

Grade 7 Science

Unit 2: Chemical Reactions and Energy

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

15 lessons (investigations and weekly readings) and a words quiz. Use this pack with the unit's **Teacher Guide**, **Student Procedure Guide**, **Student Work Pages** and **Science Literacy Student Reader** (download them once from the course) to teach the whole unit without the internet.

What is in this pack

- A plan for each lesson: the lesson question, how many class days it takes, the Teacher Guide pages to follow, and the student pages to print.
- For each weekly reading: the Student Reader pages, words to know and the exercise page.
- The words quiz, ready to print, with its key at the back.

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Lesson schedule

Each investigation lesson takes the number of class days shown (about 45 minutes a day). Do each reading over a week alongside the lessons. Tick each one off as you go.

	Lesson	Days	Student pages
☐	Reading: Science Literacy Preface: Put Yourself in This Scene	1 week	—
☐	Lesson 1: How can we heat up food when we don't have our typical methods available?	3	3 to print
☐	Lesson 2: How do heaters get warm without a flame?	2	3 to print
☐	Reading: Science Literacy Collection 1: A Hot Meal on the Go	1 week	1 to print
☐	Lesson 3: What other chemical reactions could we use to heat up food?	3	6 to print
☐	Lesson 4: How much of each reactant should we include in our homemade flameless heater?	2	4 to print
☐	Reading: Science Literacy Collection 2: The Heat Is On	1 week	1 to print
☐	Lesson 5: How can we refine our criteria and constraints?	1	4 to print
☐	Lesson 6: How can we redesign our homemade flameless heater?	3	7 to print
☐	Lesson 7: How did our design compare to others in the class?	1	2 to print
☐	Reading: Science Literacy Collection 3: Putting Ideas to Work	1 week	1 to print
☐	Lesson 8: What effects might result from our design changes?	2	4 to print
☐	Lesson 9: What is our optimal design for a homemade flameless heater?	3	5 to print
☐	Lesson 10: How can we decide between competing designs?	1	1 to print
☐	Reading: Science Literacy Collection 4: Good, Better, Best	1 week	1 to print

	Lesson	Days	Student pages
☐	Words quiz	—	—

Page numbers are PDF page numbers of each file, so they match what your PDF reader shows.

Reading: Science Literacy Preface: Put Yourself in This Scene

Words to know

- **flameless heater** — self-heating food packaging included an object with Meals, Ready-to-Eat (MREs)
- **science literacy** — the ability to read, hear, and comprehend information about scientific topics and demonstrate understanding in discussion and through writing
- **skepticism** — doubt about the proven truthfulness of something

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 25–28: the steps, materials and timing for this lesson.

Read

Read Science Literacy Student Reader, Preface: “Put Yourself in This Scene”: PDF pages 6–7. Look at the pictures and maps together.

Check for understanding

- Use one of today's words in a sentence of your own.

Lesson 1: How can we heat up food when we don't have our typical methods available?

LESSON QUESTION

How can we heat up food when we don't have our typical methods available?

Plan about **3 class days** for this lesson.

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 29–60: the steps, materials and timing for this lesson.

Student pages to print

- Student procedures for this lesson — Student Procedure Guide, PDF pages 6–12
- Initial Model — Student Work Pages, PDF pages 7–8
- Initial Design Reflection — Student Work Pages, PDF pages 9–10

For the teacher

- Teacher Reference — Teacher Guide, PDF pages 301–303

Check for understanding

- Explain your answer to the lesson question, using evidence from your investigation:
How can we heat up food when we don't have our typical methods available?

Lesson 2: How do heaters get warm without a flame?

LESSON QUESTION

How do heaters get warm without a flame?

Plan about **2 class days** for this lesson.

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 61–90: the steps, materials and timing for this lesson.

Student pages to print

- Student procedures for this lesson — Student Procedure Guide, PDF pages 13–15
- Reference: Ingredient List for MRE Heater — Student Procedure Guide, PDF pages 47–48
- Reference: Ingredient List for Hand Warmer — Student Procedure Guide, PDF page 49

For the teacher

- Teacher Reference — Teacher Guide, PDF pages 304–307

Check for understanding

- Explain your answer to the lesson question, using evidence from your investigation:
How do heaters get warm without a flame?

