

# ✓ Chemical Reactions & Energy Notebook Check

Present

Complete

- ✓ Notebook Divider
- Progress Tracker
  - Entry 1 (defined problem)
  - Entry 2 (tested parts of solution/models)
  - Entry 3 (Refined what it needs to do)
- MRE Notice & Wonder
- MRE Initial Model
- Comparing Models T Chart
- Hand Warmer & MRE Heater Temp Chart
- Beaker Mystery
- Data Table for Chemical Reactions Lab
- Energy Transfer Model
- Analyzing Data Collection Methods
- Small Group Data Table
- Focal Question / Notes

\_\_\_\_\_'s Notebook | Scored by: \_\_\_\_\_

## Chemical Reactions & Energy

- MS-P21-4: Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.
- MS-ESS1-2: Evaluate competing design solutions using a systematic process to determine how well each design meets the criteria and constraints of the problem defined by the design challenge and identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- MS-ESS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

## Chemical Reactions & Energy Progress Tracker



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| Progress Tracker pg. ____                                                           |                                                                                                         |
|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| Unit Question: How can we use chemical reactions to design a solution to a problem? |                                                                                                         |
| What did we do as engineers?                                                        | What did we figure out that can help us with our design?                                                |
| we identified our problem                                                           | dire expensive<br>• can be hard to get<br>• may not be able to eat the food<br>• not know how to use it |

| Progress Tracker pg. ____                                                           |                                                                             |
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| What did we do as engineers?                                                        | What did we figure out that can help us with our design?                    |
| we identified criteria and constraints                                              | criteria for our<br>Homemade flameless<br>heater:<br>• effective - gets hot |

| Progress Tracker pg. 2                                                              |                                                                                                                                                                                                                                                                   |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| we test parts of our design solution                                                | • We tested the temperature change when hand warmers are activated and the temperature change in MRE heaters<br>• MRE heaters get much warmer<br>• classmates tested different chemical reaction.<br>• we will use copper sulfate (Rust Killer) and Aluminum foil |

| Progress Tracker pg. 3                                                              |                                                                                                                    |
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| What did we do as engineers?                                                        | What did we figure out that can help us with our design?                                                           |
| we refined what our solution needs to do                                            | • the heater should be under 40g<br>• weigh less than 750g<br>• needs to be 40-60°C (when you activate the heater) |

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| Progress Tracker pg. 3                                                              |                                                                                                                    |
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Heating food with a  
MRE Heater

- | N                                                                                                                                                                                                                                                                                                                                                                                                                                         | W                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Heater contains Chili, Heater, cheese spread, napkins, candy, sports drink mix, cookies, nuts, Raisin mix and crackers (a lot of stuff, packed in one bag)</li> <li>• The heater looks like a hand warmer</li> <li>• when you heat it it expands</li> <li>• you can hear bubbling</li> <li>• it smells a little</li> <li>• the <del>box</del> box was hot</li> <li>• it heats up fast</li> </ul> | <ul style="list-style-type: none"> <li>• Does the heater work a hand warmer like</li> <li>• How much do they cost</li> <li>• How long exactly do they last</li> <li>• what do they taste like</li> </ul> |

Situations where MRE would be useful

- war
- natural disasters
- if you stranded
- Search and rescue
- camping
- power outage
- cold
- Apocalypse

Related phenomena

- Hand warmers



Pres✓

Pres✓

- Pres✓

Pres✓

Date: Dec. 8/9, 2022 Per. 3

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41

- 41



| Similar                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Different                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Similarity is a measure of how alike two things are.</li> <li>• It is a relative measure, meaning it is only meaningful when compared to other things.</li> <li>• Similarity can be measured in many ways, such as by comparing physical characteristics, behavior, or opinions.</li> <li>• Similarity is often used to group things together, such as in classification or clustering.</li> <li>• Similarity is a key concept in many fields, including psychology, sociology, and computer science.</li> </ul> | <ul style="list-style-type: none"> <li>• Difference is a measure of how unlike two things are.</li> <li>• It is a relative measure, meaning it is only meaningful when compared to other things.</li> <li>• Difference can be measured in many ways, such as by comparing physical characteristics, behavior, or opinions.</li> <li>• Difference is often used to distinguish things from one another, such as in classification or clustering.</li> <li>• Difference is a key concept in many fields, including psychology, sociology, and computer science.</li> </ul> |

