

BALLOON POWERED CARRIER CHALLENGE

First Grade - Earth Science



PURPOSE

IN THE BALLOON POWERED CARRIER CHALLENGE, STUDENTS WILL:

- Build a balloon-powered carrier able to transport a load across the classroom rug area using the Engineering Design Process (EDP)
- Exhibit understanding of relevant science content/concepts
- Construct relevant questions
- Determine effectiveness of their design/process
- Use appropriate tools and materials to complete task
- Answer the Focus Question: "How can you design and build a carrier able to transport safely across the lava?"

NEXT GENERATION SCIENCE STANDARDS (NGSS)

Students who demonstrate understanding can:

K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in K-2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. <ul style="list-style-type: none"> Develop a simple model based on evidence to represent a proposed object or tool. 	ETS1.B: Developing Possible Solutions <ul style="list-style-type: none"> Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. 	Structure and Function <ul style="list-style-type: none"> The shape and stability of structures of natural and designed objects are related to their function(s).
Connections to K-2-ETS1.B: <i>Developing Possible Solutions to Problems</i> include: Kindergarten: K-ESS3-3, First Grade: 1-PS4-4, Second Grade: 2-LS2-2		
Articulation of DCIs across grade-levels: 3-5.ETS1.A ; 3-5.ETS1.B ; 3-5.ETS1.C		
Common Core State Standards Connections: ELA/Literacy — SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (K-2-ETS1-2)		

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

Students who demonstrate understanding can:

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

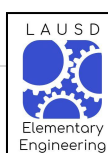
K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in K-2 builds on prior experiences and progresses to simple descriptive questions. <ul style="list-style-type: none"> Ask questions based on observations to find more information about the natural and/or designed world(s). (K-2-ETS1-1) Define a simple problem that can be solved through the development of a new or improved object or tool. (K-2-ETS1-1) Developing and Using Models Modeling in K-2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. <ul style="list-style-type: none"> Develop a simple model based on evidence to represent a proposed object or tool. (K-2-ETS1-2) Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. <ul style="list-style-type: none"> Analyze data from tests of an object or tool to determine if it works as intended. (K-2-ETS1-3) 	ETS1.A: Defining and Delimiting Engineering Problems <ul style="list-style-type: none"> A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2-ETS1-1) Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1) Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1) ETS1.B: Developing Possible Solutions <ul style="list-style-type: none"> Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2-ETS1-2) ETS1.C: Optimizing the Design Solution <ul style="list-style-type: none"> Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-3) 	Structure and Function <ul style="list-style-type: none"> The shape and stability of structures of natural and designed objects are related to their function(s). (K-2-ETS1-2)
Connections to K-2-ETS1.A: <i>Defining and Delimiting Engineering Problems</i> include: Kindergarten: K-PS2-2, K-ESS3-2		
Connections to K-2-ETS1.B: <i>Developing Possible Solutions to Problems</i> include: Kindergarten: K-ESS3-3, First Grade: 1-PS4-4, Second Grade: 2-LS2-2		
Connections to K-2-ETS1.C: <i>Optimizing the Design Solution</i> include: Second Grade: 2-ESS2-1		
Articulation of DCIs across grade-levels: 3-5.ETS1.A (K-2-ETS1-1),(K-2-ETS1-2),(K-2-ETS1-3); 3-5.ETS1.B (K-2-ETS1-2),(K-2-ETS1-3); 3-5.ETS1.C (K-2-ETS1-1),(K-2-ETS1-2),(K-2-ETS1-3)		
Common Core State Standards Connections: ELA/Literacy — RI.2.1 Ask and answer such questions as <i>who, what, where, when, why, and how</i> to demonstrate understanding of key details in a text. (K-2-ETS1-1) W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (K-2-ETS1-1),(K-2-ETS1-3) W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (K-2-ETS1-1),(K-2-ETS1-3) SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (K-2-ETS1-2)		
Mathematics — MP.2 Reason abstractly and quantitatively. (K-2-ETS1-1),(K-2-ETS1-3) MP.4 Model with mathematics. (K-2-ETS1-1),(K-2-ETS1-3) MP.5 Use appropriate tools strategically. (K-2-ETS1-1),(K-2-ETS1-3) 2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (K-2-ETS1-1),(K-2-ETS1-3)		

