3: Benchmark C: Develop, design and safely conduct scientific investigations and communicate the results.	4. Identify and apply science safety procedures. 6. Communicate scientific findings to others through a variety of methods (e.g., pictures, written, oral and recorded observations).

Scientific Ways of Knowing

Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

Grade 3: Benchmark C: Explain the importance of keeping records of observations and investigations that are accurate and understandable.	2. Keep records of investigations and observations and do not change the records that are different from someone else's work.
Grade 3: Benchmark D: Explain that men and women of diverse countries and cultures participate in careers in all fields of science.	4. Identify various careers in science. 5. Discuss how both men and women find science rewarding as a career and in their everyday lives.

Content Area: Mathematics

Patterns, Functions, & Algebra

Students use patterns, relations and functions to model, represent and analyze problem situations that involve variable quantities. Students analyze, model and solve problems using various representations such as tables, graphs and equations.

Grade 3: Benchmark F: Construct and use a table of values to solve problems associated with mathematical relationships.	7. Create tables to record, organize and analyze data to discover patterns and rules. 8. Identify and describe quantitative changes, especially those involving addition and subtraction; e.g., the height of water in a glass becoming 1 centimeter lower each week due to evaporation.

Data Analysis and Probability Standard

Students pose questions and collect, organize, represent, interpret and analyze data to answer those questions. Students develop and evaluate inferences, predictions and arguments that are based on data.

Grade 3: Benchmark A: Gather and organize data from surveys and classroom experiments, including data collected over a period of time.	1. Collect and organize data from an experiment, such as recording and classifying observations or measurements, in response to a question posed.
Grade 3: Benchmark C: Construct charts, tables and graphs to represent data, including picture graphs, bar graphs, line graphs, line plots and Venn diagrams.	6. Translate information freely among charts, tables, line plots, picture graphs and bar graphs; e.g., create a bar graph from the information in a chart.

Grade 3: Benchmark D: Read, interpret and construct graphs in which icons represent more than a single unit or intervals greater than one; e.g., each  = 10 bicycles or the intervals on an axis are multiples of 10.	3. Read, interpret and construct bar graphs with intervals greater than one.
Grade 3: Benchmark F: Conduct a simple probability experiment and draw conclusions about the likelihood of possible outcomes.	9. Conduct a simple experiment or simulation of a simple event, record the results in a chart, table or graph, and use the results to draw conclusions about the likelihood of possible outcomes.

Measurement Standard

Students estimate and measure to a required degree of accuracy and precision by selecting and using appropriate units, tools and technologies.

Grade 3: Benchmark E: Tell time to the nearest minuet.	3. Tell time to the nearest minuet and find elapsed time using a calendar or stopwatch.

Preparation for activity

Prepare student copies of Appendices A, C, D, and E.

Teachers Note: you will need two copies of Appendix A.

Gather materials for Cooties game.

Request for parent volunteers to bake and donate 150 cupcakes.

Teacher's Note: A class of 30 will need a total of 150 uniced cupcakes. This will allow for 6 groups to decorate 12 cupcakes on day 3 and 12 cupcakes on day 4. It is important to complete day 4 as it is the redesign phase which emphasizes the importance of the engineering design process.

Critical Vocabulary

Community - A place where people live, work and play.

Consumer - A person who uses a good or service.

Distribution - The delivery of merchandise (goods) to retail stores.

Distributor - A firm that sells and delivers merchandise to retail stores or acts as an intermediary in business. ("Investorwords.com", n.d.)

Goods - Products that people want and need that they can touch and/or hold.

Opportunity Cost - The next best alternative that must be given up when a choice is made; not all alternatives, just the next best choice. ("NetMBA Business Knowledge Center", 2010)

Process- "A series of gradual changes bringing about a result" ("Glossary of Social Studies Terms and Vocabulary", n.d.)

Processes - The steps, or sequence of events by which something develops "(major world processes are population growth, economic development, urbanization, resource use, international trade, global communication, and environmental impact)". ("Glossary of Social Studies Terms and Vocabulary", n.d.)

Producers - A person who makes a good or provides a service.

Production - The act of growing, making or manufacturing goods and services.

