

Unit 2

Chemical Reactions and Energy:

How can we use chemical reactions
to design a solution to a problem?

Student Work Pages





Chemical Reactions and Energy

How can we use chemical reactions
to design a solution to a problem?

Student Work Pages

Core Knowledge Science



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ISBN: 978-1-68380-719-3

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How can we use chemical reactions
to design a solution to a problem?

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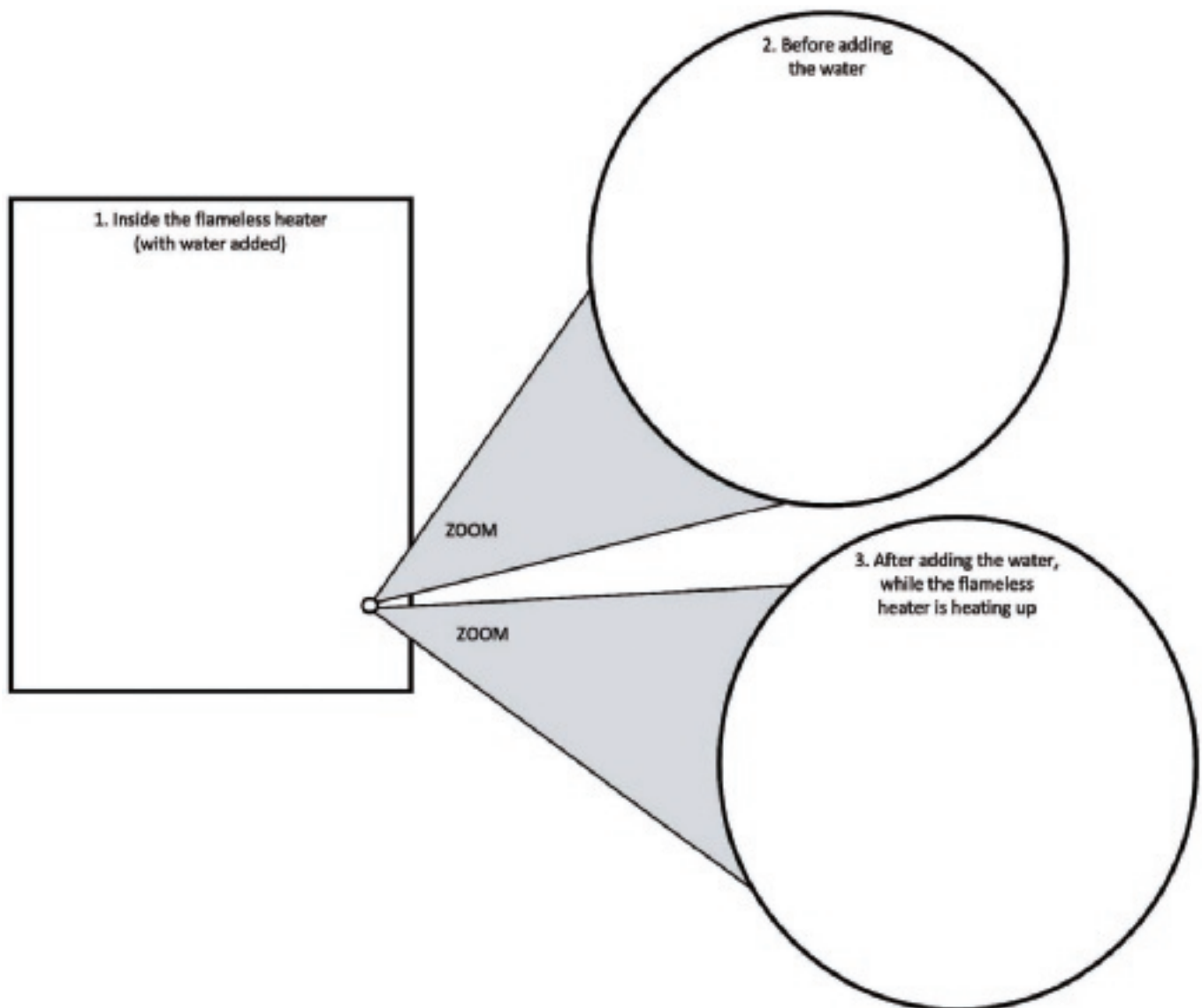
Name: _____

Date: _____

Initial Model

Develop an initial model to explain: “How does a flameless heater work to heat up food just by adding room-temperature water?”

