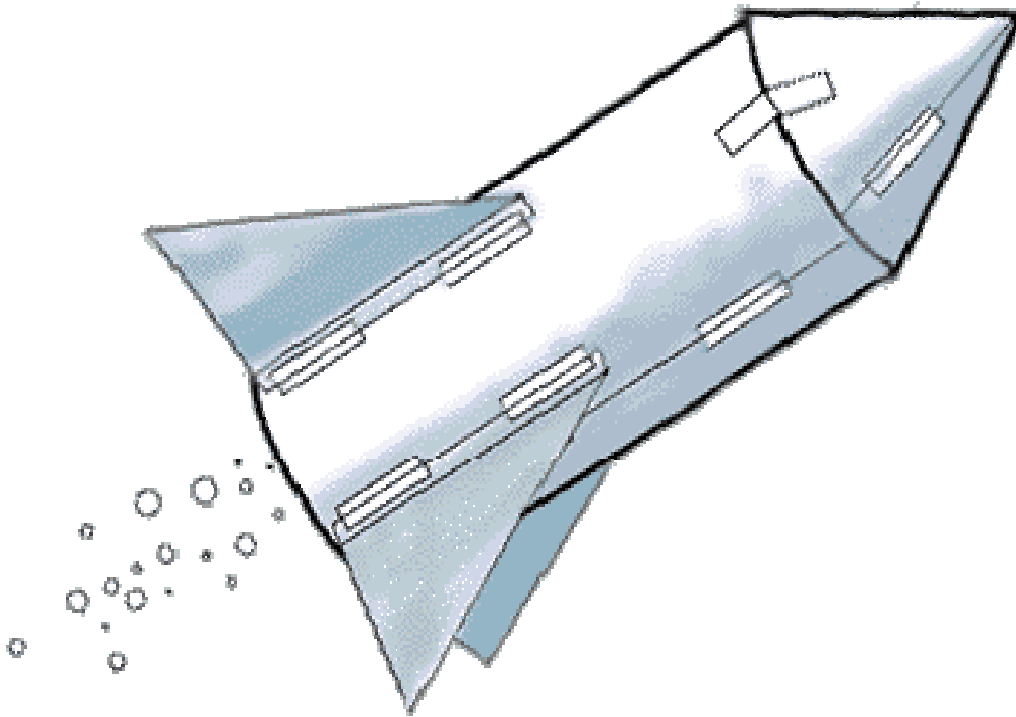


# STEM CIP

Science/Technology/Engineering/Mathematics  
Curriculum Integration Project



## 3-2-1 Lift Off

Student Curriculum Module



# **3-2-1 Lift Off**

**A Study of Force, Motion,  
Change of Matter, and Transfer of Energy**

## **Student Curriculum Module**

Written by

**Hays B. Lantz, Jr., Ed.D.**

**Nancy Smaroff, M.S.W.**

Mathematics Consultant

**Joe Mills, Jr., M.Ed.**



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# Science, Technology, Engineering, and Mathematics (STEM) Curriculum Integration Project (CIP) (STEM-CIP)

**Welcome to the exciting world of STEM.** STEM is a new way to learning Science, Technology, Engineering, and Mathematics (STEM). These four disciplines are taught together, as one, rather than being taught as separate as in the past. The natural connections among the four disciplines have always been there in scientific and engineering research labs and in professional work settings, but not always in your classroom.

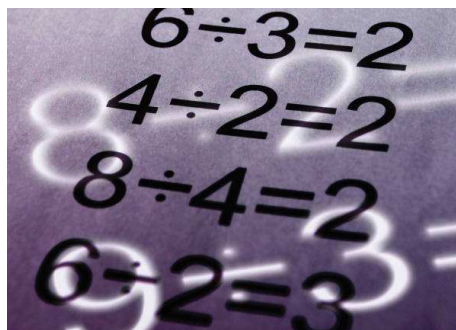


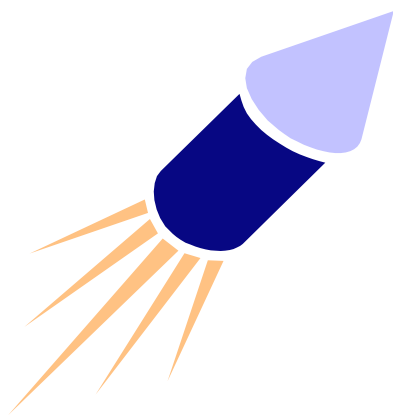
The modules of the STEM-CIP Project have been designed to engage you in stimulating, real, and current problems and questions. These problems and questions involve the life, physical, environmental, and earth/space sciences, technology, engineering, and mathematics, in other words STEM.