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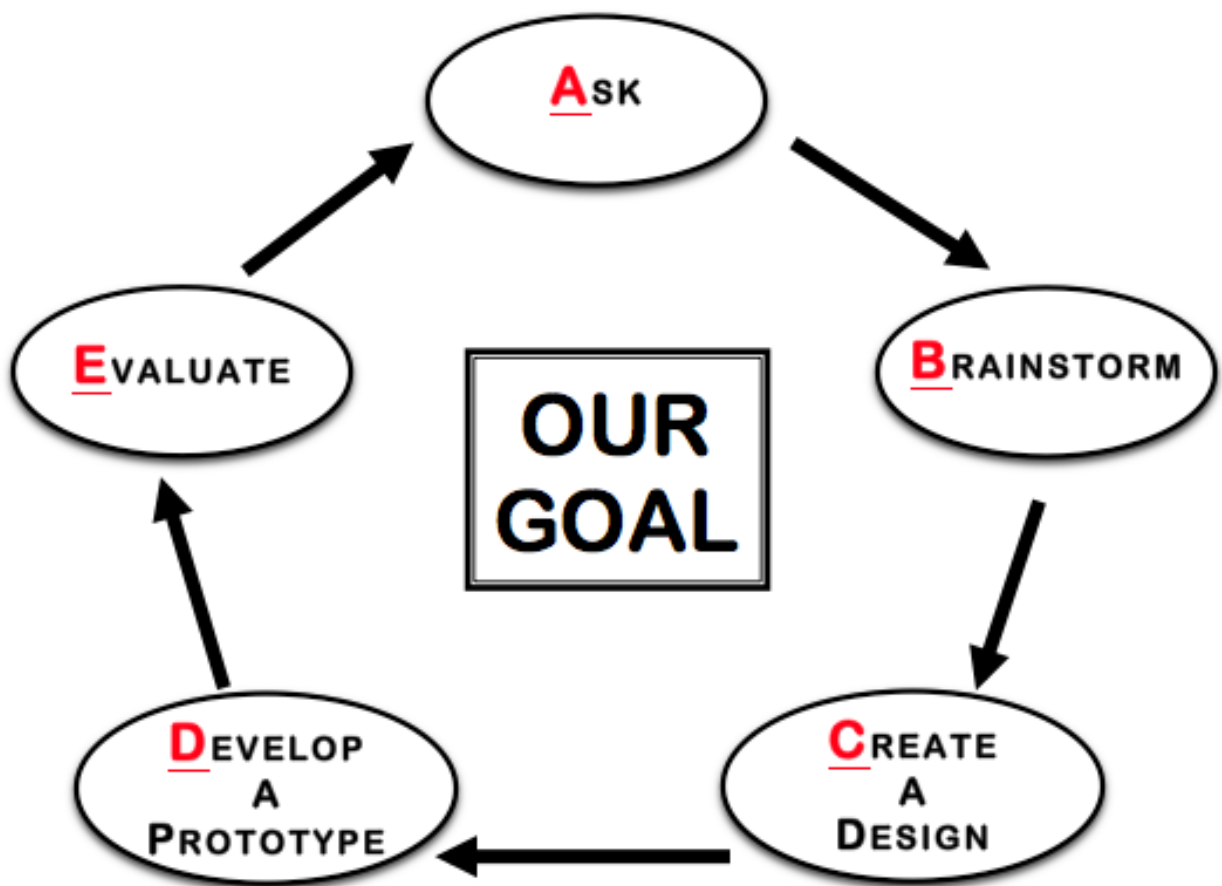
CA ENGLISH LANGUAGE DEVELOPMENT CONNECTIONS

- **P1.1.A.1** Exchanging information and ideas with others through oral collaborative conversations on a range of social and academic topics.
- **P1.1.A.3** Offering and supporting opinions and negotiating with others in communicative exchanges.
- **P1.1.B.5** Listening actively to spoken English in a range of social and academic contexts.
- **P1.1.C.10** Writing literary and informational texts to present, describe, and explain ideas and information, using appropriate technology
- **P1.1.C.11** Supporting own opinions and evaluating others' opinions in speaking and writing

SPECIAL EDUCATION (SPED):

To make accommodations or modifications for students with special needs, provide simple directions, instructions, provide multiple opportunities for repetition, make frequent checks for understanding, use visuals to accompany all vocabulary, simplify questions, be specific with sequence and steps, provide opportunity for paraphrasing, and adjust time and pacing.

THE ENGINEERING DESIGN PROCESS (EDP)



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ASK

- What is the **problem** or **need**?
- What is already out there?
- What are the **requirements (criteria)** and **restrictions (constraints)**?

BRAINSTORM

- What are possible **solutions**?
- Choose your two best solutions.

CREATE - A - DESIGN

- **Draw** a diagram with labels.
- Have a critical design review (peer review & input).
- What materials are available?

DEVELOP - A - PROTOTYPE

- Follow your best diagram and **build** a Prototype.
- **Test** the prototype!

EVALUATE

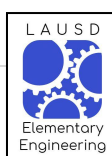
- **Improve** your prototype!
- Conduct more compatibility tests.