1. In the rectangle area, draw the parts of the flameless heater we can see when water is added.
2. In the top zoom-in circle, model what you think is happening at a spot inside the flameless heater **at a scale we cannot see before** water is added.
3. In the bottom zoom-in circle, model what you think is happening at the same spot inside the flameless heater **at a scale we cannot see after** water is added, when the heater is heating up.



Name: _____

Date: _____

Initial Design Reflection

Take a moment to reflect on the process of creating and sharing your design for a do-it-yourself flameless heater.

1. What went well when creating or sharing your initial design?

2. What was difficult about creating or sharing your initial design?

Name: _____

Date: _____

Data Table for Chemical Reactions Lab

Group: _____

My role: _____

Substances used:

A.

B.

C.

Time (min)	<u>Low</u> amounts used	<u>Medium</u> amounts used	<u>High</u> amounts used
	A. _____	A. _____	A. _____
	B. _____	B. _____	B. _____
	C. _____	C. _____	C. _____
	Temperature data (°C)	Temperature data (°C)	Temperature data (°C)
0.0 (start temp)			
0.5			
1.0			
1.5			
2.0			
2.5			
3.0			
3.5			
4.0			
4.5			
5.0			
Observations:			



Safety

Ensure that the lab has engineering controls (eyewash station and shower) available.

1. Wear indirectly vented chemical splash goggles, a nonlatex apron, and nitrile gloves during the setup, hands-on, and take-down segments of the activity.
2. Immediately wipe up any spilled water on the floor—this is a slip and fall hazard.
3. Follow your teacher's instructions for disposing of waste materials.
4. Secure loose clothing, remove loose jewelry, wear closed-toe shoes, and tie back long hair.
5. Wash your hands with soap and water immediately after completing this activity.
6. Never eat any food items used in a lab activity.
7. Never taste any substance or chemical in the lab.
8. Use caution when working with heated liquids—this can burn skin!
9. Safety guidelines need to be in place for the hydrogen gas that is generated by these reactions (root killer). Guidelines should include the use of vented containers to avoid the build up of pressure and the elimination of potential ignition sources like sparks and flames. The amounts of hydrogen generated by these reactions do not pose an inhalation hazard. Use appropriate lab ventilation.

Name: _____

Date: _____

Class Data for Chemical Reactions Lab

Directions

1. Circle the highest or lowest temperature reached by the chemical process that you investigated for each amount (low, medium, and high).
2. Determine the maximum temperature change by subtracting the starting temperature from the amounts you circled. Place your group's values (including the sign +/-) in the "Maximum temperature change" column for each amount.

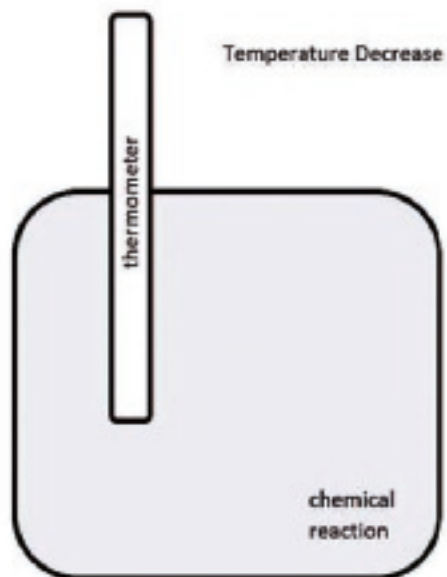
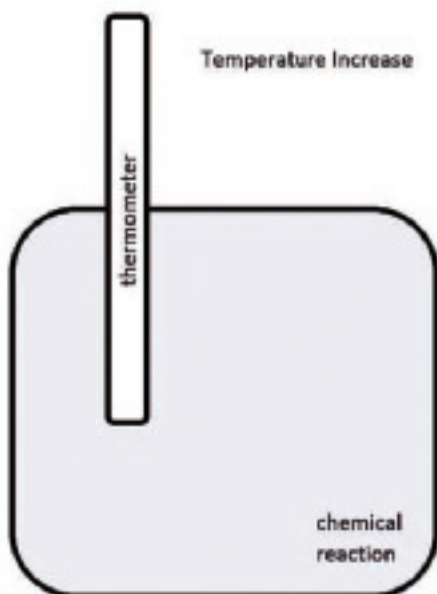
Group	Substances	Maximum temperature change	If you touched the cup, would it feel warmer or colder over time?	How do the amounts of reactants affect the temperature change?
A	Low baking soda + vinegar			
	Medium baking soda + vinegar			
	High baking soda + vinegar			
B	Low baking soda + vinegar			
	Medium baking soda + vinegar			
	High baking soda + vinegar			
C	Low steel wool + vinegar + air			
	Medium steel wool + vinegar + air			
	High steel wool + vinegar + air			
D	Low root killer + foil + saltwater			
	Medium root killer + foil + saltwater			
	High root killer + foil + saltwater			
E	Low root killer + foil + saltwater			
	Medium root killer + foil + saltwater			
	High root killer + foil + saltwater			
F	Low cabbage juice + vinegar			
	Medium cabbage juice + vinegar			
	High cabbage juice + vinegar			

