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| **Hands-On Activity Template** **Part 1: Activity Overview** | | |
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| **Activity Title** | **Click or tap here to enter your Activity Title.** | |
| **Focus Grade Target** | **Click to select a grade**. | |
| **Subject Area(s)**  Check all subject areas that apply to this activity.  [Subject area definitions](https://www.teachengineering.org/subjectareas) | ☐​ Algebra  ​☐​ Biology  ​☐​ Chemistry  ☐​ Computer Science  ​​☐​ Data Analysis and Probability  ☐​ Earth/Space  ☐​ Geometry  ​☐​ Life Science ​ | ☐​ Measurement  ​​☐​ Numbers and Operations  ☐​ Physical Science ​  ☐​ Physics ​  ☐​ Problem Solving  ​☐​ Reasoning and Proof  ​​  ☐​ Science & Technology |
| **Time Required:** | **Click or tap here to enter the Time Required.** Estimate the time required to complete the activity in minutes; you may add a brief explanation for longer activities, such as “three 50-minute class periods”. | |
| **Expendable Cost Per Group** | ​​**Click or tap here to enter text.** In US dollars; what material costs are associated with this activity **per group** that cannot be re-used in another activity? For example, do not include the cost of common classroom or laboratory items such as scissors, paper, a microscope, or beakers.​    Important Note: we strive to meet the **“engineering on a shoestring”** approach of **no more than $20 per activity** – group size x cost per group. If the activity requires substantial non-expendable items that are not typically found in classrooms, such as Arduino, LEGO robots, etc., please contact your editors at TeachEngineering. | |
| **Group Size**  Check the box that applies to this activity. | Independent (1 student)  Pairs (two students)  Small groups (three to five students)  Whole class | |
| **Keywords** | **Click or tap here to enter Keywords.** Add 4-10 words here in alphabetical order that a layperson or teacher may use to search for your activity. | |

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| **Instructional Summary – 200 words** |

Summarize what your activity is about in one paragraph using the present tense. [See an example.](https://www.teachengineering.org/activities/view/cub_energy2_lesson04_activity2#summary)

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| **Engineering Connection – 60-100 words** |

Describe how the scientific and mathematical concepts being studied in this activity pertain to real-world engineering. (Do not recap the activity summary.) Explain for the teacher how everyday engineering ties to what is being done in the lesson or activity. ​[See an example.](https://www.teachengineering.org/activities/view/cub_energy2_lesson04_activity2#engineeringconnection)​

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| **Classroom Testing Information** |

Briefly describe the K-12 classroom or informal learning center testing conducted with this curriculum. Please include the date, school, location, grade level, and number of students.

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| **Educational Standards** |

In priority order, list up to four educational STEM standards that students would learn because of completing this activity. If students need a prerequisite skill to complete the activity, then list what is required.

For each standard, include the source, year, grade band, standard nomenclature (e.g., number(s)/letter(s)), and standard summary. Example: North Carolina, science, 2004, 1.01 (grades 8-8): Identify and create questions and hypotheses that can be answered through scientific investigations. ID# S1028531

**Provide at least ONE from each of the following:**

List [Next Generation Science Standards](https://www.nextgenscience.org/overview-dci) (NGSS)

List [Common Core Math Standards](http://www.corestandards.org/Math/)

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| **Learning Objectives** |

Using bullet points and statement form, identify up to three main goals or student outcomes of the activity. For example:

After this activity, students should be able to:

* Describe the flow of electrical energy through a simple circuit.
* Discuss the effects of gravity and friction in the context of their roller coaster designs.
* Solve problems involving pressure, density and Pascal's law.
* Think and outline design iteration suggestions.

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| **Prerequisite Student Knowledge (optional)** |

List any skills or knowledge a student must already have to be successful in this activity, such as knowledge of a certain concept or topic, specific math skills, etc. Example: “A familiarity with compass directions” or “A basic understanding of gravity and friction” or “The ability to calculate median, mean, and mode.”

# **Part 2 Activity Instructional Plan**

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| **Equipment and Materials** |

Provide a bullet list of equipment and materials and the quantities needed for each group/class needs for the activity; this includes multimedia resources such as links, YouTube/Vimeo videos, etc.

We recommend providing source information, part numbers, estimated pricing, and/or links to online stores to assist teachers in finding *unique* items, etc. Make sure all materials and equipment are listed in the Procedure below.

