Printable Resources

The Lunchbox of the Future

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Appendix A: Pre-Test and Post-Test

Name _____

Science

1. A material that limits the transfer of energy from one object to another is:

   a. A conductor

   b. An insulator

   c. A matrix

   d. Radiation

2. What is one way that matter can be changed from one state to another?

   _____

3. Which scenario below does NOT demonstrate conservation of matter?

   a. A sheet of paper is burned in a fire.

   b. A sheet of paper is shredded into small pieces.

   c. Water in a bag is placed in a freezer.

   d. Salt is dissolved in a glass of water.

4. Joe held an ice cube in his hand. Which describes the flow of energy?

   a. The ice added cold energy to Joe's hand.

   b. The ice added heat energy to Joe's hand.

   c. Joe's hand took cold energy from the ice.

   d. Joe's hand added heat energy to the ice.

Economics

Mr. Lemon decides to start a lemonade business. He hires Greg to work for him. Greg makes the lemonade and sells it to Theresa.

5. In the above situation, who is the consumer? _____

6. In the above situation, who is the producer? _____

7. In the above situation, who is the entrepreneur? _____

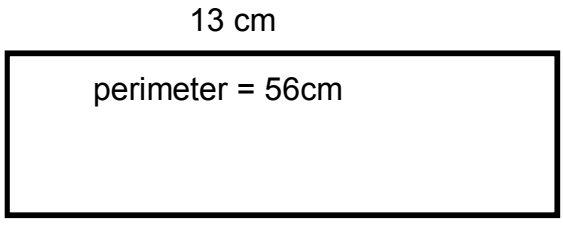
8. Mr. Lemon must choose between plastic or paper cups for his lemonade business. He chooses the paper cups because they are cheaper. His opportunity cost was _____.

Math: Show your work.

9. What is the area of the rectangle below? _____

10. What is the perimeter of the rectangle below? _____

11. A rectangle has a perimeter of 56 cm. One side is 13 cm. Label the measurements of the remaining 3 sides.



Pre-Test and Post-Test Answer Key

Name _____

Science

1. A material that limits the transfer of energy from one object to another is:

   a. A conductor

   b. An insulator

   c. A matrix

   d. Radiation

2. What is one way that matter can be changed from one state to another?

   ___adding or removing heat_____

3. Which scenario below does NOT demonstrate conservation of matter?

   a. A sheet of paper is burned in a fire.

   b. A sheet of paper is shredded into small pieces.

   c. Water in a bag is placed in a freezer.

   d. Salt is dissolved in a glass of water.

4. Joe held an ice cube in his hand. Which describes the flow of energy?

   a. The ice added cold energy to Joe's hand.

   b. The ice added heat energy to Joe's hand.

   c. Joe's hand took cold energy from the ice.

   d. Joe's hand added heat energy to the ice.

Economics

Mr. Lemon decides to start a lemonade business. He hires Greg to work for him. Greg makes the lemonade and sells it to Theresa.

5. In the above situation, who is the consumer? **_Theresa_____**

6. In the above situation, who is the producer? **__Greg_____**

7. In the above situation, who is the entrepreneur? **___Mr. Lemon_____**

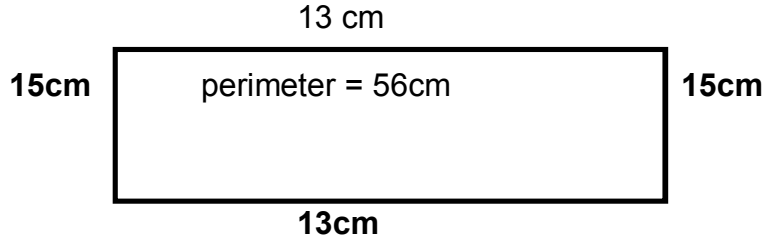
8. Mr. Lemon must choose between plastic or paper cups for his lemonade business. He chooses the paper cups because they are cheaper. His opportunity cost was **_plastic cups_____**.

Math: Show your work.

9. What is the area of the rectangle below? **___136 square inches____**

10. What is the perimeter of the rectangle below? **__50 inches_____**

11. A rectangle has a perimeter of 56 cm. One side is 13 cm. Label the measurements of the remaining 3 sides.



Appendix B: Engineering Design Challenge

Many people, both children and adults, pack food to eat later in the day. Depending upon where and when the person is planning to eat, there may not be a way to heat their food, which can lead to the growth of harmful bacteria and illness. Therefore, people may not be able to have both hot and cold food or drinks.

You are an entrepreneur looking to create a lunchbox that will keep hot foods hot and cold foods cold for as long as possible. This will help keep people safe from food-borne illnesses and provide a more pleasant eating experience.