Be sure you have transferred other groups' data into this table so that you can see the data from the whole class.

Use the evidence in the class data table and your prior knowledge to answer these questions in your science notebook. Any questions you have not answered will be completed as home learning. We will discuss the answers in our next class.

1. Which chemical reaction(s) caused an increase in temperature?
2. Which reaction do you think is the best candidate for trying in our homemade flameless heater?
Why do you think that?
3. Think back to what we learned in *Cup Design Unit*. What happens to particles when the temperature increases?
You can use words and/or pictures to explain your thinking.
4. What happened to the temperature when we added *more* reactants?

5. You put a thermometer into the chemical reaction. On the following diagrams that show two types of reactions, draw an arrow between the thermometer and the chemical reaction to show the direction of energy transfer in each reaction. Do this for both reactions.



Name: _____

Date: _____

Energy Transfer Models

Systems description and data	Model	Caption
1 × Rxn 1 × Food Δ Food temperature _____		
2 × Rxn 1 × Food Δ Food temperature _____		
1 × Rxn 2 × Food Δ Food temperature _____		

Name: _____

Date: _____

Analyzing Our Data Collection Methods

Part of the procedure	Why are these methods important for answering the question “Which proportion of reactants will work best?”	In what ways do the methods support accurate data collection? What suggestions do you have for improving the accuracy of our data collection?
Measuring reactants 		
Collecting temperature data 		
Examining the solids and liquids 		

Small-Group Data Table



Safety Reminder

Ensure that the lab has engineering controls (eyewash station and shower) available.

1. Wear indirectly vented chemical splash goggles, a nonlatex apron, and nitrile gloves during the setup, hands-on, and take-down segments of the activity.
2. Immediately wipe up any spilled water on the floor—this is a slip and fall hazard.
3. Follow your teacher's instructions for disposing of waste materials.
4. Secure loose clothing, remove loose jewelry, wear closed-toe shoes, and tie back long hair.
5. Wash your hands with soap and water immediately after completing this activity.
6. Never eat any food items used in a lab activity.
7. Never taste any substance or chemical in the lab.
8. Use caution when working with heated liquids—this can burn skin!
9. Safety guidelines need to be in place for the hydrogen gas that is generated by these reactions (root killer). Guidelines should include the use of vented containers to avoid the build up of pressure and the elimination of potential ignition sources like sparks and flames. The amounts of hydrogen generated by these reactions do not pose an inhalation hazard. Use appropriate lab ventilation.

Group: _____

Grams of aluminum (Al) _____

Grams of copper sulfate (CuSO_4) _____

Time (min)	Temp (°C)	Observations
0 (starting temp)		Observations about the <i>solid</i> collected in the coffee filter:
0.5		
1.0		
1.5		
2.0		
2.5		Observations about the <i>liquid</i> collected after filtering:
3.0		
3.5		
4.0		
4.5		
5.0		
Max temp change		

Design Must-Haves

Team name: _____ Class period: _____ Team members: _____

Your team will use a large piece of paper to model your design before you build your prototype. The following information must be clearly shown in your design, and your teacher must approve this design before you begin construction on your prototype.