Productivity – "The amount of output per unit of input" ("Labor Productivity and Unit Labor Cost", n.d.)

Services- An intangible act, which satisfies the wants or needs of consumers such as medical advice and education" ("Glossary of Social Studies Terms and Vocabulary", n.d.)

Timeframe

Day	***Time Allotment***	***Activities***
1	45 - 50 minutes	Five students per team 1. Pretest 2. Hook (videos) Show I Love Lucy video on assembly line 3. BrainPop- animated video on assembly line 4. KWL Chart - KWL chart about assembly lines.
2	45 - 50 minutes	1. Assembly of "Cootie" 2. Class Discussion of Design Process and Assembly lines 3. Have groups plan for Assembling "Cootie." 4. Assemble "Cooties" after planning time. 5. Class Discussion: compare results from the two assembly periods.
3	50 - 60 minutes	2. Introduction to Main Activity (Cupcakes) 3. Hand out cupcake rubric Appendix D 4. Have teams engineer their cupcake decorating and packaging assembly line. 5. Hand out Cupcake Wars Worksheet Appendix E 6. Initial assembly line test.
4	50 - 60 minutes	1. Class discussion on cupcake decorating and packaging assembly line. 2. Have teams redesign their assembly line process to improve their results.

		3. Assembly of Cupcakes using redesigned assembly line 4. Complete Cupcake Wars worksheet 5. Teacher records scores using the Cupcake Rubric (Appendix E)
5	50 - 60 minutes	1. Class Bar Graph 2. Class Discussion 3. Complete KWL chart

Materials & Equipment

(Following supplies are for class of 30 split into 6 teams)

Internet and Projection capabilities for videos (Day 1)

Electronic white board or poster paper

2 Cootie games by Hasbro

60 pairs of disposable gloves

Plastic table cloths (optional: to make cleanup easier)

Paper towels (optional: for cleanup)

Disinfectant spray (optional: for cleanup)

I box of Little Debbie cupcakes (Day 5)

150 undecorated cupcakes (75 for day 3 and 75 for day 4)

24 clam shell plastic cupcake boxes

4 bags M&M's (total of 600 m&m's)

6 bags gummy bears (total of 300 gummy bears)

6 cans of Frosting

7 mini spatulas (for frosting)

7 tablespoons (for frosting)

6 Analog Chess Timers

Embroidery floss

Tape

14 4" x 6" index cards with 2 inch square cut in center

Safety & Disposal

All students will need to wash hands.

It is recommended that students with long hair, pull it back.

Students should wear plastic gloves during the cupcake assembly process.

Discuss proper etiquette for sneezing and coughing around food.

Be aware of any student allergies and products used in this lesson.

Pre-Activity Discussion

Review economics concepts:

- What is production, consumption and distribution? (elicit examples)
- Why are consumers and producers economically important?
- How does a company meet supply and demand?

Teacher Instructions

Day One

1. Administer Pretest (Appendix A).

2. Use provided rubric to grade Pretest (End of Appendix A).

3. Show the "I Love Lucy" video which takes place in the chocolate factory.
   http://videowap.tv/video/gomHsXu1pu0/Lucy-in-Candy-Factory.html
   - Discuss how Lucy and Ethel were having difficulties with keeping up with their jobs on the assembly line.

4. Next, show the students the animated video on assembly lines from "BrainPop"
   http://www.brainpop.com/socialstudies/economics/assemblyline/preview.weml
   Teacher's Note: You can access BrainPop for free for a 5-day trial.

5. Create a KWL chart with the students about assembly lines
   - K- What They Know
   - W- What They Want to Learn
   - Teacher's Note: L- What They Learned (this part will be filled in on Day 5). Use of an electronic white board and PowerPoint for the KWL chart will help students track knowledge throughout the lesson.

Day Two

1. Recap Day One's lesson.

2. Explain to students that they are going to put together a "Cootie" as a team.
   - Explain that every member of the team must help in the assembly.
   - Show them an example of what the final product should look like.
   - Give each team the parts to assemble the "Cootie". Do not give them any planning time.
   - Immediately allow teams one minute for assembling the "Cootie".
   - At the end of one minute, they need to stop and examine their "Cootie" creation.
   - Conduct a class discussion about what worked and what didn't work.