Based on consumer surveys, lunchbox users want a lunchbox that is lightweight, pleasing to look at, and have at least two separate compartments for hot and cold foods. Consumers want a lunchbox that is able to easily hold common food items or containers, but is not too large or heavy to carry around.

In order to sell your design, you will need to produce a prototype of the lunchbox to present to potential consumers. You will be competing with other entrepreneurs to prove that your lunchbox is the best in the market.

Appendix C: Lunchbox Survey

Consumer's name _____

1. How often do you pack your lunch each week?

2. What type of lunchbox do you use? What is it made of?

3. Do you pack cold foods? _____ If yes, how do you keep them cold?

   If no, why not?

4. Do you pack hot foods? _____ If yes, how do you keep them warm?

   If no, why not?

If you think of additional questions, write them here with the consumer's answer.

5. Question: _____

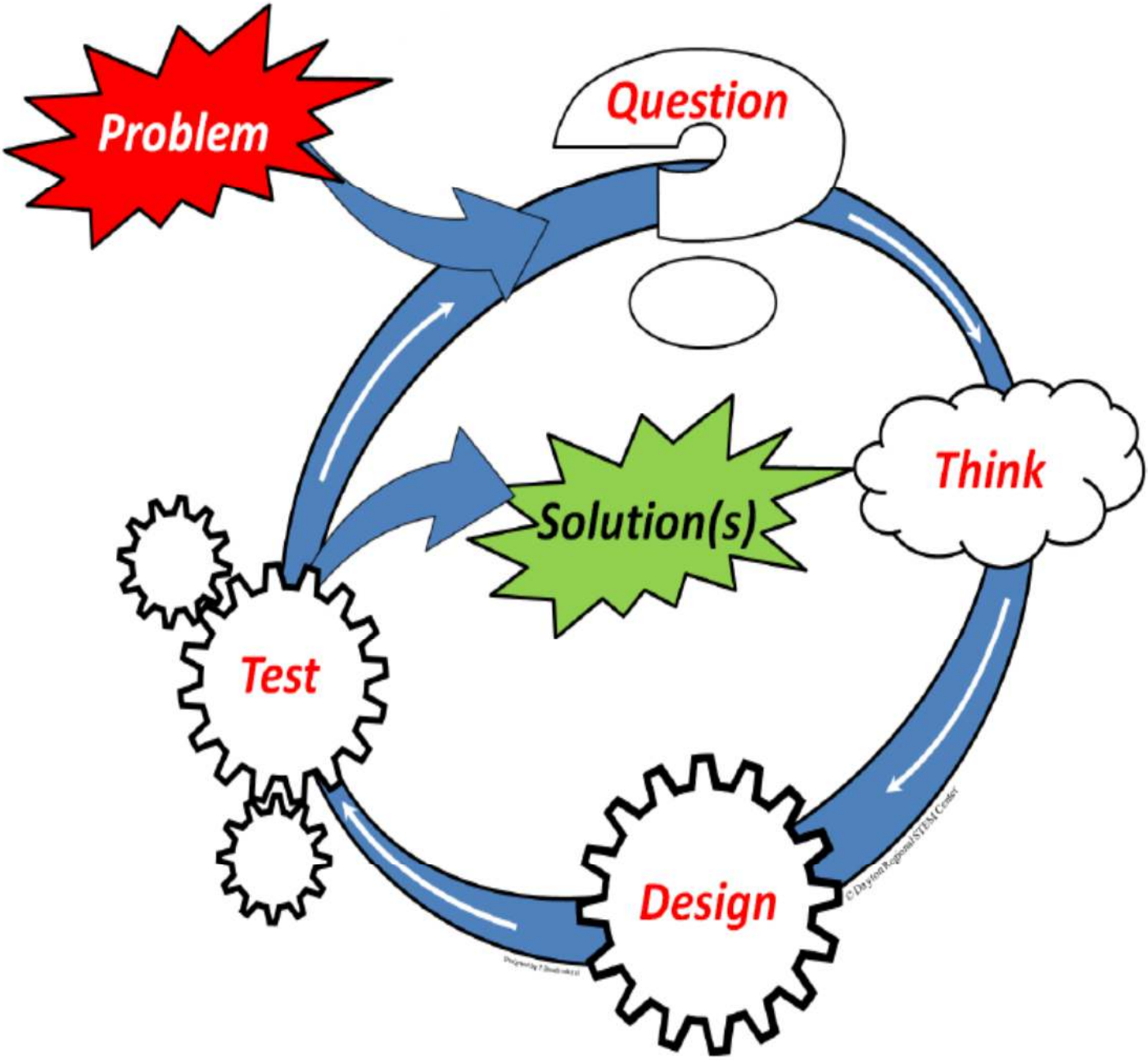
   Answer: _____

6. Question: _____

   Answer: _____

Entrepreneur's Name _____ Team _____

Appendix D: Engineering Design Process Diagram



Appendix E: Melting an Ice Cube Data Sheet

Names _____

Objective: Follow the Engineering Design Process to find the fastest way to melt an ice cube. Learn what others do and then find an even faster way.