Design must-haves	Team check	Teacher check
Use at least 250 mL of saltwater—write on your design how much you plan to use.		
The exact amounts of aluminum and copper sulfate you plan to use are listed.		
How you chose or calculated the amounts of reactants you will use and what trade-offs you had to make are explained. If you change the amount of reactants for your version 2 design, explain your reasoning (and how energy transfer has been improved since the previous design).		
A materials list including individual item costs and total cost to produce one heater is included.		
The materials you plan to use are specifically labeled in the design.		
A plan for how you will vent the gas produced during the reaction without spilling the liquid out of that opening is explicitly described.		
A way to test the temperature of your “food” at least every 5 minutes is described.		
Be sure your design includes: - an energy transfer model showing how the energy will be transferred from the reaction system to the food system and - a particle level model showing what is happening to the food when this energy is transferred to it (you may use zoom-ins to show particle motion).		

Scaling Down Design

Team name: _____ Class period: _____

Team members: _____

To make sure that each group has the opportunity to test their prototypes, every group will scale down their designs to $\frac{1}{4}$ the size. Below is a table to help your group think about all the measurements that will need to be scaled down.

- Use the first column to write in all the measurements from your design.
- Divide each measurement by 4.
- Write the new scaled-down measurements in the last column. You will use the last column to test your designs.

Note: The size of the existing containers will not match perfectly to the scaled-down size of containers your group calculates. Use a size of container that is as close to your calculations as possible.

Material	Amount or size in design	Scaling down to $\frac{1}{4}$	Scaled-down amounts for testing design
Copper sulfate		Divide "Amount in design" by 4	
Aluminum		Divide "Amount in design" by 4	
Saltwater		Divide "Amount in design" by 4	
Amount of "food" (water bead soup)		Divide "Amount in design" by 4	
Size of reaction container		Divide "Size in design" by 4	
Size of food container		Divide "Size in design" by 4	

Name: _____

Date: _____

Design Testing Matrix

	Total cost of heater	Total mass of food + reactants + packaging	Heats food to what temperature?	Time to heat food	How-to instructions
Design solution criteria and constraints					
My team's prototype	\$3 or less	700 grams or less	Heats food to 40-47°C		

How-to Instructions Must-Haves

Team name: _____ Class period: _____ Team members: _____

Design Instructions Must-Haves	Team Check
These things must be present in your instructions and match your revised full scale design: • List of materials needed to build the flameless heater • Exact amounts of aluminum, copper sulfate and saltwater needed to build the flameless heater are included. • The amounts listed reflect the actual amounts needed to build the flameless heater at scale. Remember our previous test was at $\frac{1}{4}$ scale.	
Labeled pictures/diagrams are included with steps when needed.	
Safety steps are included for before, during, and after use of this flameless heater.	
Steps are numbered.	
Each step includes one action and is easy to follow.	
Labeled pictures/diagrams are included with steps when needed.	

Name: _____

Date: _____

Exit Ticket

Below is an Energy Transfer Model similar to the one we constructed back in Lesson 3. Assume this Energy Transfer Model represents your group's design solution.

First, answer the questions that follow to consider how you will update the model using information from your group's design solution. Then, use the updated model to identify ways to optimize your design so that it raises the temperature of the food from room temperature to 40-47°C. Finally, you will revise the model to highlight and explain the modifications to your design.

Group's Design Solution									
reaction system		energy		food system		temperature increased to _____ °C			
Optimize and Update Design Solution									
temperature increased to 40-47°C									

Caption:

Questions

1. What temperature did your design solution get to? (Write it in the space on the Group's Design Solution model above that says "increased temperature to ____°C".)
2. Complete the following for your group's design:
 - a. What was the mass of reactants (total) used? _____ g
 - b. What was the mass of saltwater used? _____ g
 - c. Label the model above to show this information.
3. Complete the following for your group's design:
 - a. How much "food" (water beads) did you use to test your specific design? _____g
 - b. Label the model above to show this information.
4. Draw an updated Energy Transfer Model that optimizes your group's design solution. Consider which parts of your model that you think would be productive to change and then draw an updated model that shows the changes you think your group should implement for the redesign.
 - a. Consider how each component could be optimized and updated:
 - i. Does your group need to change the amounts of reactants? The amount of saltwater? If you do, how will you show the new amounts of each in your revised design solution?
 - ii. Does your group need to change the amount of "food"? If yes, how will you show the new amount of "food" on your design solution?
 - iii. How do you predict energy flow will change after your changes are made? How will you show the predicted new temperature? Will the size of the energy arrow change or stay the same?
 - b. Are there other components in your design that are not represented in the Energy Transfer Model that you would consider changing in order to optimize energy flow to the food? List what other parts of your group's design you might consider changing and explain how changing them would improve the function of your heater.
5. Create a caption below your revised model describing each change you made and why you chose the specific parts of your model to change. Your caption should include the following:
 - a. an explanation for how each of the changes you make will result in your food system reaching the target temperature
 - b. one or more pieces of evidence you collected from previous investigations that helped you understand that your change will result in the desired effect