BACKGROUND FOR THE TEACHER

You may teach this lesson once students have completed:

FOSS CA – AIR AND WEATHER

Investigation # 1, Parts 1-6



MATERIALS

FOR EACH TEAM (2 students)

- Found objects from around the school campus
 - milk / juice cartons
 - breakfast / lunch trays
- Warehouse catalog items
 - yarn
 - construction paper
 - pipe cleaners
- FOSS materials
 - jumbo straws
 - oblong balloons
 - round balloons
 - Zip bags, 4-liter
 - Zip bags, 1-liter
- tape
- scissors
- markers (for decoration)

FOR THE LESSON

- area rug (lava-filled gorge)
- flight line materials
 - fishing line
 - jumbo straw
 - two chairs
 - duct tape
- beloved classroom object for transportation (small, lightweight, stuffed animal)

GETTING READY

1. Schedule the Investigation

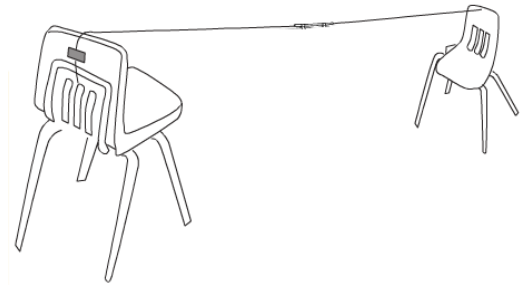
This part requires three 45-minute sessions: one for planning, one for testing and evaluation, and one for redesigning.

2. Gather/Obtain Materials

Be sure to allot time for milk / juice carton and tray collections.

3. Prepare Materials

Set up the flight line as in Investigation 6, Part 6 (p.75 of Teacher Guide) **without** the straw or large zip bag.



4. Plan Partners/Teams

5. Print Focus Questions

Have Focus Questions printed on self-stick labels OR precut labels for gluing into Science Notebook –

How can you design and build a carrier able to transport safely across the lava?

GUIDING THE ACTIVITY

Students will engage in the Engineering Design Process (EDP).

Setting the Context

Call students to the rug and ask them how they were able to get their balloon rockets to travel across the flight line. [The compressed air inside the balloon propelled (pushed) the balloon forward.] Recall how many pumps of air were required to get the “rocket” across the designated area.

1. **ASK**

Present Problem or Need

- Tell students that today they will be working with a partner to use their scientific knowledge about air in order to solve a problem for the <classroom object>.
- The <classroom object> must be safely transported from one side of a lava-filled gorge to the other side using compressed air.
 - Display the Focus Question and have students stick/glue the Focus Question into their Science Notebooks.

“How can you design and build a carrier able to transport <_____> safely across the lava?”

Present Requirements and Restrictions

- **Requirements** (Criteria) *standards that must be met; rules/directions that must be followed:*
 - Teams consist of two members.
 - The carrier must transport the <classroom object> across the entire span of the lava-filled gorge (area rug).
 - The <classroom object> must remain safely inside the carrier.
 - The carrier must incorporate a straw so it may be attached to the flight-line.

- **Restrictions** (Constraints) *limitations that keep something from being the best it could be; may be problems that arise or issues that come up:*
 - Teams may only use materials provided by the teacher.
 - The number of balloon pumps used must be determined during the Create-a-Design stage.

2. **B**RAINSTORM

- Teams may handle materials at the material station, but are not allowed to modify them or take materials back to their own table.
- Teams are allowed to handle the <classroom object> to observe weight and size.

3. **C**REATE - A - DESIGN

- Each member must draw a design individually, without team member input, into his/her science notebook.
 - Title the page "My design"
 - Students should label parts of their design (i.e. carton, round balloon, tape, etc.)
- Team members share designs with one another, compromise, and collaborate in order to create into a "team design" incorporating an aspect of each member's own design.
 - Title the next page in the science notebook, "Team design"
 - Team members should each draw and label parts of this collaborative design.

4. **D**EVELOP - A - PROTOTYPE

- Teams build carriers according to their collaborative designs.
 - Teams are allowed to test their designs OFF the flight line, but without the <classroom object>.

5. **E**EVALUATE

- Teams will test the success of their balloon-powered carriers one at a time.
 - Before the launch, teams will announce the number of pumps they will inject into their balloons and carry out their plan.
 - Teacher facilitates discussion about student successes and challenges.
 - Successes are determined by distance travelled (entire flight line) and the safety of the <classroom object>
 - After observing all designs and receiving input from classmates, students redesign and retest.
 - Have students answer the Focus Question in their science notebooks.
 - For scaffolding, sentence frames work well. For example, “We got our < classroom object > safely across the lava by _____.”
 - If students are not yet able to write out the complete answer, students may be given a printed sentence frame to complete.
 - Possible answer: *We got our <classroom object> safely across the lava by propelling it with compressed air.*”