Method One: How do you and your partner plan to melt your ice cube?

_____

_____

Weight before testing: _____ Weight after testing: _____

How much of your ice cube was melted?

A little (1)	About half (2)	Almost all (3)	All (4)

How long did it take? _____

Method Two: How do you and your team plan to melt the ice cube?

_____

_____

Weight before testing: _____ Weight after testing: _____

How much of your ice cube was melted?

A little (1)	About half (2)	Almost all (3)	All (4)

How long did it take? _____

Appendix F: How Cold Is Your Water?

Name _____

Problem: Which of the 3 cups will keep the water the coldest?

Hypothesis:

_____

Materials: 1 paper cup, 1 Styrofoam cup, 1 plastic cup

Cold water

3 Thermometers

Timer/ Stopwatch

Procedure: Pour equal amounts of water in each cup. Record the start temperature and again every 10 minutes until 40 minutes have passed.

Observation: Record in Celsius

Minutes	Temperature in Plastic Cup	Temperature in Paper Cup	Temperature in Styrofoam Cup
Start			
10			
20			
30			
40			

Conclusion:

1. Which cup kept the water the coldest?

2. What are some properties of that cup?

3. How can this information help you design a lunchbox?

4. Record your temperature observations for each cup on the line graph below.

Appendix G: Material Price List

Team _____

Material	Amount	Unit Cost	Quantity	Total
Shoebox	1	$6.00		
Cotton Balls	10	$0.25		
Plastic Wrap	12” x 12”	$0.10		
Copy Paper	1 sheet	$0.05		
Aluminum Foil	12” x 12”	$1.00		
Napkins	1	$0.05		
Craft Sticks	10	$0.40		
Bubble Wrap	12” x 12”	$1.35		
Cardboard	12” x 12”	$0.75		
Packing Peanuts	10	$1.50		
Styrofoam Cups	1	$0.10		
Total Cost				

Unit Cost x Quantity = Total
For example: 7 Styrofoam cups (7 x $0.10 = $0.70)

Appendix H: Materials Selection Matrix

Name _____

Directions: Write four materials at the top of the chart. Rank each material from best to worst. Add the scores for each material.

Material Selections	Material 1	Material 2	Material 3	Material 4
Criteria	rank	rank	rank	rank
Insulation Rank each material from 10 (worst), 20, 30, 40 (best)				
Cost Rank each material from 5 (most), 10, 15, 20 (least)				
Easy to Use Rank each material from 2 (hardest), 4, 6, 8 (easiest)				
Total for each material				

Discuss your scores with your team.

How will this information help you design your lunch box?

What materials will your team choose to use and why?

Appendix I: Lunchbox Measurement Data Sheet

Name _____

Directions: Use a ruler and the given equations to find the length, width, area, and perimeter of your lunchbox and various lunch items.

Useful Equations: Area = Length x Width

Perimeter = S1 + S2 + S3 + S4

Object	Length (cm.)	Width (cm.)	Area (cm^2)	Perimeter (cm.)
lunchbox				

Which object had the largest area? Which had the smallest area?

Which object had the largest perimeter? Which had the smallest perimeter?

What relationship, if any, do you see between area and perimeter?

When designing a lunchbox, which measurement is more important to take into consideration, area or perimeter? Why?

Challenge Find the area and perimeter of an apple, or any other non-rectangular lunch item.

Appendix J: Lunchbox Design Selection Matrix

Directions: Rank each design according to the criteria using 1, 2, 3, and 4. 4 is the best and 1 is the worst. Then multiply the value by the rank to get the score. Total each design's score at the bottom. Then total the score for each design by adding all team members' scores for each design.

Names	**Design 1** _____	**Design 2** _____	**Design 3** _____	**Design 4** _____
Criteria	**Rank**	**Rank**	**Rank**	**Rank**
Seems to be Lightweight (3-heaviest, 6, 9, 12)				
Seems to Fit Containers (8-least, 16, 24, 32-most)				
Seems to use insulation (10-worst, 20, 30, 40				
Seems most Inexpensive (5, 10, 15, 20-cheapest)				
Total				
Team Total *Add totals from each team member*				

Discuss as a team how you ranked the different criteria for each design and why you ranked them that way. Remember that criticism should be for the design, not the designer.

