Louisiana Believes

Distance Learning Support for OpenSciEd Grade 8
Unit 7.2 Chemical Reactions and Energy

This resource is designed to support teachers in implementing distance learning for OpenSciEd Grade 7 Unit 7.2, Unit 4 in the Louisiana Guide to Piloting OpenSciEd Grade 8. It is intended as a supporting document and should be used in conjunction with the OpenSciEd Unit 7.2 Teacher Edition. The resources contained in this document have been adapted from OpenSciEd with permission under Creative Commons 4.0 licensing.

The OpenSciEd Remote Learning Resources linked below contain detailed information about adapting specific routines to a remote learning environment and a wide variety of options including those for students who do not have internet access:

- Fostering Productive Norms
- Anchor Phenomenon Routine
- Navigation Routine
- Supporting Discourse
- Problematizing Routine

This guidance document is considered a "living" document as we believe that teachers and other educators will find ways to improve the document as they use it. Please send feedback to STEM@la.gov so that we may use your input when updating this guide.

Updated December 29, 2021

DEPARTMENT of EDUCATION
Louisiana Believes

Norming Language	
Term	**Description**
Virtual Class Pre-Work	Assignments that students should do prior to virtual class meetings in order to be prepared to engage in discussions, there may be multiple assignments throughout a given lesson
Virtual Class Post-Work	Assignments designed for students to apply learning from virtual class meetings, there may be multiple assignments throughout a given lesson
Virtual Class	Live sessions with students through any digital conferencing platform, teachers may choose to allow students without internet to call in during these sessions and record virtual class sessions to share with those who cannot join
Thinking Deeper Documents	Progress trackers for students to use throughout each lesson to record and revise their thinking about science concepts related to the phenomenon; contain assignments for students to complete before, during, and after virtual classes, discussion boards, and home investigations
Lesson Slideshows	Lesson progression specific to each lesson used to guide student work; used during pre-work, post-work, virtual classes, home investigations, and discussion boards; can be shared with students in their entirety at the beginning of the lesson or broken into small portions and shared as needed
Discussion Boards	Assignments designed for students to share ideas and engage in discussion with one another over time rather than a live environment; students will use their Thinking Deeper Documents to brainstorm prior to submitting; teachers may choose to allow students without internet to text in responses and may screenshot/download and share portions of or full discussions via text (ex. through apps like Remind)
Home Investigations	Investigations with readily available materials designed for students to perform at home; teachers may choose to substitute videos or photos of data collection for students who cannot complete investigations at home

Lesson Set Overview: Lessons 1, 2, 3, 4, 5

Lesson Set 1: Lessons 1-5		
Provided Resources Students Will Need	**Additional Resources Students Will Need**	**Additional Materials for Students Without Internet Access**
Lesson Slideshows for each lesson: L1, L2, L3, L4, L5 **Thinking Deeper Documents for each lesson:** Lesson 1 TDD, Lesson 2 TDD, Lesson 3 TDD, Lesson 4 TDD, Lesson 5 TDD **Additional Documents:** Lesson 1: Questions for Family and Friends about MREs Lesson 4: Data Collection Procedure *(linked in slideshow)*, Class Data - *edited based on class demonstrations* Lesson 5: Reading 1, Reading 2, Reading 3 *(linked in slideshow)*	**Teacher-Made Resources:** What We Do as Engineers - all lessons Energy Transfer Model - L2, L3 Lesson 1: ● Notice/Wonder Assignment ● Questions for Family and Friends about MREs ● Initial Model Assignment and Slideshow, Jamboard, etc. for viewing models ● Design Question Board ● Ideas for Investigations Class Record Lesson 3: ● Optional Home Investigation materials: baking soda, vinegar, plastic zipper bag, goggles, gloves, and any other appropriate safety attire (see teacher guide for guidelines) Lesson 4: ● Stakeholder Survey- *teacher/student made, after completion* (Optional premade: Stakeholder Survey)	**Prior to Lesson**: Lesson 1: ● Video of Opening an MRE, Video of Eating an MRE Lesson 2: ● Investigation of the flameless heater video ● Cutting open a flameless heater video ● Hand warmer investigation video ● Content of the hand warmer video Lesson 3: ● Doubling Systems Investigation Video Lesson 5: ● Reading 1, Reading 2, Reading 3 **After Lesson Completion:** Design Question Board (Lesson 1) Energy Transfer Model (Lessons 2, 3) What we do as Engineers (all lessons) Virtual Class recordings (all lessons)

Students should ideally join VIRTUAL CLASS on the following days:

Day 2 & 4 - Lesson 1

Day 6 -Lesson 2

Day 7 & 8 - Lesson 3

Day 11 - Lesson 4

Day 13 - Lesson 5

Formative and Summative Assessment Opportunities:

Lesson 1: Initial Model (on TDD)
Lesson 2: Data tables and Building Understandings Questions (on TDD)
Lesson 3: Data Analysis and Reflection Questions (Day 1, TDD), Model Assignment and Model Revisions (Day 3)
Lesson 4: Analyzing Our Data Collection Methods (on TDD)
Lesson 5: Reading Annotations Assignment (Day 1)