Peer Feedback on Designs

(Each person completes one of these tables for each of their partner teams' designs.)

What is this team's most promising design idea or feature? And why?	What question(s) do you have?	What suggestion or idea do you have to help improve their design?

What is this team's most promising design idea or feature? And why?	What question(s) do you have?	What suggestion or idea do you have to help improve their design?

Discussion Diamond Graphic Organizer

Directions

To begin, each team member chooses a corner of the Discussion Diamond and writes

- their name and
- the top two criteria or constraints they personally think the team should change.

Round 1

- Each person gets one minute to share their rankings and to talk about the justification for why they ranked the proposed change the way that they did.
- No interruptions, no questions from other teammates

To be sure you are including justifications in your answer, use the following sentence starter:

Our design could be improved if we change _____ to _____ because _____.

Round 2

- The whole team discusses freely with one another, asking questions to specific team members and adding any ideas you may have thought of when other team members presented their ideas.
- The goal is to come to a consensus as a team about which 2-3 proposed changes you think are important to investigate further.
- Write these two proposed changes in the center of the diamond.

Name

Proposed changes

1. _____

2. _____

TEAM CONSENSUS
Changes to investigate further

1. _____

2. _____

Name

Proposed changes

1. _____

2. _____

Name

Proposed changes

1. _____

2. _____

Name

Proposed changes

1. _____

2. _____

Adapted from Wingert, K. (2016). How can I foster curiosity and learning in my classroom? Through talk! *STEM Teaching Tools Initiative, Institute for Science + Math Education*. Seattle, WA: University of Washington. Retrieved from <http://STEMteachingtools.org/brief/35>

Optional Decision Matrix for Class Practice Consequences Chart

Decision Matrix

1. Assign each criterion a color and draw a square or circle the criterion that color for reference.
2. Create a Consequences Chart on scrap paper using the colors you assign for each criterion for the arm that addresses changes to that criterion.

Criteria and constraints	Access to method	Cost	Time involved	Enjoyment	Health	Safety
Possible method	We need to have reliable access to this method.	We need to be able to afford it.	The method should not take longer than 30 minutes	We should find the method enjoyable.	This should be beneficial for mental and physical health.	The method must be safe.
Walking						
Taking the school bus						
Riding my bike						
Getting a ride						

Stakeholder Impact Chart

Who are the stakeholders that will be affected by these design changes?	In what way(s) will they be affected?	+ or -	Is this effect the intended goal of the action or is it a side effect?	Has the stakeholder placed themselves in this situation voluntarily?	How important to <u>you</u> are the interests of this stakeholder? 1 = very important 2 = somewhat important 3 = unimportant	If the effect is negative, do <u>you</u> feel it is directly offset by a greater good elsewhere?

Adapted from Edelson, D. C., Tarnoff, A., Schwille, K., Bruozas, M., & Switzer, A. (2006). Learning to make systematic decisions. *The Science Teacher*, 73(4), 40-45.

How-To Instructions Must-Haves

Team name: _____

Class period: _____

Team members: _____

Your team must also revise your how-to instructions for the assembly and use of your homemade heater. Write these instructions on a separate page. Remember that you will be handing these instructions to another team to test, so be sure they are clear and easy to follow and include any important information from *Design Must-Haves*. Consider looking at your partner team feedback on *How-to Instructions Must-Haves*, *Consequences Chart*, *Stakeholder Impact Chart*, and *Design Testing Matrix* to inform revision of your instructions.