Similar

## Different

- Same symbol to represent water
- we both show how the bag is ho with stem th

• mini used pots to  
repersen the stuff  
inside the heater will  
I used triegs  
• used circles = 0  
and I lost  
combined the =  $\Delta = 8$

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Hand warmer 36 44

|                  | 0 min | 5 min                                | 10 min | 15 min                                                                                        |
|------------------|-------|--------------------------------------|--------|-----------------------------------------------------------------------------------------------|
| Temperature (°C) |       | 81.7                                 | 89.5   | 90.8                                                                                          |
| Notes            |       | It's gray<br>thick, powdery<br>solid |        | has more<br>chunks, not<br>as fine of<br>a powder<br>there's also<br>a little orange<br>in it |

Mass before  
mass of MRE heater: 30.54g, mass of  
everything: 98.30g  
mass of the rest of the  
setup: 70.50g  
Total ~ 101.04g

Mass before  
mass of beaker warmer  
(sh. bin) with the  
rest of the setup: 36.16g

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Chemical Reactions & Energy

## BEAKER MYSTERY

Before color: Make 3 observations about each beaker:

Beaker 1:

1. clear
2. pretty sure it's water
- 3.

Beaker 2:

1. looks pretty much the same
2. the same
3. there is steam coming out of it

After color: Make 3 observations about each beaker and draw a sketch of the beakers:

Beaker 1:

1. it turns purple
2. the color is all over it
- 3.



Beaker 2:

1. stays more or less the same
2. it makes bubbles
- 3.



1. Based on your observations, what do you think the difference is between the two beakers?

1. Beaker 1 is cold water, Beaker 2 is hot water

2. What could be the reasoning for the difference in how the food coloring dispersed in the liquid? (Explain the science. Why did this happen?)

- when a substance is hot the atoms move fast so that would move the atoms of food coloring faster than cold atoms which would move slower.

## HEAT & TEMPERATURE

### Data Table for Chemical Reactions Lab

Group: A+B My Role: \_\_\_\_\_ Date: \_\_\_\_\_

Substances used:

A. Baking Soda

B. Vinegar

C.

| Time (min)       | Low amounts used |      | Medium amounts used |      | High amounts used |      |
|------------------|------------------|------|---------------------|------|-------------------|------|
|                  | A                | B    | A                   | B    | A                 | B    |
| 0.0 (start temp) | 19.2             | 19.2 | 21.2                | 21.2 | 21.2              | 21.2 |
| 0.5              | 19.4             | 17.5 | 17.5                | 17.1 | 17.1              | 17.1 |
| 1.0              | 20.1             | 17.5 | 17.5                | 17.5 | 17.5              | 17.5 |
| 1.5              | 20.3             | 17.8 | 17.8                | 18.3 | 18.3              | 18.3 |
| 2.0              | 20.4             | 17.8 | 17.8                | 18.1 | 18.1              | 18.1 |
| 2.5              | 20.6             | 17.8 | 17.8                | 19   | 19                | 19   |
| 3.0              | 20.7             | 18   | 18                  | 19.1 | 19.1              | 19.1 |
| 3.5              | 20.9             | 18.2 | 18.2                | 19.1 | 19.1              | 19.1 |
| 4.0              | 21.0             | 18.5 | 18.5                | 19.2 | 19.2              | 19.2 |
| 4.5              | 21.0             | 18.6 | 18.6                | 19.2 | 19.2              | 19.2 |
| 5.0              | 21.5             | 19.2 | 19.2                | 19.2 | 19.2              | 19.2 |

Observations:

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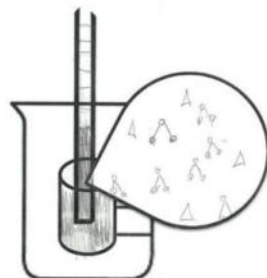
Chemical Reactions & Energy