Provide all measurements in **metric units**. You may also provide customary US or English units as a secondary measurement. Example, “a length of string, 2 m (~6 ft.)” For example:

Each group needs:

* 1 laptop computer
* 1 scale
* 10 g iron filings
* 1 Arduino Uno microcontroller ([available online](https://store.arduino.cc/usa/arduino-uno-rev3))

For the entire class to share:

* poster paper
* cardboard
* magic markers

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| **Introduction and Motivation (for students) – at least 250 words (or 1/2/ page)** |

# Develop a script of the first 5 minutes of class for teachers to use with their students to introduce the activity. Write with the point of view of the teacher talking directly to students. Engage students in authentic and meaningful scenarios that reflect the practice of science and engineering as experienced in the real-world.

Provide support for teachers to cultivate student questions that come from their experience, community, or culture as appropriate. What investigating questions would you ask to motivate them?

Provide opportunities for students to connect their explanation of a phenomenon and/or design problem to questions from their own experience.

# Include teacher instructions and answers in parentheses, such as: (Write the equation on the classroom board.) or (Possible answers: xxx, yyy, zzz.)

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| **Procedure** |

**Clearly explain the step-by-step procedure to follow to conduct the hands-on activity.** Make sure to include connections to engineering and address activity objectives. To clarify the activity setup and procedure, reference images throughout this section and the activity write-up. Use figure numbers if the image is referenced in the text. Include metric units. Use the following format below. [See an example.](https://www.teachengineering.org/activities/view/cub_energy2_lesson04_activity2#procedure)

**Background** (for teachers only; use as a guide to help students make sense of the concepts on their own)

Clearly explain any essential background information (such as the explanation of science, engineering and/or math concepts related to the activity) the teacher may need to know to successfully complete this activity. Usually in paragraph format.

**Before the Activity** (how does a teacher prepare for the activity? – example text and formatting below)

* Gather materials and make copies of the worksheet…
* Describe any other pre-activity preparation here…
* (Bullet format suggested)

**During the Activity** (outline the exact steps a teacher follows to guide students through the entire activity – example text and formatting below)

**Part 1**

1. Example: Divide the class into groups of three or four students each…
2. Describe step-by-step procedures here…
3. (Numbered list format)

(For images, see **Part 5: Photos and Images** below on how to properly reference and cite images in your submission.)

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| **Assessment (Pre-Activity, Formative, and Summative)** |

Provide assessment tools/activities for teachers to assess the learning objectives. How do you know if the students “got it” during and after the activity? Provide active and embedded ways (formative assessment\*) for the teacher to gauge what students are learning about the topic/content throughout the activity, and a performance-based way to assess student understanding of the learning objectives at the end of the activity (summative assessment).

Browse the TE collection for example assessment tools and activities. [See an example.](https://www.teachengineering.org/activities/view/cub_energy2_lesson04_activity2#assessment)

Pre-Activity Assessment

Describe the assessment procedure so the teacher knows what to do **before the activity**; if posing discussion questions, provide example answers. Include detailed sample items and/or list the name of the actual assessment that you will be attaching.

Activity Embedded (Formative) Assessment

Describe the assessment procedure **during** the activity so the teacher knows what to do; if posing discussion questions, provide example answers. Include detailed sample items and/or list the name of the actual assessment, this can include worksheets, lab notebooks, prototype development, etc.

Post-Activity (Summative) Assessment

Describe the assessment procedure **after** the activity so the teacher knows what to do. Include detailed sample items and/or list the name of the actual assessment, this can include reflection questions (with answers provided), exit tickets, final presentations, etc.

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| **Academic Vocabulary** | **Definitions (you may source definitions from Wikipedia or Wiktionary; )** |
| *orbit* | *The gravitationally curved trajectory of an object.* |
| *particle* | *A small localized object to which can be ascribed several physical or chemical properties such as volume, density, or mass.* |

[See an example.](https://www.teachengineering.org/activities/view/cub_energy2_lesson04_activity2#vocab)

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| **Troubleshooting Tips and Potential Safety Issues (optional)** |

Think through likely common snags that might be encountered while conducting the activity. Suggest solutions, approaches to avoid pitfalls, etc. What should you consider if the activity does not work right the first time? What could you change?

What safety measures must be considered? (Ex. Use eye protection, caution near flames, etc.)