Lesson Set Overview: Lessons 6, 7, 8

Lesson Set 2: Lessons 6-8		
Provided Resources Students Will Need	**Additional Resources Students Will Need**	**Additional Materials for Students Without Internet Access**
Lesson Slideshows for each lesson: L6, L7, L8 **Thinking Deeper Documents for each lesson:** Lesson 6 TDD, Lesson 7 TDD, Lesson 8 TDD **Additional Documents:** Lesson 6: Design Model Must-Haves (linked within slideshow), Exit Ticket Lesson 8: Ranking Justification Assignment (adjust as needed)	**Teacher-Made Resources:** What We Do as Engineers - all lessons Lesson 6: ● Thinking Deeper Documents from Lessons 4 & 5 (Progress Trackers) ● Design Question Board ● Ideas for Investigation Lesson 7: ● Class models to use for peer review Lesson 8: ● Consequences Chart Assignment	**Prior to Lesson**: Lesson 6: Access to Team Model Design (by text, a designated partner to add suggestions, etc.) **After Lesson Completion:** Virtual Class recordings (Lessons 6, 8) Discussion Board (Lesson 7)
Students should ideally join VIRTUAL CLASS on the following days: Day 2 & 3 - Lesson 6 Day 5 - Lesson 8		
Formative and Summative Assessment Opportunities: Lesson 6: Team designs, Exit Ticket Lesson 8: Final design plan changes and their justifications		

Lesson Set Overview: Lessons 9 & 10

Lesson Set 3: Lessons 9-10		
Provided Resources Students Will Need	**Additional Resources Students Will Need**	**Additional Materials for Students Without Internet Access**
Lesson Slideshows for each lesson: L9, L10 **Thinking Deeper Documents for each lesson:** Lesson 9 TDD, Lesson 10 TDD **Additional Documents:** Lesson 9: Home Learning Survey Lesson 10: Sea Turtle Assessment A or Sea Turtle Assessment B, Design Testing Matrix	**Teacher-Made Resources:** Lessons 9: ● Thinking Deeper Documents from Lessons 1-8 ● What We Do As Engineers Board ● Team Model Design (by text, a designated partner to add suggestions, etc.) ● Peer Design Poll ● Design Question Board Lesson 10: ● Home Learning Class Survey Results ● Graffiti Board Assignment	**Prior to Lesson**: **After Lesson Completion:** Virtual Class recordings (Lessons 9) Model Designs and Discussions (Lesson 9)
Students should ideally join VIRTUAL CLASS on the following: Day 1 & 3 - Lesson 9		
Formative and Summative Assessment Opportunities: Lesson 9: Team Design Revisions Lesson 10: Sea Turtle Assessment A or Sea Turtle Assessment B		

Lesson 1 (4 days) - Anchoring Phenomenon

NOTE: This lesson was originally done over three days. Day 3 allows a day between virtual classes and the activities account for about half as much time as the other days. If time allows, the teacher may choose to have students complete Day 3 activities after the Virtual Class on Day 2 rather than including an additional day in the schedule.

In this **Lesson**, students will need the following materials to appropriately engage in learning:

- Lesson Slideshow
- Thinking Deeper Document
- Notice/Wonder Assignment - *teacher-made*
- Questions for Family and Friends about MREs
- Initial Model Assignment and Slideshow, Jamboard, etc. for viewing models - *teacher made*
- What We Do as Engineers Poster - *teacher made*
- Design Question Board - *teacher made*
- Ideas for Investigations Class Record - *teacher made*

In this **Lesson**, students who don't have home internet need the following print-outs or files to best engage in learning:

- Lesson Slideshow
- Thinking Deeper Document
- Anchor Phenomenon Videos: Video of Opening an MRE, Video of Eating an MRE
- Notice/Wonder Assignment - *teacher-made*
- Questions for Family and Friends about MREs
- Initial Model Assignment and Slideshow, Jamboard, etc. for viewing models - *alternate way to submit and completed document*
- What We Do as Engineers Poster - *teacher made*
- Design Question Board - *teacher made*
- Ideas for Investigations Class Record - *teacher made*
- Virtual Class recordings - *after completion*

In this **Lesson**, students should join virtual classes on the following days to engage in learning:

- Day 2
- Day 4

Lesson 1 (4 days) - Anchoring Phenomenon

Day 1		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Part 1 & 2 (17 min) INTRODUCE AN INTERESTING PHENOMENON & DEMONSTRATE USING AN MRE Slides A-H	1. Share Lesson Slideshow & Thinking Deeper Document with students. 2. Create an assignment for students to submit 1 Notice and 1 Wonder (ex: google form).	VIRTUAL CLASS PRE-WORK: 1. Watch two videos about MREs and record notices and wonderings.. 2. Submit one notice and one wonder to the teacher.
Parts 3 & 7 (15 min) DEVELOP AN INITIAL MODEL & ASSIGN HOME LEARNING Slide I & J	1. Create assignments for students to submit their initial models. (ex: google slides) *NOTE: Students may need explicit instructions to upload their models to the assignment.* 2. Assign Questions for Family and Friends about MREs for home learning. NOTE: If not using google form, create your own assignment.	VIRTUAL CLASS PRE-WORK: 1. Create an initial model (either digital or on paper then upload a photo) and attach to the initial model assignment to be used during the virtual class. 2. Question friends and family about MREs assignment. Submit a response to your teacher.