How-to instructions must-haves	Team check	Teacher check
These things must be present in your instructions and match your revised full-scale design:		
List the materials needed to build the flameless heater.		
Exact amounts of aluminum, copper sulfate, and saltwater needed to build the flameless heater are included.		
The amounts listed reflect the actual amounts needed to build the flameless heater at scale. Remember, our previous test was at $\frac{1}{4}$ scale.		
Describe a plan for how you will safely vent the gases produced during the reaction without spilling the liquid out of that opening.		
Safety steps are included for before, during, and after use of this flameless heater.		
Steps are numbered.		
Each step includes one action and is easy to follow.		
Labeled pictures or diagrams are included with steps when needed.		

Design Must-Haves

Team name: _____ Class period: _____ Team members: _____

Your team will use a large piece of paper to model your design before you build your heater. The following information must be clearly shown in your design, and your teacher must approve this design before you begin construction on your heater.

Design must-haves	Team check	Teacher check
Design uses at least 250 mL of saltwater, and the amount you plan to use is written on your design.		
The exact amounts of aluminum and copper sulfate you plan to use are listed.		
How you chose or calculated the amounts of reactants you will use and what trade-offs you had to make is explained. If you change the amount of reactants for your version 2 design, explain your reasoning (and how energy transfer has been improved since the previous design).		
A materials list including individual item costs and total cost to produce one heater is included.		
The materials you plan to use are specifically labeled in the design.		
Reasoning (using evidence from the Consequences Chart, Stakeholder Impact Chart, and Design Testing Matrix) for why you chose/changed those materials is included. Include 2-3 trade-offs and parts of other designs you used to optimize your design.		
A materials list including individual item costs and total cost to produce one heater is included.		
The materials you plan to use are specifically labeled in the design.		
A plan for how you will vent the gas produced during the reaction without spilling the liquid out of that opening is explicitly described.		
A way to test the temperature of your "food" at least every 5 minutes is described.		
Be sure your design includes - an Energy Transfer Model showing how the energy will be transferred from the reaction system to the food system and - a particle-level model showing what is happening to the food when this energy is transferred to it (you may use zoom-in bubbles to show particle motion).		

Partner Info Sheet for Final Design

Team name: _____ Class period: _____

Team members: _____

Total cost of heater (provided by design team)	Total mass of food + reactants + packaging	Heats food to what temperature? (°C)	Time to heat food	How-to instructions (Why were they easy or hard to use?)

Design team: _____ Class period: _____

Testing team: _____

Total cost of heater (provided by design team)	Total mass of food + reactants + packaging	Heats food to what temperature? (°C)	Time to heat food	How-to instructions (Why were they easy or hard to use?)

Name: _____

Date: _____

Questions from Our DQB

Look through the list of questions from our DQB. Mark questions with how you think the class has answered them by putting the appropriate symbol next to each question.

- We did not answer this question or any parts of it yet: o
- Our class answered *some parts of* this question, or the ideas we developed help me see how I could now answer *some parts of* this question: ✓
- Our class answered this question, or the ideas we developed help me see how I could now answer this question: ✓ +

Questions from our classroom DQB

1.

Science Literacy Exercise Page 1

Use with Reading Collection 1

Roadmap for Reading

This week's reading collection focuses on how chemical reactions can preserve food and generate heat to warm food or keep your hands and feet warm on a cold day.

"Collection 1: A Hot Meal on the Go" consists of 5 selections.

- 1 What's Cooking?
- 2 Food for Thought
- 3 Military Memoir: MREs
- 4 Winter Ritual
- 5 Hot Hands for Sale!

As you read:

- Consider the general purpose of each part: is it a description, an explanation, a procedure, or an attempt to persuade?
- Consider how data and graphics support the narrative text and how narrative text clarifies the data and graphics.
- Consider how each part of the reading relates to knowledge you gained from the previous part.

Written Response

Develop a menu for a two-day hiking trip. It should include the following:

- Enough food for breakfast, lunch, and dinner for two days
- Food choices that are nutritious and delicious
- Recipes for food preparation
- Itemized list of ingredients needed

Plan your menu.

- Before you begin, review the criteria in the Evaluation Guidelines that follow to help you clearly understand the expectations of the exercise.
- Make a list of your favorite foods for breakfast, lunch, and dinner.
- Take notes on information you have gotten from the selections you have read.
- Do some research using credible sources to add to or edit your menu to make it appropriate for a two-day hiking trip.

Create your menu.