   Examples: Students didn't know what parts they were supposed to assemble, not everyone had the opportunity to assemble part of the "Cootie", etc.

3. Discuss how assembly lines change production.
   Teachers Note: Record students thoughts to refer to on Day 5.

- Refer to “I love Lucy” video clip and the KWL chart.
- Explain that the constraint on everyone helping is important in a society because if one person is not able to perform a task someone else needs to be able to help so the community does not suffer. Discuss implications with students.

4. Introduce the Engineering Design Process (Appendix B)
   - Discuss how a problem is solved by using this process (use diagram as a visual).

5. Provide each student team with a chess timer. Explain that one tam member is in charge of being the inspector and will monitor production and control the timer.

6. Allow the students 10 minutes of planning to come up with an efficient assembly of their “Cootie”.

7. Have the teams conduct their assembly following their assembly line plan.
   - As the students are performing their assembly lines, use the “Cootie” Rubric to assess them.

8. Conduct a class discussion about what worked and what didn’t work; allow them to elaborate on which “Cootie” assembly was more efficient.
   Teacher’s Note: If students are largely successful challenge teams to put together 2 or 3 cooties in one minute or shorten the assembly time to 30 seconds. Then lead a discussion on what student’s learned including the potential for increased profits with increased production.

 A manufacturing engineer or industrial engineer from AFRL can assist students on their brainstorming and implementation of their engineered assembly line as well as discuss improvements and real world applications of this process.

Day Three

1. Recap Day Two.

2. Display a decorated cupcake.
   - Discuss that students will now employ their manufacturing engineering knowledge in the creation of an assembly line to decorate and package cupcakes.
     - Distribute cupcake rubric Appendix E.
     - One tablespoon of frosting
     - Four M & M’s, all of the same color with m’s showing to create a square pattern
     - Two gummy bears back to back in the center of the cupcake.
   - Discuss the criteria for the “perfect” cupcake.

3. Provide student with the following scenario:
   - “Your team has been hired to work on designing an assembly line to mass-produce cupcakes for a local bakery. Your team must design a model assembly line to mass produce 12 “perfect” decorated cupcakes and package them in the quickest time possible, to keep costs down. You will be given 13 plain cupcakes and 15 minutes to assemble them to the customer’s specifications”.

4. Use the Cupcake Wars Worksheet (Appendix E) to have students calculate labor costs for today. Teacher's Note: Save these figures for day 4. Allow students to use calculators to verify math.

5. Have teams discuss and plan how they are going to form an assembly line using the Engineering Design Process.

6. Have students draw out their initial design including person, task, and ordering.
   Teacher's Note: Emphasize the importance of planning elicit that a plan saves time and money and keeps all individuals invested in the same ideas.

7. Allow students 5 minutes to set up their assembly line.

8. Allow students 15 minutes for their first initial assembly line test.
   Teacher's Note: Be sure student's leave their time from today's test on their chess timer for comparison on Day 4.

9. Have the "Inspector" (see student roles) time their group using an analog chess timer and catalog perfect, not perfect, number of completed cupcakes, and 3 observations about the final results while the rest of the team cleans up.
   Teacher's Note: The inspection notes are vital to day 4 and 5 discussions.

10. Clean up assembly lines.

 A manufacturing engineer or industrial engineer from AFRL can assist students on their brainstorming and implementation of their engineered assembly line as well as discuss improvements and real world applications of this process.

Day Four

1. Allow the students 5 minutes to revisit their plan for creating their cupcakes.

2. The inspector will keep track of time for each group as they can decorate, package, and box their 12 "perfect" cupcakes.
   Teacher's Note: Be sure student's leave their time from today's test on their chess timer for data analyses.

3. As they are mass-producing, complete the Cupcake Rubric for assessment.

4. Allow each team to examine their "competitor's" outcome.

5. Discuss what worked in their redesign.

6. Use the Cupcake Wars Worksheet (Appendix E) to have students calculate labor costs and production output for today based on their redesign production. Compare costs to their initial

assembly line output from day 3.Teacher's Note: Allow students to use calculators to verify math.