Appendix K: Engineering Team Role Cards

Process Engineer

Reports team progress and questions to the teacher
Keeps track of time, including using timekeeping technology
Keeps track of all student and team designs and worksheets

Data Engineer

Collects and analyzes data for the team
Makes and checks graphs for the team
Performs calculations for the team
Collaborate with Materials Science Engineer in calculating the cost of the lunchbox

Materials Science Engineer

Gathers materials for the team
Tracks how much material is being used in design construction phase
Collaborate with Math Manager in calculating the cost of the lunchbox

Design Engineer

Makes the team sketches, including labels for measurements and materials
Ensure that the lunchbox follows the design
Records any adjustments made to the design during construction

Appendix L: Performance Assessment Checklist

Our lunch box is/has:

___ Lightweight

-The total weight of our lunchbox is _____.

___ Attractive

-It is decorated with _____.

___ At least two separate compartments for hot and cold foods

-It has _____ compartments.

___ Able to fit all desired food items or containers

-We were able to fit these items together in our lunchbox:

_____

_____

_____

_____

_____

_____

___ No larger than the largest lunchbox measured in class

-Our lunchbox is ____cm wide, _____cm long, and ____cm tall.

___ Inexpensive

-The total cost of our lunchbox is $_____.

Appendix M: Performance Assessment Rubric (Teacher Version)

Name _____

	1 Basic	2 Developing	3 Proficient	4 Advanced
Engineering Design Process	Student followed at least 2 steps of the Engineering Design Process in creating a prototype.	Student followed at least 4 steps of the Engineering Design Process, not including a second design.	Student followed all the steps of the Engineering Design Process, including sketching a second design.	Meets criteria from level 3, and, in addition, student is able to explain the reasons for changes in the redesign using data gathered during testing.
Documentation	Student recorded data from at least one experiment throughout the unit.	Student recorded data in at least two experiments in addition to the final prototype testing.	Student recorded data during all experiments and tests, including the final prototype testing.	Meets criteria from level 3, and, in addition, communicates the meaning of the data clearly to others.
Prototype	Prototype meets at least 2 out of 6 constraints.	Prototype meets 3-4 out of 6 constraints.	Prototype meets 5 out of 6 constraints.	Prototype meets 6 out of 6 constraints, or student is able to explain how they will meet those constraints in a new design.
Presentation	Student participates in presenting their project to the class. Some components of the presentation are not addressed.	Student presents a section of the teams data, but does not collaborate with the team to ensure that all components are addressed in the presentation.	Student collaborates with the team in presenting all required components to the class.	Meets criteria from level 3, and, in addition, collaborates with the team in engaging the audience in a fun or original way.

Teamwork	Student participates in the team project, but does not complete tasks for his/her role. Team members have to complete portions of his/her role.	Student completes minimum required tasks within the team, but does not collaborate with others to complete other tasks.	Student fully fulfills his/her role within the team, picking up extra tasks as needed to complete the project.	Meets criteria from level 3, and, in addition, demonstrates leadership within the team.