- Use your notes to create your two-day menu on a separate sheet of paper.
- Indicate how the foods you include will be prepared with recipe information. Will they require water to reconstitute them, or will they need to be heated? Indicate how many flameless heaters you will need.
- Use drawings, descriptions, photographs, or other graphics to help make your menu appealing and clear.
- Read your menu over carefully to make sure it provides a simple explanation.
- Compare your menu with someone else's, and discuss how they are the same and different.
- Attach this page to the front of your menu when you turn it in.

Evaluation Guidelines

Element	1	2	3	Feedback
Content	Incomplete or missing information	Complete but basic and simple menu choices with minimal supporting recipes	Comprehensive, varied menu plan with complete recipe support	
Argument	Not varied, nutritious, or delicious	Food choices are not varied and have minimal nutrition and appeal	Uses graphics and words that present a varied menu with nutritious and delicious food choices	
Organization	Disorganized information that is difficult to follow	Complete menu with minimal preparation information	Complete menu supported by graphics and complete preparation information	
Grammar and mechanics	Several errors or omissions	Some errors	No errors	

Additional Feedback Notes:

Science Literacy Exercise Page 2

Use with Reading Collection 2

Roadmap for Reading

This week's reading collection focuses on endothermic and exothermic chemical reactions that can be helpful or harmful.

"Collection 2: The Heat Is On" consists of 5 selections.

- 1 Exothermic and Endothermic Reactions
- 2 Chemistry Club
- 3 Thawing Out Ice Melt Myths
- 4 Never Mix These Chemicals
- 5 The Exo Expo

As you read:

- Consider the general purpose of each part: is it a description, an explanation, a procedure, or an attempt to persuade?
- Consider how data and graphics support the narrative text and how narrative text clarifies the data and graphics.
- Consider how each part of the reading relates to knowledge you gained from the previous part.

Written Response

Write a story about a chemical reaction involving household chemicals. Your story should include the following:

- A beginning that describes the setting and characters
- A climax that describes the chemical reaction
- A conclusion that explains what happened because of the chemical reaction

Plan your story.

- Before you begin, review the criteria in the Evaluation Guidelines that follow to help you clearly understand the expectations of the exercise.
- Think about the household chemicals in your home that can be combined in helpful and harmful ways.
- Take notes on information you have gotten from the selections you have read.
- Decide if you want to write a true or fictional story.
- Decide if you want to make your story funny or scary about a chemical reaction that occurs or does not occur as planned.

Create your story.

- Use your notes to write a draft of your story on a separate sheet of paper.
- Read your draft, and make sure you include the following content:
 - What chemicals were involved?
 - Who mixed the chemicals?
 - Why were the chemicals mixed?
 - What happened (or did not happen) during the chemical reaction?
 - What kinds of short-or long-term effects occurred due to the chemical reaction?
- Use drawings, descriptions, photographs, or other graphics to help make your story appealing and understandable.
- Read your story over carefully to make sure it includes all the content listed above.
- Compare your story with someone else's, and discuss how they are the same and different.
- Attach this page to the front of your story when you turn it in.

Evaluation Guidelines

Element	1	2	3	Feedback
Content	Incomplete or missing information	Basic story about a chemical reaction	Engaging story about how a chemical reaction occurred and what happened as a result	
Argument	Lacks clear understanding and connection between the events of the story	Relates what happened without extra detail	Uses graphics and words that relate the experience with a clear point	
Organization	Not a clear beginning, middle, or conclusion	Includes a beginning, middle, and ending	Compelling beginning, dramatic climax, and meaningful conclusion	
Grammar and mechanics	Several errors or omissions	Some errors	No errors	

Additional Feedback Notes:

Name: _____

Date: _____

Science Literacy Exercise Page 3

Use with Reading Collection 3

Roadmap for Reading

This week's reading collection focuses on the engineering design process and how it is applied.

"Collection 3: Putting Ideas to Work" consists of 5 selections.

- 1 The Engineering Design Process
- 2 Famous Hollywood Engineers
- 3 Funky Failed Prototypes
- 4 Gathering Feedback
- 5 Engineering in Poetry

As you read:

- Consider the general purpose of each part: is it a description, an explanation, a procedure, or an attempt to persuade?
- Consider how data and graphics support the narrative text and how narrative text clarifies the data and graphics.
- Consider how each part of the reading relates to knowledge you gained from the previous part.