7. Discuss what did not work in their redesign and how it could be improved upon.

8. Clean up assembly lines.

Day Five

1. Provide students with paper to create a team bar graph for the results of their "perfect" cupcakes and "not-so-perfect" cupcakes.
   Teacher's Note: To address Data Analysis and Probability Benchmark C have students create a bar graph where the interval is greater than one.

2. Conduct a class discussion about how using the engineering design process helped to create a high-quality, cost efficient, on-time delivery of their product
   - Examine the amount of waste, the number of "not-so-perfect" cupcakes, the quantity produced in the given time, etc.
   - Look at the Little Debbie box and examine the contents: discuss how as a consumer you are looking for uniformity and how unhappy you would be with this product if you opened it and it did not contain sprinkles, or was misshapen, or not entirely coated in frosting.
     - Also, emphasize that a product has to have repeatability in the manufacturing process, generating it at acceptable standards, and delivered promptly to the customer.
   - Discuss quantitative changes in production due to redesign. Work through these applied math problems as a class. Examples include increased number of perfect cupcakes, decreased production time, how much time it took to complete each cupcake, etc.

3. Finish KWL chart (from Day 2).

4. Have students complete the Post-Test.

5. Clean up assembly lines.

Background Information

"The assembly line is often described as a process that uses machines to move material from one place to another, but in practice, machines are not always needed. For instance, mass-market jewelers often use assembly lines in which materials are handed from one worker to another, without the benefit of machinery. At its most basic, an assembly line is a series of stations at which people or machines add to or assemble parts for a product. One of the values of the assembly line is its versatility: it can be simple, but it has the capacity to be very complex. An assembly line can begin as many different lines each devoted to a different component of a product, with the lines converging upon one another, becoming fewer until only one line is left for the final product. Automotive companies often have assembly lines that begin with raw materials and end five miles away with a completed automobile. A structure for a complex assembly line begins as one main line with stations along it that are fed by lines running perpendicular to it, with each of these side lines feeding components for the finished product.

Although the assembly line has occasionally been considered outmoded, it has survived by repeatedly changing its form" ("Encyclopedia.com", 2011).

Instructional tips

Be mindful of student's with food allergies.

If purchasing latex gloves, be mindful of students with latex allergies.

Post critical vocabulary with definitions for students to refer to throughout the lesson.

Analog chess timers can record two sets of times. Each timer should be labeled to identify the group as well as the time for day 3 and day 4. Note that students may use an online analog chess timer, stopwatch, or the classroom clock but the choice of timer may alter the Mathematics Measurement standard addressed in this lesson.

Assignment of Student Roles and Responsibilities:

Students will share the responsibility of performing experimental tests. Additionally, students will assume the following roles:

Member	***Role Name***	***Brief Description***
1	Team Leader	Responsible for designing production line layout and assignment of personnel To maximize output Items to be considered: Height of assembly line (Ergonomics) Distance from station to station Pre-measured icing and decorations Visual instructions at each station
2	Assembler 1	Spread icing evenly with a tablespoon or spatula
3	Assembler 2	Placing M&M's as directed
4	Assembler 3	Placing gummy bears as directed
5	Inspector	Using the quality control tools, objectively accept or reject each cupcake. Package cupcakes Time the production process

Student Instructions

The instructions below are optional. They may be provided to students if they are unable to develop their own production line plan.

Production Assembly Line

Instructions: Devise a production line to consistently to produce identical cupcakes in the most efficient manner.

Station	Detail	Description
Station 1	Cupcake	Inventory staging area (To be donated by volunteers)
Station 2	Application	Specify exact amount of icing to be spread uniformly
Station 3	M&M Decoration	Place (4) M&M candies, of the same color, at the corners of the cupcake in a square pattern. “M” must be facing up and placed as specified.
Station 4	Gummy Bear Decoration	Place (2) gummy bears of same color, standing back to back, in center of square.
Station 5	Quality Control	Inspector is to examine each cupcake for uniformity. Inspector will either “accept” or “reject” each cupcake. Inspection Tools: Tools are needed to minimize the subjectivity of the inspector’s decision. Use a 4“ x 6” index card with a 2” square cut out in the middle to inspect decorations (By taping embroidery floss across the square to make four equal quadrants, the index card will assist the inspector in checking for symmetry.) Inspect for correct color scheme. Package: uniformly

Optional Stations – If team size varies, add additional decoration stations and packaging station.