Day 2		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Parts 4-6, 8-12 (45 min) COMPARE INITIAL MODELS REVIEW NORMS DEVELOP A CONSENSUS MODEL REVIEW COMMUNITY SURVEY RESULTS BRAINSTORM RELATED SITUATIONS NOTICE/WONDER ABOUT SITUATIONS MREs USED DEFINE PROBLEM AND PROPOSE SOLUTION PROGRESS TRACKER Slides K-GG	Prior to the Virtual Class, the teacher should: 1. Review Notice/Wonder responses from students in preparation to facilitate discussion. 2. Collect and compile models to share during virtual class (ex. Slideshow, shared doc, Jamboard) and decide how students will compare models (ex. break-outs for discussions, viewing models on the shared document/platform if break-outs are not possible) 3. Arrange to develop a consensus model and the "What We Do as Engineers" poster using a method or platform that will allow sharing with students when complete. (ex. Jamboard, shared google doc, etc.) VIRTUAL CLASS: 1. Discuss and review initial models and record similarities and differences. 2. Discuss overall similarities and differences between models. 3. Review norms and choose a focal norm. Share reflections on norms. (have a few students volunteer or utilize the chat feature if available) 4. Develop an initial Consensus Model. 5. Record and share new questions about MRE's and flameless heaters. 6. Discuss results from how our community used MREs and record notices and wonders. 7. Create a list of situations in which an MRE could be useful. 8. Record notice and wonders about when and where MREs have been used. 9. Brainstorm and discuss problems using MREs with flameless heaters. 10. Stop and Jot about why MREs include a heater. 11. Record possible solutions and discuss. 12. Reflect on what we just did as engineers: defining problems, proposing solutions. Start the "What We Do as Engineers" poster. 13. Reflect on norms and share out if time allows.	

Day 3		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Part 13 (5 min) DISCUSS CRITERIA AND CONSTRAINTS Slide HH & II	*NOTE: You will need to update the "What We Do as Engineers" poster. Consider doing this at the beginning of the Virtual Class during the debrief.*	VIRTUAL CLASS PRE-WORK: 1. Recall the meaning of "criteria" and "constraints", record some possible criteria and constraints for a homemade flameless heater and update progress tracker.
Part 14 (10 min) DEVELOP AN INITIAL DESIGN SOLUTION Slides JJ & KK		VIRTUAL CLASS PRE-WORK: 1. Individually plan and design a homemade flameless heater.

Day 4		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Part 15-20 (50 min) COMPARE INITIAL DESIGN SOLUTIONS COMPARE AND REFLECT ON INITIAL DESIGNS GENERATE DESIGN QUESTIONS BUILD A DESIGN QUESTION BOARD GENERATE & SHARE IDEAS FOR INVESTIGATION Slides LL-QQ	Prior to the Virtual Class, the teacher should: 1. Create assignments for students to submit their investigation ideas (ex: google slides) 2. Prepare to create a Design Question Board and Ideas for Investigations Class record on platform of choice and to share them with students when complete. VIRTUAL CLASS: 1. Debrief on last time's design work including challenges and collect ideas for how we can improve. 2. Reflect on other students' initial designs recording new ideas that could be used moving forward. 3. Generate design questions by considering all of the experiences in class so far and recording questions that will help us continue to the next step. 4. Teacher begins to build the Design Question Board using the platform of their choice (ex. Google Jamboard, Pinup, etc.) 5. Brainstorm and record at least one investigation that could answer a design question from the DQB. Share and create a class record of these ideas. *(Note: If short on time, students can brainstorm in class and submit their ideas for post-work.)*	

Return to Lesson Set Overview

Lesson 2 (2 days) - Investigation

In this **Lesson**, students will need the following materials to appropriately engage in learning:

- Lesson Slideshow
- Thinking Deeper Document
- What we Do as Engineers Board - *teacher made, after completion*

In this **Lesson**, students who don't have home internet need the following print-outs or files to best engage in learning:

- Lesson Slideshow
- Thinking Deeper Document
- Investigation of the flameless heater video
- Cutting open a flameless heater video
- Hand warmer investigation video
- Content of the hand warmer video
- What we Do as Engineers Board- *teacher made, after completion*
- Energy Transfer Model - *teacher made, after completion*
- Virtual Class recordings - *after completion*

In this **Lesson**, students should join virtual classes on the following days to engage in learning:

- Day 2

Lesson 2 (2 days) - Investigation

Day 1		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Part 1 (5 min) NAVIGATION Slides A-B	1. Share Lesson Slideshow with students. 2. Share Thinking Deeper Document with students.	VIRTUAL CLASS PRE-WORK: 1. Reflect on what made the heater get hot and brainstorm how we can investigate this MRE heater to explain what is happening.
Part 2 (15 min) PREPARE FOR FLAMELESS HEATER AND HAND WARMER INVESTIGATIONS Slides C-D		VIRTUAL CLASS PRE-WORK: 1. Brainstorm what type of data should be collected and how much to collect.
Part 3 (25min) PLAN AND CARRY OUT THE FLAMELESS HEATER INVESTIGATION AS A CLASS Slides E-H		VIRTUAL CLASS PRE-WORK: 1. Watch the investigation of the flameless heater and record data. 2. Watch the video Cutting open a flameless heater and observe images of what's inside a flameless heater. 3. Analyze the ingredient list and make predictions about which substance might be causing them to get warm.

Day 2		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Parts 4-7 (45 min) CARRY OUT THE HAND WARMER INVESTIGATION IN SMALL GROUPS HAVE A BUILDING UNDERSTANDING DISCUSSION ABOUT OUR RESULTS NAVIGATION Slides I-R	Prior to the Virtual Class, the teacher should: 1. Arrange for students to work in small groups to plan for data collection, watch and collect data for the investigation. *(Note: If your platform does not allow this, you may watch the investigation as a class or have students watch independently.)* VIRTUAL CLASS: 1. Revisit what was done in the previous investigation. 2. Discuss the set-up for the investigation on the hand warmer. 3. Discuss what data should be collected in the investigation. 4. Watch the Hand warmer investigation in small groups and record data into the table. 5. Watch the video Contents of a hand warmer and observe images of the contents of the hand warmer before and after activation. 6. Analyze the ingredient list and make predictions about which substance might be causing them to get warm. 7. Building understanding discussion to identify that a chemical reaction is occurring in the flameless heater and the handwarmer. Create Energy Transfer Model. 8. Update progress trackers. 9. Update the What We Do as Engineers Board. 10. Consider what we should investigate next time.	