Reading: Science Literacy Collection 1: A Hot Meal on the Go

Words to know

- **chemical reaction** — a process that involves converting one or more substances (the reactants) into one or more other substances (the products) by rearranging their atoms
- **criteria** — the goals that a design needs to meet
- **reconstitute** — to restore food to its original form by adding water to it

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 91-97: the steps, materials and timing for this lesson.

Read

Read Science Literacy Student Reader, Collection 1: "A Hot Meal on the Go": PDF pages 8-17. Look at the pictures and maps together.

Student pages to print

- Exercise Page 1 — Student Work Pages, PDF pages 49-50

Check for understanding

- Use one of today's words in a sentence of your own.

Lesson 3: What other chemical reactions could we use to heat up food?

LESSON QUESTION

What other chemical reactions could we use to heat up food?

Plan about **3 class days** for this lesson.

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 98–140: the steps, materials and timing for this lesson.

Student pages to print

- Student procedures for this lesson — Student Procedure Guide, PDF pages 16–21
- Data Table for Chemical Reactions Lab — Student Work Pages, PDF pages 11–12
- Class Data for Chemical Reactions Lab — Student Work Pages, PDF pages 13–16
- Energy Transfer Models — Student Work Pages, PDF pages 17–18
- Reference: Chemical Reactions Lab Instructions — Student Procedure Guide, PDF pages 50–56
- Reference: Some Common Gases — Student Procedure Guide, PDF page 57

For the teacher

- Teacher Reference 1 — Teacher Guide, PDF pages 308–313
- Rubric — Teacher Guide, PDF pages 314–315
- Answer Key — Teacher Guide, PDF pages 316–317

Check for understanding

- Explain your answer to the lesson question, using evidence from your investigation: What other chemical reactions could we use to heat up food?

Lesson 4: How much of each reactant should we include in our homemade flameless heater?

LESSON QUESTION

How much of each reactant should we include in our homemade flameless heater?

Plan about **2 class days** for this lesson.

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 141–162: the steps, materials and timing for this lesson.

Student pages to print

- Student procedures for this lesson — Student Procedure Guide, PDF pages 22–24
- Analyzing Our Data Collection Methods — Student Work Pages, PDF pages 19–20
- Small-Group Data Table — Student Work Pages, PDF pages 21–22
- Reference: Investigation Procedure for Proportion of Reactants — Student Procedure Guide, PDF pages 58–61

For the teacher

- Teacher Reference — Teacher Guide, PDF pages 318–320
- Answer Key — Teacher Guide, PDF page 321

Check for understanding

- Explain your answer to the lesson question, using evidence from your investigation:
How much of each reactant should we include in our homemade flameless heater?

Reading: Science Literacy Collection 2: The Heat Is On

Words to know

- **chemical reaction** — a process that involves converting one or more substances (the reactants) into one or more other substances (the products) by rearranging their atoms
- **effective** — successful; producing the desired results
- **endothermic reaction** — a chemical reaction in which energy is absorbed
- **exothermic reaction** — a chemical reaction in which energy is released
- **product** — a substance in the system at the end of a chemical reaction
- **reactant** — a substance in the system at the start of a chemical reaction
- **test** — in engineering and design, to try out a solution

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 163–168: the steps, materials and timing for this lesson.

Read

Read Science Literacy Student Reader, Collection 2: “The Heat Is On”: PDF pages 18–27. Look at the pictures and maps together.

Student pages to print

- Exercise Page 2 — Student Work Pages, PDF pages 51–52

Check for understanding

- Use one of today's words in a sentence of your own.

Lesson 5: How can we refine our criteria and constraints?

LESSON QUESTION

How can we refine our criteria and constraints?

Plan about **1 class days** for this lesson.

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 169–185: the steps, materials and timing for this lesson.