Formative Assessments

Appendix A: Pre/Post-test

Appendix D: Cupcake Wars Rubric

Post-Activity Discussion

Conduct a class discussion about how using the engineering design process helped to create a high-quality, cost efficient, on-time delivery of their product.

Discuss how technology such as an assembly can extend human abilities and benefit our society.

Examine the amount of waste, the number of “not-so-perfect” cupcakes, the quantity produced in the given time, etc. Also, emphasize that a product has to have repeatability in the manufacturing process, generating it at acceptable standards, and delivered promptly to the customer

Technology Connection

Integration Model	***Application Description***
Technology that supports students and teachers in **adjusting, adapting, or augmenting** teaching and learning to meet the needs of individual learners or groups of learners	Internet videos
Technology that supports students and teachers in **dealing effectively with data**, including data management, manipulation, and display	Electronic white board (optional) Power Point: : student generated bar graphs and KWL chart (optional) Calculators Chess Timers
Technology that supports students and teachers in conducting **inquiry**, including the effective use of Internet research methods	Internet videos Cooties
Technology that supports students and teachers in **simulating** real world phenomena including the modeling of physical, social, economic, and mathematical relationships	Internet videos
Technology that supports students and teachers in **communicating and collaborating** including the effective use of multimedia tools and online collaboration	Electronic white board Power Point: student generated bar graphs and KWL chart

Interdisciplinary Connection

Content Area: English Language Arts

Reading Process: Concepts of Print, Comprehension Strategies and Self-Motivating Strategies Independent Reading

Grade 3: Benchmark A Establish a purpose for reading and use a range of reading comprehension strategies to understand literary passages and text.	10. Independently read books for various purposes (for enjoyment, for literary experience, to gain information, or to perform a task

Title	Author	Description
Charlie Needs a Cloak	Tomie dePaola	This story lists special skills that Charlie needs to produce his cloak
My First Book of How Things are Made	George Jones	This book details the manufacturing process of 8 inventions from raw product to design.

Home Connection

Send home a letter to families summarizing lesson concepts. Invite families to continue the assembly line process at home during dinner: Have a taco or mini pizza dinner and where each family member can place toppings on the food.

Check out books from library about the assembly line process.

Visit a local pizzeria and watch how pizzas are made. (For example: Dewey's in Dayton has a window where you can watch the pizza's being assembled. Although one person is responsible for the creation of a single pizza, the equipment has been set up in an assembly line fashion with different stations for the process. Students could then critique this assembly and suggest improvements for increased productivity).

Differentiated Instruction

Process

- Students could be given the Cootie and an analog chess timer prior to lesson to practice prior to lesson.
- Students could be grouped according to like needs.

- Students could be given hard copy of engineering process for reference (Appendix B).

Product
- Cupcake criteria could be varied, depending on specific student needs such as fine motor issues.
- Student could be given written instructions with pictures.

Content
- Pretest and posttest may be read to student.
- Oral evaluation may be necessary on pretest and posttest.

Extension

Students may continue with a biography about Henry Ford and the automotive assembly line.
http://www.kyrene.k12.az.us/schools/brisas/sunda/inventor/ford/

Students may create a timeline of the development of the assembly line.

Students may visit a manufacturing plant that uses an assembly line.

Students may discuss the negative effects of this production method:
teachers.net/lessons/posts/3372.html
*Task can become boring to the worker
*Worker never learns a real skill
*Workers are not paid very well
*Boredom can result in carelessness
causing injuries

Career Connection

Industrial Engineering –"engineering that deals with the design, improvement, and installation of integrated systems (as of people, materials, and energy) in industry" ("Encyclopedia Britannica", 2011)

Manufacturing engineers "have the task of making manufacturing processes better, faster, and cheaper. Their success or failure directly impacts the advancement of technology, products, and the spread of innovation to consumers. A professional in this field constantly reviews the allocation of resources, analyzes productivity, and seeks ways to maximize production while minimizing cost. Manufacturing engineering careers offer challenging opportunities that never fail to engage intellectual curiosity and push the edge of innovative thinking". "A manufacturing engineer works on the creation of products, processes, and technology". This career field is quite diverse as one manufacturing engineer may specialize on nano technology while another specializes in automobiles. ("WorldWideLearn: The World's Premier Online Directory of Education", 2011)