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Lesson 3 (3 days) - Investigation

Note: Including the virtual class from the previous lesson, there are three virtual classes in a row. If scheduling is a problem, the Day 1 activities for this lesson can be conducted asynchronously by recording one or more of the labs instead of demonstrating live. Note that you may also need to give students more specific guidance around data collection and analysis if choosing this option.

In this **Lesson**, students will need the following materials to appropriately engage in learning:

- Lesson Slideshow
- Thinking Deeper Document
- Optional Home Investigation materials: baking soda, vinegar, plastic zipper bag, goggles, gloves, and any other appropriate safety attire (see teacher guide for guidelines)
- Model Share Assignment - *teacher made*
- Energy Transfer Models - *after completion*
- What we Do as Engineers Board- *teacher made*

In this **Lesson**, students who don't have home internet need the following print-outs or files to best engage in learning:

- Lesson Slideshow
- Thinking Deeper Document
- Optional Home Investigation materials: baking soda, vinegar, plastic zipper bag, goggles, gloves, and any other appropriate safety attire (see teacher guide for guidelines)
- Doubling Systems Investigation Video
- Energy Transfer Models - *after completion*
- What we Do as Engineers Board - *teacher made, after completion*
- Virtual Class recording - *after completion*

In this **Lesson**, students should join virtual classes on the following days to engage in learning:

- Days 1 & 2

Lesson 3 (3 days) - Investigation

Day 1		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Parts 1-4 (45 min) NAVIGATION PREPARE TO INVESTIGATE WHICH REACTION IS THE BEST CANDIDATE TO TRY IN OUR HOMEMADE FLAMELESS HEATER CONDUCT THE CHEMICAL REACTIONS LAB FIND PATTERNS IN THE DATA FROM THE INVESTIGATION Slides A-P	Prior to the Virtual Class, the teacher should, 1. Prepare to demonstrate one or more of the labs and allow students to collect data as a class. *Note: Consider allowing students to conduct a version of the baking soda and vinegar lab as a home investigation. If students conduct the investigation in a plastic zipper bag, they may be able to feel the drop in temperature during the reaction on the outside of the bag. You would need to communicate to guardians ahead of time to secure permission and ensure proper safety measures (see teacher guide for information on safety.)* *Sample data* 2. Make any necessary adjustments and share Lesson Slideshow and Thinking Deeper Document with students. VIRTUAL CLASS: 1. Consider questions that were brought up at the end of Lesson 2 and revisit our ideas for investigations. 2. Prepare to investigate other materials and the revised materials that will be used. 3. Observe a revised materials list and record notices and wonderings about the materials. 4. Discuss and make a prediction about what happens when more or less reactants are used. 5. Discuss the procedure used for the Chemical Combinations Lab. Demonstrate the procedure for at least one group to students during the virtual class. If time allows, demonstrate other groups as well. 6. Review Data collected on slides L - O, explaining to students what the data means and differences in each table. Model how to record the maximum temperature change for at least the first data set or two. 7. Use the data collected to find patterns in the temperature changes in the different investigations by answering sensemaking questions. *(Note: If time is short, students may complete this following the Virtual Class as post-work.)*	

Day 2		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Parts 5 - 8 (55 min) BUILDING UNDERSTANDINGS ADD ENERGY TO THE PARTICLE-LEVEL REACTION MODEL NAVIGATION AND ENERGY TRANSFER MODELS Slides Q - Z	Prior to the Virtual Class, the teacher should: 1. Arrange for students to share models with a partner in break-outs if available. *Note: This can be done via shared documents if break-outs are not available on your platform.* VIRTUAL CLASS: 1. Building understanding discussion to figure out which reaction heats up the most. 2. Discuss the terms Endothermic and Exothermic. 3. Identify and record what we have done as engineers on Progress Trackers. 4. Discuss the chemical reaction happening with the root killer. 5. Revisit and review what was learned in the Bath Bomb unit. 6. Conduct a class discussion to build a particle model of the reaction. 7. Build out aluminum first with class. Then, allow students to work on their own to complete the rest. 8. Share and discuss models with a partner. 9. Discussion to focus on the energy in the reaction and add energy ideas to the energy transfer model. 10. Lead a discussion about energy transfer, generate a simple energy transfer model, and introduce the energy transfer data chart. 11. Preview post-work.	

Day 3		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Part 9 (8 min) NEW ENERGY TRANSFER MODEL Slides AA- BB		VIRTUAL CLASS POST-WORK 1. Create a model to show energy transfer for a different amount of reactants.
Part 10 (7 min) PRESENT NEW ENERGY TRANSFER MODELS TO THE CLASS Slide CC	1. Create an assignment for students to share their models and a discussion board to share ideas when comparing them. 2. Review student ideas and facilitate discussion as needed.	VIRTUAL CLASS POST-WORK/DISCUSSION BOARD: 1. Share and compare models. 2. Reflect on additional questions.
Parts 11 & 12 SET UP AND VIEW DOUBLING SYSTEMS INVESTIGATION Slides DD-GG		VIRTUAL CLASS POST-WORK 1. Predict what will happen if we double the food system, but keep the original reaction system. 2. Watch the investigation video and record data.
Part 13 REVISITING MODELS AND COMPLETING CAPTIONS Slides HH-JJ		VIRTUAL CLASS POST-WORK 1. Revise model as needed. 2. Create captions to explain what is happening with each model.