## **Build your own thermometer:**

1. Fill the bottle half full with the red rubbing alcohol and water mixture.
2. Use an index card and permanent marker to mark the straw with equal increment marks
3. Put the straw in the bottle.
4. Use the modeling clay to wrap around where the straw enters the bottle. Position the straw so that the liquid does NOT touch the bottom or the side of the bottle.
5. Use a pipette to drop liquid into the straw so that the liquid is visible above the bottle.
6. Your thermometer is now ready to record some data!
7. Draw a sketch of your thermometer in both the hot and cold water.
8. Sketch the zoom-in (on a scale you cannot see) to show the differences in water molecules.



HOT water



COLD water

HEAT & TEMPERATURE

used  
data (°C)



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Name: \_\_\_\_\_

Date: 1/26/23

## Energy Transfer Models

| Systems description and data                                 | Model | Caption                                                                                                     |
|--------------------------------------------------------------|-------|-------------------------------------------------------------------------------------------------------------|
| 1X Run<br>1X Food<br><br>A Food temperature<br><u>29.6°C</u> |       | There is one Reaction system going how to one Food system making a little difference                        |
| 2X Run<br>1X Food<br><br>A Food temperature<br><u>48°C</u>   |       | There are double the reactions so that means the energy would be double make the temp go up.                |
| 1X Run<br>2X Food<br><br>A Food temperature<br><u>29°C</u>   |       | There is only one Reaction system and two food systems so the energy has to spread out making the heat less |

## Small-Group Data Table

Group: A

Grams of aluminum (Al): 1

Grams of Root Killer: 5.9  
copper sulfate (CuSO<sub>4</sub>)

| Time (min/sec)         | Temp (°C)   | Observations                                                 |
|------------------------|-------------|--------------------------------------------------------------|
| 0/0<br>(starting temp) | <u>19.6</u> | Observations about the solid collected in the coffee filter: |
| 0.5/30                 | <u>19.8</u> |                                                              |
| 1.0/60                 | <u>20.4</u> |                                                              |
| 1.5/90                 | <u>26.8</u> |                                                              |
| 2.0/120                | <u>29.8</u> |                                                              |
| 2.5/150                | <u>30.2</u> | Observations about the liquid collected after filtering:     |
| 3.0/180                | <u>30</u>   |                                                              |
| 3.5/210                | <u>29.8</u> |                                                              |
| 4.0/240                | <u>29.5</u> |                                                              |
| 4.5/270                | <u>29.3</u> |                                                              |
| 5.0/300                | <u>29</u>   |                                                              |
| Max temp change        | <u>9.4</u>  |                                                              |

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Date: 1/23/23 Per: 3

## 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             | The digital scale allows us to measure different amounts of reactants.                                     | <ul style="list-style-type: none"> <li>• Digital pocket scale</li> <li>• Prevents spilling</li> <li>• Zero after placing parchment</li> <li>• Record at the best time</li> <li>• (1) 1.0 gram</li> </ul>             |
| Collecting temperature data     | We can find the one with the lowest temperature change.                                                    | <ul style="list-style-type: none"> <li>• Use the thermometer</li> <li>• At the sides of cup</li> <li>• Use both thermometers</li> <li>• Gently swirl cup constantly</li> </ul>                                       |
| Examining reactants and liquids | We can find the one with the lowest temperature change.                                                    | <ul style="list-style-type: none"> <li>• Funnel allows us to add reactants</li> <li>• Prevents spillage</li> <li>• Gently swirl cup constantly</li> <li>• Record at the best time</li> <li>• (1) 1.0 gram</li> </ul> |

Look on other Page for 49

## Focal questions what we figured out

|                                                                 |                          |
|-----------------------------------------------------------------|--------------------------|
| What temp is to hot                                             | 48°C and up can burn you |
| A) how warm dose need to get to a certain temp to avoid illness | above 60°C               |
| B) how warm dose need to get for people to enjoy it             | 40°C                     |