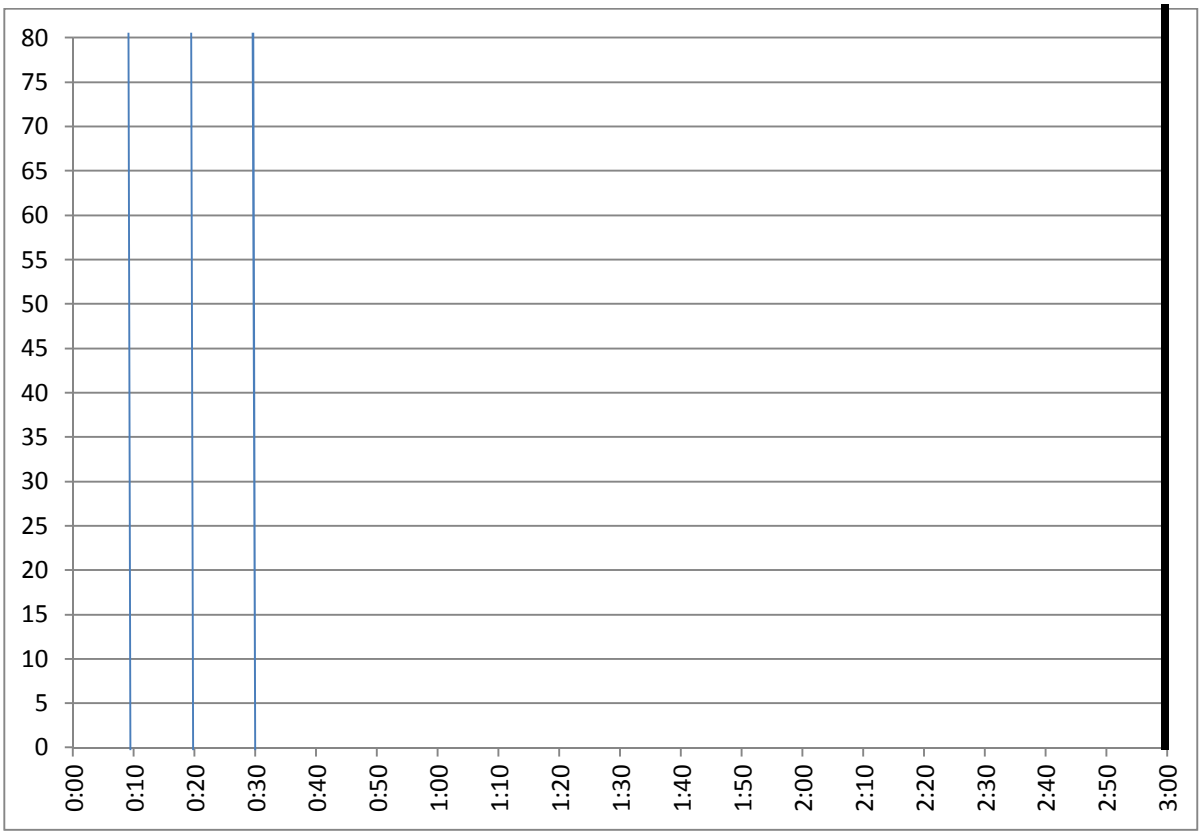
Score: _____

Appendix N: Design Test Data Sheet

Fill in the data collected during the testing of your design.

	Initial Temperature	Temperature at 10 minutes	Temperature at 20 minutes	Temperature at 30 minutes
Hot Container				
Cold Container				

Create a **line graph** of the temperature readings. Use a blue pen to graph the cold temperatures. Use a red pen for the hot temperatures.



Use a ruler to extend the lines to 3:00 (3 hours). Use the readings from 0:10 and 0:30 to set your ruler to draw your line.

Appendix O: Marketing Guide

What is the brand name of your lunchbox?

_____

Before choosing how to decorate your lunchbox, answer these questions about your target consumer:

--Who will buy this lunchbox? Boys Girls Both

--How old will the consumer be? _____

--What kind of decorations will these consumers like?

_____

_____

_____

How will you present this product to your consumers? (What will make them want to buy this lunchbox?)

Commercial

Song or jingle

Dance

Skit

PowerPoint or Prezi

Other _____

Appendix P: Prototype Analysis and Reflection

Name _____

Directions: Complete the following questions based on the results of your lunchbox design test.

Based on the results of your lunchbox test, list two ways in which your lunchbox design succeeded. Why do you think your design succeeded in the ways it did?

1.

2.

Based on the results of your lunchbox test, list two ways in which your lunchbox design failed. What do you think was the reason for this failure?

1.

2.

Discuss with your group the successes and failures of your design and come up with four changes you would make to improve your lunchbox.

1.

2.

3.

4.

Appendix Q: Optional Service Learning Component

Service-Learning is a teaching strategy that is beneficial to students and the community. It enhances instruction and teaches reflection while encouraging civic responsibility. The Service-Learning project should meet curriculum needs while providing the community with a needed and valuable service. A project should be selected that integrates subjects and increases students' motivation to learn (National Service-Learning Clearinghouse, 2013).

Suggested Service Projects for this Unit:

- Food Drive
    - Can the Principal – Fill his/her office with cans
    - Food Can Sculptures: http://canstruction.org/
- Donated Lunch Box Collection
- Work at a local food bank
- Volunteer to pack meals for kids (Backpack Buddies)
- Hold a Hunger & Homeless Awareness Week

For more information:

National Service Learning Clearinghouse: www.servicelearning.org

Ohio Campus Compact: www.ohiocampus.org

Appendix R: Peer Review

Peer Review

Name _____ Team ____

Team Members	Willingness to work	Good Ideas	Gets Along with Team	Comments

Evaluate your team members with 5 being the highest and 1 being lowest.

Peer Review

Name _____ Team ____

Team Members	Willingness to work	Good Ideas	Gets Along with Team	Comments

Evaluate your team members with 5 being the highest and 1 being lowest.