Part 14 UPDATING PROGRESS TRACKERS Slide KK		VIRTUAL CLASS POST-WORK 1. Update progress tracker with what engineers do and what we figured out.
Part 15 NAVIGATION Slide LL		VIRTUAL CLASS POST-WORK 1. Reflect on what we learned and how we might apply what we figured out to our homemade heater designs.

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Lesson 4 (2 days) - Investigation

Note: Some of the lesson components have been shifted to best take advantage of the virtual class on Day 2 and to allow students to observe at least one of the investigations. As a result of this shift, some activities from Day 2 have been added to Lesson 5 Day 1 as pre-work.

In this **Lesson**, students will need the following materials to appropriately engage in learning:

- Lesson Slideshow
- Thinking Deeper Document
- What we Do as Engineers Board - *teacher made*
- Stakeholder Survey - *teacher/student made* (Optional premade: Stakeholder Survey)

In this **Lesson**, students who don't have home internet need the following print-outs or files to best engage in learning:

- Lesson Slideshow
- Thinking Deeper Document
- Data Collection Procedure
- Class Data - *edited based on class demonstrations*
- What we Do as Engineers Board - *teacher made, after completion*
- Stakeholder Survey- *teacher/student made, after completion* (Optional premade: Stakeholder Survey)
- Virtual Class recording - *after completion*

In this **Lesson**, students should join virtual classes on the following days to engage in learning:

- Day 2

Lesson 4 (2 days) - Investigation

Day 1		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Part 1 (5 min) NAVIGATION Slides A, B	1. Share Lesson Slideshow with students. 2. Share Thinking Deeper Document with students.	VIRTUAL CLASS PRE-WORK: 1. Reflect on what we've figured out about chemical reactions and brainstorm what else we need to figure out. 2. Reflect on the best proportions of reactants to combine.
Part 2 (15 min) PLAN FOR PROPORTION OF REACTANTS INVESTIGATION Slides C-G		VIRTUAL CLASS PRE-WORK: 1. Consider how we can test what amount of each reactant will work best. 2. Predict what amounts of reactants we can test. 3. Evaluate data collection procedure.
Parts 3-4	*These lesson components will be addressed in the Virtual Class on Day 2.*	

Day 2		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Parts 3-8 (55 min) CONDUCT PROPORTION OF REACTANTS INVESTIGATION REFLECT ON TYPES OF INSTRUCTIONS BUILDING UNDERSTANDING DISCUSSION ABOUT OUR RESULTS UPDATE OUR PROGRESS TRACKER DISCUSS STAKEHOLDER PREFERENCES AND ASSIGN HOME LEARNING Slides H-Q	Prior to the VIRTUAL CLASS, the teachers should: 1. Prepare to demonstrate one or more of the group investigations. 2. Make necessary adjustments to the class data to prepare for sharing data for the other investigation(s) with students. 3. Create a discussion board for students to share and reflect on ideas about stakeholders for the post-work. VIRTUAL CLASS: 1. Revisit class discussion board as navigation to conduct the investigation. 2. Observe one or more of the investigations and record the temperature change. 3. View sample data from additional investigations and record data. 4. Revisit suggestions for improving accuracy in data collection and revise as needed. 5. Reflect on instructions and discuss. 6. Building understanding discussion to analyze our results. 7. Figure out how to calculate the amount of reactants in percentage and calculate the optimal amount of each reactant used in terms of percent of the total reactants. 8. Apply what we have figured out to our designs. 9. Update progress tracker. 10. Discuss stakeholders. 11. Update Progress Tracker. 12. Preview post-work. *(Share the discussion board assignment with students and encourage them to complete it as soon as possible. You will need this to adapt and share the stakeholder survey.)* VIRTUAL CLASS POST-WORK: 1. Reflect on questions for stakeholders and aspects of design for feedback and share ideas on the discussion board. Students will complete the home learning from Part 8 alongside Day 1 Lesson 5 pre-work.	

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Lesson 5 (2 days) - Putting Pieces Together/Investigation

Note: Students will need access to the results of the survey in order to navigate into Lesson 5 pre-work. To allow time for data collection and distribution as well as pre-work for the virtual class, an extra day has been added to this lesson.

In this **Lesson**, students will need the following materials to appropriately engage in learning:

- Lesson Slideshow
- Thinking Deeper Document
- What we do as Engineers Board - *teacher created*

In this **Lesson**, students who don't have home internet need the following print-outs or files to best engage in learning:

- Lesson Slideshow
- Thinking Deeper Document
- One of the following: Reading 1, Reading 2, Reading 3
- What we do as Engineers Board - *teacher created*
- Virtual Class Recordings - *after completion*

In this **Lesson**, students should join virtual classes on the following days to engage in learning:

- Day 2

Lesson 5 (2 days) - Putting the Pieces Together/Investigation

Day 1		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Part 8 continued (Lesson 4) HOME LEARNING Slide R	1. Share Lesson Slideshow with students. 2. Share Thinking Deeper Document with students. 3. Review and adapt the sample stakeholder survey based on discussion board responses and share with students.	VIRTUAL CLASS POST-WORK: 1. Conduct a survey of stakeholders..
Part 1 (5 min) NAVIGATION Slide A		VIRTUAL CLASS PRE-WORK: 1. Reflect on Stakeholder Survey.
Part 2 (10 min) OBTAIN INFORMATION ABOUT FOOD TEMPERATURE FROM VARIOUS SOURCES Slide B	1. Assign students one of the texts to read and annotate.	VIRTUAL CLASS PRE-WORK: 1. Read and annotate the assigned source to find information that will define our target temperature range.