The design for an assembly line is determined by analyzing the steps necessary to manufacture each product component as well as the final product. All movement of material is simplified, with no cross flow, backtracking, or repetitious procedure. Work assignments, numbers of machines, and production rates are programmed so that all operations along the line are compatible". ("Encyclopedia Britannica", 2011)

Additional Resources

Animated Educational Site for Kids – Science, Social Studies, English, Math, Arts	www.Brainpop.com
How crayons are manufactured	www.crayola.com
Charlie Needs a Cloak interactive story on YouTube	http://www.youtube.com/watch?v=A16Hv6Gx41M
The assembly line then and now video clip (with ROBOTS doing the work).	http://www.history.com/videos/history-of-the-holidays-the-story-of-labor-day#history-of-the-holidays-the-story-of-labor-day
Go to the lesson titled: Lean on Me, We Depend on Each Other	www.econedlink.com
Lean Manufacturing is discussed in this video.	http://www.youtube.com/watch?v=_3YXiTOO-tQ

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Teacher Reflections

- Were students focused and on task throughout the lesson? *Insert answer here.*
- If not, what improvements could be made the next time this lesson is used? *Insert answer here.*
- Were the students led too much in the lesson or did they need more guidance? *Insert answer here.*
- Did the students learn what they were supposed to learn? *Insert answer here.*
- How do you know? *Insert answer here.*

- How did students demonstrate that they were actively learning? *Insert answer here.*
- Did you find it necessary to make any adjustments during the lesson? *Insert answer here.*
- What were they? *Insert answer here.*
- Did the materials that the students were using affect classroom behavior or management? *Insert answer here.*
- What were some of the problems students encountered when using the …? *Insert answer here.*
- Are there better items that can be used next time? *Insert answer here.*

Appendix A: Pre Test / Post Test

Name:_____

1. A person who buys a good that someone else has made is called a _____.

   a. Producer
   b. Manufacturer
   c. Consumer
   d. assembly line worker

2. A person who makes a good or provides a service is called a _____.

   a. producer
   b. buyer
   c. consumer
   d. market

3. _____ are products that people want and need that they can touch and hold.

   a. buyer
   b. goods
   c. barter
   d. distributer

4. A factory uses steel to make airplane parts.

   This is an example of:

   a. bartering
   b. production
   c. consumption
   d. economy

5. An assembly line works well in factories because _____.

   a. an assembly line takes longer to make a product.
   b. more products can be uniformly made in a shorter time using an assembly line.
   c. people must learn more than one job to work on an assembly.
   d. people can make friends much easier at work.

6. Describe how an assembly line would work for making a pizza using words and pictures (please label your picture with words).

- ✓ The pizza must have a crust, pizza sauce, cheese, pepperoni and onion.
- ✓ The pizza also needs to be placed into a box after it is assembled.
- ✓ Include at least 4 people on your assembly line.

Draw the assembly line in this box. Remember to label your picture using words.

Explain how the assembly line works using words. (Hint use words such as First, Second, Next)