Written Response

Write a poem about the engineering design process. Establish criteria for the poem that includes the following:

- a message either describing the design process, explaining a part of the design process, or reflecting on the importance of the design process
- a lesson for your readers to help them understand the design process

Plan your poem.

- Before you begin, review the criteria in the Evaluation Guidelines that follow to help you clearly understand the expectations of the exercise.
- Think about the engineering design process: identifying a problem, coming up with possible solutions, and testing and refining the product.
- Choose a topic and message about the design process you want to convey.
- Take notes on information you have gotten from the selections you have read.
- Decide what type of poem you want to write.
- Decide if you want to make your poem funny or serious.

Create your poem.

- Use your notes to write a draft of your poem on a separate sheet of paper.
- Use drawings, descriptions, photographs, or other graphics to help make your poem appealing and understandable.
- Read your poem over carefully to make sure it meets the criteria you established.
- Compare your poem with someone else's, and discuss how they are the same and different.
- Attach this page to the front of your poem when you turn it in.

Evaluation Guidelines

Element	1	2	3	Feedback
Content	Poem is not related to the design process or does not accurately describe the design process	Provides basic information about the design process in a straightforward way	Uses interesting words and rhythms to convey a meaningful message related to the design process	
Creativity	Unclear and unsupported message	Includes a message but lacks creativity	Uses graphics and words to support a meaningful and creative message	
Organization	Disorganized and difficult to follow	Straightforward organization	Creative and compelling development of ideas	
Grammar and mechanics	Several errors or omissions	Some errors	No errors	

Additional Feedback Notes:

Name: _____

Date: _____

Science Literacy Exercise Page 4

Use with Reading Collection 4

Roadmap for Reading

This week's reading collection focuses on the engineering design process and how it is applied.

"Collection 4: Good, Better, Best" consists of 5 selections.

- 1 Who Are Stakeholders?
- 2 Design Test Matrix
- 3 Science Interviews Podcast
- 4 Toothpaste to Smile About!
- 5 A Survey of Food Poisoning Victims from MREs

As you read:

- Consider the general purpose of each part: is it a description, an explanation, a procedure, or an attempt to persuade?
- Consider how data and graphics support the narrative text and how narrative text clarifies the data and graphics.
- Consider how each part of the reading relates to knowledge you gained from the previous part.

Written Response

Describe at least five stakeholders for a product or service. Establish criteria that includes the following:

- a description of the product or service you chose
- a profile of each stakeholder explaining what interest they have in the product

Plan your descriptions.

- Before you begin, review the criteria in the Evaluation Guidelines that follow to help you clearly understand the expectations of the exercise.
- Choose a product or service that you like or would like to have.
- Think about the different people involved in designing, producing, selling, buying, and using the product or service.
- Identify what kinds of people or organizations/groups would have a special interest in the product or service.
- Take notes on the information you have gotten from the selections you read.
- Decide what format your description will take. Will you profile each stakeholder as if they were a character in a movie, or will you make a bulleted list or create a chart?
- Compile the same information about each stakeholder so that your reader can compare their interests.

Create your descriptions.

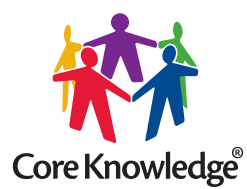
- Use your notes to write a draft of your descriptions on a separate sheet of paper.
- Use drawings, photographs, or other graphics to help make your descriptions appealing and understandable.
- Read your descriptions over carefully to make sure they meet the criteria you established.
- Compare your descriptions with someone else's and discuss how they are the same and different.
- Attach this page to the front of your descriptions when you turn them in.

Science Literacy Exercise Page 4, Continued

Evaluation Guidelines

Element	1	2	3	Feedback
Content	Does not include basic information about different stakeholders in a product/service	Includes basic information about each stakeholder in a product/service	Creatively describes each stakeholder so that their differences are obvious	
Argument	Lacks understanding of the different types of stakeholders and their interests	Demonstrates understanding of differences in stakeholders	Uses graphics and words to show distinct differences among stakeholder interests	
Organization	Disorganized descriptions that are difficult to follow	Descriptions are straightforward and organized	Descriptions are creative and include a related comparison that is easy to understand	
Grammar and mechanics	Several errors or omissions	Some errors	No errors	

Additional Feedback Notes:



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