Day 2		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Part 2-6 (35 min) OBTAIN INFORMATION ABOUT FOOD TEMPERATURE FROM VARIOUS SOURCES DEFINE A TARGET FOOD TEMPERATURE RANGE REVISE INITIAL CRITERIA AND CONSTRAINTS CHART ORGANIZE THE CLASS-LEVEL WHAT WE DO AS ENGINEERS BOARD NAVIGATION Slide C-M	Prior to the Virtual Class, the teacher should: 1. Review reading annotations to prepare to support student groups when sharing. 2. Arrange for students to share and discuss information in groups of three where each student was assigned a different reading. *(Note: If breakouts are not possible, alternatives are to have students review annotations by sharing documents and/or utilize chat features and whole-class discussion as needed.)* VIRTUAL CLASS: 1. Share information in small groups to answer questions about food temperature. 2. Discussion to define a target temperature for food that our homemade heaters will warm up. 3. Teacher organizes criteria we need to consider for our design solutions. 4. As a class, decide the constraints we want to define for cost. 5. Decide as a class, how we should limit weight. 6. Discuss the trade-off between the amount of food and the amount of reactants. 7. Add the word trade off to the word wall. 8. Update our progress tracker. 9. Organize the What we Do as Engineers Board.	

Return to Lesson Set Overview

Lesson 6 (3 days) - Investigation

In this **Lesson**, students will need the following materials to appropriately engage in learning:

- Lesson Slideshow
- Thinking Deeper Document
- Thinking Deeper Documents from Lessons 4 & 5 (Progress Trackers)
- Design Question Board
- Ideas for Investigation
- Exit Ticket

In this **Lesson**, students who don't have home internet need the following print-outs or files to best engage in learning:

- Lesson Slideshow
- Thinking Deeper Document
- Thinking Deeper Documents from Lessons 4 & 5 (Progress Trackers)
- Design Question Board
- Ideas for Investigation
- Design Model Must-Haves
- Access to Team Model Design (by text, a designated partner to add suggestions, etc.)
- Exit Ticket
- Virtual Class Recordings - *after completion*

In this **Lesson**, students should join virtual classes on the following days to engage in learning:

- Day 2
- Day 3

Lesson 6 (3 days) - Investigation

Day 1		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Part 1 (5 min) NAVIGATION Slides A	1. Create a platform for students to post and discuss their final design on Day 3 (Google Jamboard, Google Slides, etc.) and add any additional instructions needed into the slideshow. 2. Share Lesson Slideshow and Thinking Deeper Document with students.	VIRTUAL CLASS PRE-WORK: 1. Review what was done during the last lesson and add what we did as engineers.
Part 2 (12 min) FIGURING OUT INFORMATION WE STILL NEED Slides B-J		VIRTUAL CLASS PRE-WORK: 1. Revisit the DQB and ideas for investigation to determine what we still need to answer. 2. Figure out we still need mass, cost, instructions, time and a substitute for food.
Part 3 (8 min) PREPARING FOR TEAMWORK AND REDESIGN OF HEATERS Slides K		VIRTUAL CLASS PRE-WORK: 1. Brainstorm how teamwork will be beneficial for this investigation.
Part 4 (20 min) INDIVIDUAL MODEL OUR RESIGN ON PAPER Slides L-M	**In the original Day 1, students were to redesign a flameless heater in groups. This has been altered and they will begin designing with groups in the next virtual class. Consider having students turn in their initial proposal to inform establishment of groups for the class.*	VIRTUAL CLASS PRE-WORK: 1. Consider all available materials to design an initial proposal which will be discussed and evaluated as a group at the Virtual Class. Proposal must be within safety constraints.

Day 2		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Parts 5-7 (45 min) PARTICIPATE IN A WHOLE GROUP DISCUSSION ABOUT WRITING INSTRUCTIONS PREPARE TO WORK DESIGN THE PROTOTYPES IN TEAMS NAVIGATIONS AND SELF ASSESSMENT Slides N-W	Prior to the Virtual Class, the teacher should: 1. Determine a format for design team discussions and designs (Google Jamboard, Google Slides, etc.) and prepare to assign teams. VIRTUAL CLASS: 1. Reflect on what makes instructions easy to follow. 2. Assign teams and create names. 3. Review Design Model Must-haves as a group. 4. Share individual design ideas. 5. As a team, develop a design and create their step by step directions on how to construct their design. 6. Submit work to the teacher for review. *Note: If time is short in the Virtual Class, 7 & 8 below can be done for post-work.* 7. Reflect on what was completed during the lesson and brainstorm what else needs to be done. 8. Reflect on their teamwork and fill out a Self-Assessment. **Parts 7 & 8 were altered/omitted due to the virtual format. The teacher will test the designs and not the student. Students will scale down the test design in part 8 before turning in the design on Day 3. Students will also finish redesigning their flameless heaters with their groups on Day 3.*	