_____

_____

_____

_____

_____

_____

_____

Cupcake Wars Pre/Post Test Answer Key

1.c

2.a

3.b

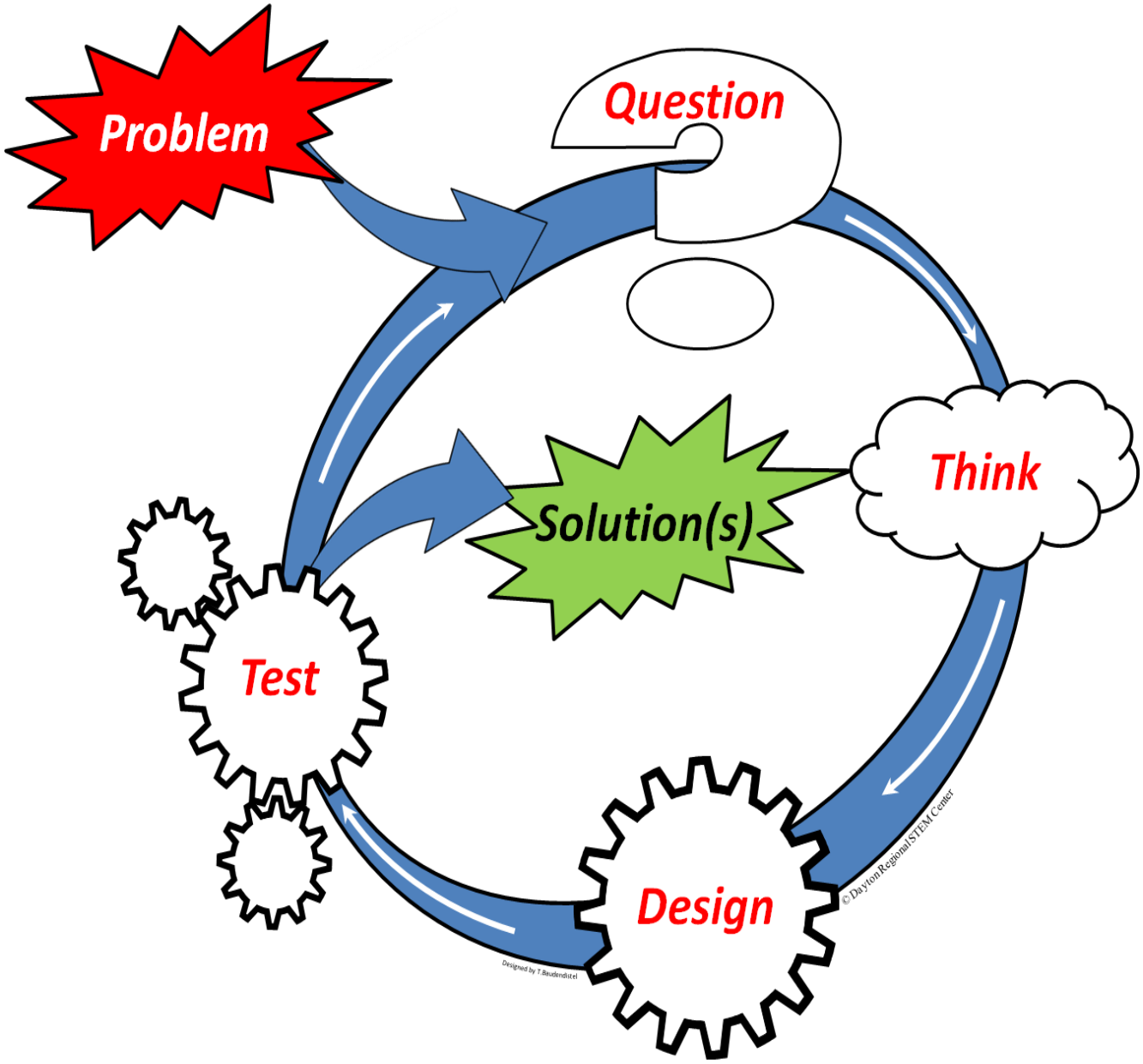
4.b

5.b

6. Total of 6 points

	3 points	2 points	1 point	0 points
Picture of Assembly Line	The assembly line is in a functional order with all 6 parts (crust, sauce, topping, topping, topping, box).	The assembly line is in a functional order with only 4 or 5 parts.	The assembly line is in a functional order with only 1, 2 or 3 parts.	The assembly line is not in a functional order and does not include any of the parts.
Explanation of the Assembly Line	The student explained the all 6 parts (crust, sauce, topping, topping, topping, box) in a functional order.	The student explained 4 or 5 parts in a functional order.	The student explained only 1, 2 or 3 parts in a functional order.	The student did not explain the assembly line in a functional order and it does not include any of the parts.