Student pages to print

- Student procedures for this lesson — Student Procedure Guide, PDF pages 25–26
- Reading: How hot does food need to get so that people do not get sick? — Student Procedure Guide, PDF pages 63–64
- Reading: What temperatures cause scald burn injuries? — Student Procedure Guide, PDF page 65
- Reading: What temperature range makes food enjoyable to eat? — Student Procedure Guide, PDF pages 66–72

Check for understanding

- Explain your answer to the lesson question, using evidence from your investigation: How can we refine our criteria and constraints?

Lesson 6: How can we redesign our homemade flameless heater?

LESSON QUESTION

How can we redesign our homemade flameless heater?

Plan about **3 class days** for this lesson.

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 186–218: the steps, materials and timing for this lesson.

Student pages to print

- Student procedures for this lesson — Student Procedure Guide, PDF pages 27–32
- Design Must-Haves — Student Work Pages, PDF pages 23–24
- Scaling Down Design — Student Work Pages, PDF pages 25–26
- Design Testing Matrix — Student Work Pages, PDF pages 27–28
- How-to Instructions Must-Haves — Student Work Pages, PDF pages 29–30
- Exit Ticket — Student Work Pages, PDF pages 31–32
- Reference: Materials Cost List — Student Procedure Guide, PDF page 62

For the teacher

- Teacher Reference — Teacher Guide, PDF pages 322–323
- Teacher Reference 2 — Teacher Guide, PDF pages 324–329
- Rubric 1 — Teacher Guide, PDF page 330
- Rubric 2 — Teacher Guide, PDF pages 331–334
- Answer Key — Teacher Guide, PDF pages 335–337

Check for understanding

- Explain your answer to the lesson question, using evidence from your investigation:
How can we redesign our homemade flameless heater?

Lesson 7: How did our design compare to others in the class?

LESSON QUESTION

How did our design compare to others in the class?

Plan about **1 class days** for this lesson.

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 219–229: the steps, materials and timing for this lesson.

Student pages to print

- Student procedures for this lesson — Student Procedure Guide, PDF pages 33–34
- Peer Feedback on Designs — Student Work Pages, PDF pages 33–34

Check for understanding

- Explain your answer to the lesson question, using evidence from your investigation:
How did our design compare to others in the class?

Reading: Science Literacy Collection 3: Putting Ideas to Work

Words to know

- **constraints** — the limitations of a design
- **criteria** — the goals that a design needs to meet
- **effective** — successful; producing the desired results
- **engineering design process** — the steps that engineers go through when designing something new or improving a design
- **feedback** — returned information that can affect future performance
- **product** — a substance in the system at the end of a chemical reaction
- **quantifiable** — can be counted or measured
- **simulate** — to imitate the function or appearance of something else
- **symbolism** — a literary method of using words or other means to represent something else, such as an idea or
- **test** — in engineering and design, to try out a solution

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 230–236: the steps, materials and timing for this lesson.

Read

Read Science Literacy Student Reader, Collection 3: “Putting Ideas to Work”: PDF pages 28–37. Look at the pictures and maps together.

Student pages to print

- Exercise Page 3 — Student Work Pages, PDF pages 53–54

Check for understanding

- Use one of today's words in a sentence of your own.

Lesson 8: What effects might result from our design changes?

LESSON QUESTION

What effects might result from our design changes?

Plan about **2 class days** for this lesson.

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 237–254: the steps, materials and timing for this lesson.

Student pages to print

- Student procedures for this lesson — Student Procedure Guide, PDF pages 35–37
- Discussion Diamond Graphic Organizer — Student Work Pages, PDF pages 35–36
- Optional Decision Matrix for Class Practice Consequences Chart — Student Work Pages, PDF pages 37–38
- Stakeholder Impact Chart — Student Work Pages, PDF pages 39–40

For the teacher

- Teacher Reference 1 — Teacher Guide, PDF pages 338–344
- Teacher Reference 2 — Teacher Guide, PDF pages 345–347

Check for understanding

- Explain your answer to the lesson question, using evidence from your investigation: What effects might result from our design changes?

Lesson 9: What is our optimal design for a homemade flameless heater?

LESSON QUESTION

What is our optimal design for a homemade flameless heater?

Plan about **3 class days** for this lesson.

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 255–275: the steps, materials and timing for this lesson.