Day 3		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Parts 9-12 (55 min) FINISH PLANNING DESIGN SELF-ASSESS ENGINEERING PRACTICES IN TEAMS SELF-ASSESS TEAMWORK INDIVIDUALLY UPDATE PROGRESS TRACKER COMPLETE EXIT TICKET Slides W-BB	VIRTUAL CLASS: 1. Finalize design and instructions as a team and submit them to be approved by the teacher. 2. Teams work together to assess their work as engineers utilizing a rubric. *Note: If time is short in the Virtual Class, any or all of the following can be completed as Post-Work.* 3. Independently rate themselves using the Teamwork Self-Assessment. 4. Consider how our work today was similar but different from what we've done before as engineers and update Progress Tracker. 5. Complete an exit ticket in their group's design by thinking about system interactions using an Energy Transfer Model. Following the Virtual Class, the teacher will need to collect and compile the designs to share with students for the next day's peer review. **Part 9 has been altered to finish their redesign of their flameless heater.*	

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Lesson 7 (1 day) - Problematizing

In this **Lesson**, students will need the following materials to appropriately engage in learning:

- Lesson Slideshow
- Thinking Deeper Document
- Class models to use for peer review - *compiled by teacher*

In this **Lesson**, students who don't have home internet need the following print-outs or files to best engage in learning:

- Lesson Slideshow
- Thinking Deeper Document
- Class models to use for peer review - *compiled by teacher*
- Discussion Board - *alternate way to contribute ideas, after completion*

In this **Lesson**, students should join virtual classes on the following days to engage in learning:

- None

Lesson 7 (1 day) - Problematizing

Day 1		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Part 1 (5 min) NAVIGATION Slide A	1. Share Lesson Slideshow and Thinking Deeper Document with students. 2. Share models of designs.	VIRTUAL CLASS POST WORK: 1. Review the team's design and identify areas for improvement.
Part 2 (25 min) REVIEW OTHER TEAMS DESIGNS AND PROCEDURES Slides B & C		VIRTUAL CLASS POST WORK: 1. Reflect on norms for peer feedback. 2. View all other teams designs and procedures. 3. Identify and record promising designs, questions, and suggestions.
Part 3 (10 min) SHARE THE MOST PROMISING DESIGN CHARACTERISTICS Slide C	1. Create and assign a discussion board for students to share promising ideas. 2. Review submissions and facilitate discussion as needed.	DISCUSSION BOARD: 1. Share 1-2 promising ideas on the discussion board.
Part 3 (10 min) ADD TO OUR PROGRESS TRACKERS Slide D		VIRTUAL CLASS POST WORK: 1. Identify and record what we did as engineers and what we figured out on progress trackers.
Part 4 (5 min) INDIVIDUALLY RANK CRITERIA AND CONSTRAINTS Slide E		VIRTUAL CLASS POST WORK: 1. Reflect on how taking this new information and discussing it as a team will improve your design.

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Lesson 8 (2 days) - Investigation/Putting Pieces Together

In this **Lesson**, students will need the following materials to appropriately engage in learning:

- Lesson Slideshow
- Thinking Deeper Document
- Ranking Justification Assignment - *adjust as needed for Virtual Class*
- Consequences Chart Assignment - *teacher made*

In this **Lesson**, students who don't have home internet need the following print-outs or files to best engage in learning:

- Lesson Slideshow
- Thinking Deeper Document
- Ranking Justification Assignment - *adjust as needed for Virtual Class*
- Consequences Chart Assignment - *teacher made*
- Virtual Class recording - *after completion*

In this **Lesson**, students should join virtual classes on the following days to engage in learning:

- Day 1

Lesson 8 (2 days) - Investigation/Putting Pieces Together

Day 1		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Parts 1-4 (45 min) NAVIGATION INDIVIDUAL IMPROVEMENT SUGGESTIONS RANKING IMPROVEMENT AS A TEAM CREATING A CASCADING CONSEQUENCES CHART THINKING THROUGH CONSEQUENCES Slides A-I	Prior to the Virtual Class, the teacher should: 1. Arrange for students to work in their design teams. 2. Prepare Ranking Justification Assignment and Consequences Chart Assignment (Google Slides, Google Drawing, etc.). 3. Make any needed adjustments and share Lesson Slideshow and Thinking Deeper Document with students VIRTUAL CLASS: 1. Reflect on ideas for revision from the previous lesson. 2. Brainstorm ways to change the design by utilizing the sentence starters. 3. Complete the discussion diamond organizer, discuss rankings and justifications, and as a team determine the two most important changes the team should make to the design. 4. In teams, create a Consequences Chart that incorporates 2-3 changes that the group decided are the most important to improve the design. 5. Reflect on consequences that have been discovered and to use those to help with design decisions.	

Day 2		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Part 5 (5 min) CONSIDERING THE CONSEQUENCES Slide J		VIRTUAL CLASS POST-WORK: 1. Reflect on whether all consequences are equal and how they will influence our design.
Part 6 (10 min) REFLECTING ON POSSIBLE CHANGES Slide K		VIRTUAL CLASS POST-WORK: 1. Reflect on stakeholder interests. Determine whether negative consequences can be offset by positive components elsewhere.
Part 7 (15 min) UPDATE PROGRESS TRACKERS AND WHAT WE DO AS ENGINEERS BOARD Slide L		VIRTUAL CLASS POST-WORK: 1. Record everything we have now completed as engineers on Progress Trackers.
Part 8 (19 min) JUSTIFY YOUR PROPOSED CHANGES Slide M		VIRTUAL CLASS POST-WORK: 1. Record the justification for all of the final decided changes.