Appendix B: Engineering Design Process



Appendix C: Cootie Rubric

Category	4	3	2	1
Completed Cootie	Cootie will have 6 parts that include: 6 legs, 2 antennae, 1 head, 2 eyes, 1 mouth, 1 body and stands on 6 legs	Cootie will have 5 out of 6 parts	Cootie will have 3-4 parts	Cootie will have 1-2 parts

Appendix D: Cupcake Wars Rubric

Category	4	3	2	1
Icing	Cupcake has 1 Tbsp. icing with none of the cupcake showing	Cupcake has 1 Tbsp. icing with 75% covered	Cupcake has 1 Tbsp. icing with 50% covered	Cupcake has 1 Tbsp. icing with 25% covered or icing is an unmeasured quantity
M & M's	3 out of 4 criteria met The same color of M & M's is used and M & M's are face up in a square pattern	3 out of 4 criteria met The same color of M & M's is used (except for 1) and M & M's are face up in a square pattern	2 out of 4 criteria met The same color of M & M's is used and M & M's are face up in a square pattern	1 out of 4 criteria met The same color of M & M's is used and M & M's are face up in a square pattern
Gummy Bears	3 out of 4 criteria met: 2 same color Gummy are face up laying in the same direction	2 out of 4 criteria met: 2 same color Gummy (except for 1) are face up laying in the same direction	1 out of 4 criteria met: 2 same color Gummy are face up laying in the same direction	1 out of 4 criteria met: 2 same color Gummy are face up laying in the same direction
Packaging	4 out of 4 criteria met: No icing on outside of package. No icing outside cupcake rim on interior of package. Cupcakes are all facing same general direction (m's or bears may be used to determine directionality, lid is	3 out of 4 criteria met: No icing on outside of package. No icing outside cupcake rim on interior of package. Cupcakes are all facing same general direction (m's or bears	2 out of 4 criteria met: No icing on outside of package. No icing outside cupcake rim on interior of package. Cupcakes are all facing same general direction (m's or bears	1 out of 4 criteria met: No icing on outside of package. No icing outside cupcake rim on interior of package. Cupcakes are all facing same general direction (m's or bears

	snapped shut.	may be used to determine directionality, lid is snapped shut.	may be used to determine directionality, lid is snapped shut.	may be used to determine directionality, lid is snapped shut.

Appendix E: Cupcake Wars Worksheet

Name: _____

Cupcake Wars Worksheet

Day 3 – 1st Assembly Line

Answer each question using the fixed price and information about your group including the number of people in your group and how many minutes each person worked. Be sure to round to the nearest minuet.

Fixed Price
Each worker will earn $ 0.17 per minute

1. There are _____ people in my group.

   Each person in my group worked for _____ minutes.

2. Each person in my group worked for _____ minutes

   x _____ people in my group

   = _____ total minutes my group worked

3. $ _____ is how much each group member will earn per minute

   x _____ total minutes my group worked

   = $ _____ cost to pay my group for making cupcakes (cost of labor)

4. My group made _____ perfect cupcakes today.

Day 4 - 2nd Assembly Line

Answer each question using the fixed prices and information about your group including the number of people in your group, how many minutes each person worked, how many cupcakes your group made. Be sure to round to the nearest minuet.

Fixed Prices

Each worker will earn $ 0.17 per minute

The cost of supplies for one cupcake is:

Cake Mix $0.10

Cupcake Liner $0.01

Frosting $0.08

4 M&Ms: $ 0.02

2 Gummy Bears $ 0.03

Cupcake Box: $0.05

The price of one cupcake is $1.00

5. There are _____ people in my group.

   Each person in group worked for _____ minutes.

6. Each person in my group worked for _____ minutes

   x _____ people in my group

   = _____ total minutes my group worked

7. $ _____ is how much each group member will earn per minute

x _____ total minutes my group worked

= $ _____ cost of labor

8. The cost to make one cupcake is

$ _____Cake Mix

+ $ _____Cupcake Liner

+ $ _____Frosting

+ $ _____4 M&Ms

+ $ _____2 Gummy Bears

+ $ _____Cupcake Box

= $ _____ cost to make one cupcake

9. My group made _____ perfect cupcakes today.

10. What changes did your team make for your assembly line today? Why did you choose to make these changes?

11. How did redesigning your assembly line affect your group's outcomes? Did you make more perfect cupcakes during the 2nd assembly line? Did you group work faster during the 2nd assembly line?

12. Did your competitors make more or less perfect cupcakes than your group did today? What improvements did other groups make to their assembly line that you did not think of?