Student pages to print

- Student procedures for this lesson — Student Procedure Guide, PDF pages 38–44
- How-to Instructions Must-Haves — Student Work Pages, PDF pages 41–42
- Design Must-Haves — Student Work Pages, PDF pages 43–44
- Partner Info Sheet for Final Design — Student Work Pages, PDF pages 45–46
- Questions from Our DQB — Student Work Pages, PDF pages 47–48

For the teacher

- Rubric — Teacher Guide, PDF pages 348–350

Check for understanding

- Explain your answer to the lesson question, using evidence from your investigation:
What is our optimal design for a homemade flameless heater?

Lesson 10: How can we decide between competing designs?

LESSON QUESTION

How can we decide between competing designs?

Plan about **1 class days** for this lesson.

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 276–281: the steps, materials and timing for this lesson.

Student pages to print

- Student procedures for this lesson — Student Procedure Guide, PDF pages 45–46

For the teacher

- Rubric — Teacher Guide, PDF pages 351–364
- Answer Key 1 — Teacher Guide, PDF pages 365–381

Check for understanding

- Explain your answer to the lesson question, using evidence from your investigation:
How can we decide between competing designs?

Reading: Science Literacy Collection 4: Good, Better, Best

Words to know

- **constraints** — the limitations of a design
- **criteria** — the goals that a design needs to meet
- **engineering design process** — the steps that engineers go through when designing something new or improving a design
- **product** — a substance in the system at the end of a chemical reaction
- **stakeholder** — an individual who has an interest in something
- **test** — in engineering and design, to try out a solution

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 282–288: the steps, materials and timing for this lesson.

Read

Read Science Literacy Student Reader, Collection 4: “Good, Better, Best”: PDF pages 38–47. Look at the pictures and maps together.

Student pages to print

- Exercise Page 4 — Student Work Pages, PDF pages 55–59

Check for understanding

- Use one of today's words in a sentence of your own.

WORDS QUIZ

Chemical Reactions and Energy

Name: _____ Date: _____

Circle the letter of the best answer.

1. Which word means “to make the best, most effective, and most to determine how it performs in comparison efficient use of a design or solution with expectations (n. a procedure for evaluating performance)”?

- a) criteria
- b) optimize
- c) exothermic reaction
- d) quantifiable

2. Which word means “successful; producing the desired results”?

- a) feedback
- b) chemical reaction
- c) effective
- d) symbolism

3. Which word means “a chemical reaction in which energy is released”?

- a) efficient
- b) reactant
- c) constraints
- d) exothermic reaction

4. Which word means “a substance in the system at the end of a chemical reaction”?

- a) product
- b) endothermic reaction
- c) quantifiable
- d) science literacy

5. Which word means “the steps that engineers go through when designing something new or improving a design”?

- a) optimize
- b) stakeholder
- c) engineering design process
- d) chemical reaction

6. Which word means “a process that involves converting one or more substances (the reactants) into one or more other substances (the products) by rearranging their atoms”?

- a) simulate
- b) quantifiable
- c) feedback
- d) chemical reaction

- 7.** Which word means “to imitate the function or appearance of something else”?
- a) engineering design process
 - b) stakeholder
 - c) symbolism
 - d) simulate
- 8.** Which word means “returned information that can affect future performance”?
- a) constraints
 - b) efficient
 - c) feedback
 - d) chemical reaction
- 9.** Which word means “a literary method of using words or other means to represent something else, such as an idea or”?
- a) symbolism
 - b) product
 - c) reconstitute
 - d) endothermic reaction
- 10.** Which word means “can be counted or measured”?
- a) reactant
 - b) effective
 - c) constraints
 - d) quantifiable
- 11.** Which word means “a chemical reaction in which energy is absorbed”?
- a) endothermic reaction
 - b) efficient
 - c) product
 - d) symbolism
- 12.** Which word means “to restore food to its original form by adding water to it”?
- a) optimize
 - b) reconstitute
 - c) simulate
 - d) chemical reaction

FOR THE TEACHER

Answers

Unit quiz key

1. b 2. c 3. d 4. a 5. c 6. d 7. d 8. c 9. a 10. d 11. a 12. b