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Lesson 9 (3 days) - Investigation

In this **Lesson**, students will need the following materials to appropriately engage in learning:

- Lesson Slideshow
- Thinking Deeper Document
- Thinking Deeper Documents from Lessons 1-8
- What We Do As Engineers Board
- Platform for Team Model Design - *teacher made*
- Peer Design Poll - *teacher made*
- Design Question Board
- Home Learning Survey

In this **Lesson**, students who don't have home internet need the following print-outs or files to best engage in learning:

- Lesson Slideshow
- Thinking Deeper Document
- Thinking Deeper Documents from Lessons 1-8
- What We Do As Engineers Board
- Access to Team Model Design (by text, a designated partner to add suggestions, etc.)
- Peer Design Poll - *teacher made*
- Design Question Board
- Home Learning Survey
- Virtual Class Recordings - *after completion*

In this **Lesson**, students should join virtual classes on the following days to engage in learning:

- Day 1
- Day 3

Lesson 9 (3 days) - Investigation

Day 1		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Part 1 (5 min) NAVIGATION Slides A, B Part 2 (40 min) UPDATE DESIGN AND PLAN IN TEAMS Slides C - F	Prior to the Virtual Class, the teacher should: 1. Arrange Team Model Design platform (Jamboard, Google Slides, etc.). 2. Make any necessary adjustments and share Lesson Slideshow and Thinking Deeper Document with students. VIRTUAL CLASS: 1. Review how we have tested parts of our design and identify what criteria was modified to optimize the design. 2. Reflect on the self-assessment from Lesson 6. 3. Review Design Must-Haves. 4. Plan redesign in teams and get teacher approval for plans. 5. Preview Day 2 post-work assignments.	

Day 2		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Part 3 (25 min) PEER REVIEW OF OTHER TEAM DESIGNS Slide G		VIRTUAL CLASS POST WORK: 1. Review the team's design utilizing the "Peer Review Chart".
Part 4 (5 min) RANK OTHER TEAM DESIGNS TO DETERMINE WHICH WILL BE DESIGNED Slide H	1. Create and share a poll assignment for students to vote on their peer's designs. 2. Share the top two designs as determined by the poll and prepare to test the designs in the upcoming Virtual Class.	VIRTUAL CLASS POST WORK: 1. Utilize the final results from the "Peer Review Chart" to identify the top two designs in the class.
Part 5 (5 min) TOP TWO DESIGNS Slide I		VIRTUAL CLASS POST WORK: 1. Identify two strengths and one weakness from each of the top two designs.

Day 3		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Parts 6-10 (55 min) PREPARE FOR TESTING DESIGN TESTING EVALUATE OUR DQB QUESTIONS REVISIT DQB NAVIGATION Slides J-N	Prior to the Virtual Class, the teacher should: 1. Arrange to test the top two designs during the class meeting. 2. Have the Design Question Board available for students and arrange for them to work with a partner to evaluate it. *(Note: If this is not possible on the platform, make use of a shared document, chat feature, and/or independent and whole-class discussion as needed.)* 3. Modify Home Learning Survey as needed and prepare to share your copy with students at the end of class. VIRTUAL CLASS: 1. Review the purpose of the data table on the Thinking Deeper Document. 2. The teacher will test the top two designs, students will complete the data table as the tests are being conducted. 3. Review original DQB and identify questions that we have and have not yet answered. 4. Identify the questions we made progress on, what we have figured out as well as any remaining questions. 5. Preview post-work assignments including the Assessment Task. VIRTUAL CLASS POST-WORK: 1. Survey friends and family about their homemade flameless heater instructions.	

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Lesson 10 (1 day) - Putting Pieces Together

In this **Lesson**, students will need the following materials to appropriately engage in learning:

- Lesson Slideshow
- Thinking Deeper Document
- Home Learning Class Survey Results - *teacher made*
- Sea Turtle Assessment A or Sea Turtle Assessment B
- Design Testing Matrix
- Graffiti Board Assignment - *teacher made*

In this **Lesson**, students who don't have home internet need the following print-outs or files to best engage in learning:

- Lesson Slideshow
- Thinking Deeper Document
- Home Learning Class Survey Results - *teacher made*
- Sea Turtle Assessment A or Sea Turtle Assessment B
- Design Testing Matrix
- Graffiti Board Assignment - *teacher made*

In this **Lesson**, students should join virtual classes on the following days to engage in learning:

- None

Lesson 10 (1 day) - Putting Pieces Together

Day 1		
Lesson Components	**Distance Learning Plan**	
	Teacher	**Student**
Part 1 (5 min) NAVIGATION Slide A	1. Compile and link survey results on Slide A. 2. Share Lesson Slideshow and Thinking Deeper Document with students.	VIRTUAL CLASS POST WORK: 1. Review Survey Results and answer questions.
Part 2 (5 min) REVIEW PROGRESS TRACKERS Slide B		VIRTUAL CLASS POST WORK: 1. Review Progress Trackers and determine what remaining questions you have.
Part 3 (30 min) DEMONSTRATE UNDERSTANDING ON AN ASSESSMENT TASK Slide C	1. Choose which assessment students will take, assign it, and share supporting resources.	VIRTUAL CLASS POST WORK: 1. Individually demonstrate understanding on an assessment about sea turtle incubators.
Part 3 (5min) PROPOSE OTHER APPLICATIONS FOR DESIGN ON GRAFFITI BOARD Slides D-F	1. Create and assign virtual “graffiti boards” for students to share their ideas about additional applications for homemade heaters. (Jamboard, Pinup, etc.)	VIRTUAL CLASS POST WORK: 1. Reflect on other applications that their homemade heaters might have besides heating up food. 2. Share ideas on “graffiti boards” and comment on other ideas.

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