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| **Worksheets and Attachments** |

List the names of any documents you will use as part of this activity such as **presentations, handouts, assessments, coding language**, etc. Please also provide **answer keys** for all handouts/assessments. **Upload these documents separately along with this template.**

Clearly label each activity and include the activity name in the file (for example, all-about-bridges-homework-assignment.docx. TeachEngineering accepts most files in an **editable format** including Microsoft Word (.docx) Microsoft Excel (.xlsx) Microsoft PowerPoint (.pptx), JPEG files (.jpg) and Portable Network Graphics (.png) and others. If you have any questions, please contact your editors at TeachEngineering.

[See an example.](https://www.teachengineering.org/activities/view/cub_energy2_lesson04_activity2#attachments)

**Part 3: Supporting Activity Information**

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| **Scaling, Extensions, and Enrichment (optional)** |

Explain modifications or suggestion to activities that would make them more or less challenging for use at various grade levels. (For example: Reducing or increasing the number of redesign steps, graphing the data, etc.) Example lead-ins:

* For lower grades,
* For older/ advanced students,

Provide additional activities that explore the activity topic further.

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| **References (optional)** |

List all references used to create the activity, especially the background knowledge section.

Consider using a modified MLA format. Provide in A-to-Z order according to authors’ last names or website banner page name, whichever appears first in citation.

# **Part 4: Contributor, Supporting Program, Acknowledgements**

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| **Contributors** |

List the names of any person who participated in the development of this activity (teachers, mentor, lab director, education staff, etc.). List the primary author first.

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| **Supporting Program and Acknowledgements** |

# If this instruction was developed as part of a special program, list the name of the supporting program and/or organization.

Example: Research Experience for Teachers (RET), University of Houston

This curriculum was developed under National Science Foundation RET grant number ABC-XXXXXXXX. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

# **Part 5: Photos and Images**

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| **Activity Photos** |

**TeachEngineering requires a minimum of two original photos per activity to** help teachers visualize the nature of the activity. We don’t expect nor require expert photos—smartphone photos work fine! However, we would like to see how teachers and students engage in the activity. (There are placeholders below for photos, but we encourage you to add as many as you like.)

You may supplement images sourced from the internet as long as they are licensed for public use (see [Requirements and Tips for Using Images](https://www.teachengineering.org/content/documents/TEAboutImages_v8.pdf)). Note: if authors plan on submitting photos that include their students, the author is responsible for securing the permissions from parents, guardians, or administrators.

**You may include illustrations or** diagrams (known as a figure) that specifically reference a topic within the text. For example, in explaining the parts of a cell or how a suspension bridge works, a figure may reference that explanation. Figures may also be used to help explain how to build a tool or a machine.

Reference where you want the image to go in the activity by simply saying **(Insert Image 1)** or (Insert Figure 1) in the text above and attach the photo in a box below.

 How to format images and figures; see below for a finished example:

**Image 1:** Insert into Procedure under “Day 1”

**Image file**: lesson01-image1-prism.jpg

**ADA Description**: A glass prism sits on a black background; a light source shining through the prism is demonstrating refraction of white light into the visible light spectrum.

**Source/Rights**: 2009 D-Kuru, CC BY-SA 3.0, Wikipedia, [source link](https://en.wikipedia.org/wiki/Prism#/media/File:Light_dispersion_of_a_mercury-vapor_lamp_with_a_flint_glass_prism_IPNr%C2%B00125.jpg).

**Caption**: Why does white light diffract into the colors of a rainbow when it shines through a prism?

**Click the center of the box below to upload an image.**

**Image 1 / Figure 1:** *Enter the location of where you want the image or figure in the text by saying* (Insert Figure 1) *here*.

**File name:** *The photo must be included as an attachment and must have the exact same name as you type here.*

*Example: lesson05-image1-pilot.jpg*

**ADA Description:** *Write this text as if describing key elements of the image to a blind person.*

**Source/Rights:** *Include copyright or identifying information for any images used. Images pulled from the Internet should be either in the public domain or licensed for use through Creative Commons (CC-BY or CC-SA); you must still attribute them to the person or website from which they were pulled as well as provide a* ***direct link*** *to the image.*

**Caption:** *This text will appear directly below the Image. This should not be the same text as used for the ADA Description.*

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**Image 2 / Figure 2:** *Enter the location of where you want the image or figure in the text by saying* (Insert Figure 1) *here*.

**File name:** *Example: activity05-image1-pilot.jpg*

**ADA Description:**

**Source/Rights:**

**Caption:**