As you learn about STEM you will be acting as an engineer using science, technology, and mathematics to solve problems through designing and creating products and processes. Many of these products you use in some form in everyday life. In the STEM-CIP modules you will design Alka-Seltzer rockets, develop models of amusement park rides, and engineer wind turbines and cars. As you do so, you will follow the same processes and thinking that engineers, scientists, and mathematicians use when they solve real world problems and questions.



So sit back, buckle up, and let's launch into the world of STEM.





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## Engagement: Let's Soar

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### Mathematics Readiness Assessment

Mathematics and science go hand-in-hand. Many times mathematics is necessary to understand and work with science concepts. In order to fully understand the science and be successful with investigations and activities in this module it is important for your teacher to know if you already know some mathematics computations and skills. On page 1 of the Student Data and Response Booklet (SDRB) is a mathematics readiness assessment designed for this module. Complete it to the best of your ability. It will not be graded; it will be used to help your teacher create strategies so that you can successfully complete the activities.

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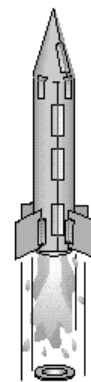
### Do You Already Know This Science?

In preparation for your main task in this module, it is important to understand what you already know about rockets and how they are launched. Answer the questions on pages 11-12 of the SDRB. Your responses are not graded and, correct or not, will help guide the lessons in this module.

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### A Rocket Launch Challenge

Your teacher has been studying about engineering Alka-Seltzer rockets and knows one way to design and launch a rocket. Watch as your teacher demonstrates the launch of an Alka-Seltzer rocket. Observe the launch carefully and then go to page 13 of the SDRB and complete the two questions.



Here is your challenge. You and your group will design, build, and launch (this is called engineering) a rocket that will fly higher than any other rocket in the challenge. The rocket you design and launch will be powered by a chemical reaction – an Alka-Seltzer tablet(s) in a liquid.

To compete in this engineering challenge, you will learn about Alka-Seltzer rockets by designing and testing them, as engineers do in their work. Your rocket design and test data will be evaluated using the rubric “Alka-Seltzer Rocket Design” which is located in the SDRB on page 50.

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*Continued on next page*

## Engagement: Let's Soar, Continued

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### Your Task

In order to participate in the challenge, you must think and work like an engineer, a scientist, and a mathematician all at the same time. We call this STEM (Science, Technology, Engineering, and Mathematics), where the four disciplines (subjects) work together.

Your task (and challenge) is to build and launch a rocket that will achieve the highest launch height using Alka-Seltzer and a liquid. As you investigate and design your rocket, think about how you use STEM.

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## Activity 3: Temperature and Dissolving Time

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### Activity Description

In this activity, you will investigate the effects of temperature on dissolving time of effervescent antacid tablets in water.



### Materials Needed

- 3 Clear cups labeled A, B, C
  - 600 mL of water (200 mL cold, 200 mL room temperature, and 200 mL hot)
  - 1 Thermometer
  - 1 Stop watch or clock with a second hand
  - 1 Graduated cylinder or beaker
  - 3 Effervescent antacid tablets
- 

### Explore

You will now conduct an experiment to test a variable that you may have thought of with your partner - temperature. **An investigation always starts with a question that can be answered through experimentation and the question is written so it includes both the independent and dependent variables.** You will be investigating the following question:



Question: Does changing the temperature of the water (independent variable) have an effect on the dissolving time of the effervescent antacid tablet (dependent variable)?

The next step a scientist, engineer, or mathematician often takes is to develop a **prediction**. A prediction is an informed guess about the outcome of the experiment based upon research or experiences of the investigator. Increasing the temperature might either decrease (speed it up) the dissolving time, increase (slow it down) the dissolving time, or it might not have any effect on it at all.

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### Make a Prediction

**3a.** On page 18 of the SDRB, respond to 3a and make a prediction about how you think temperature will affect dissolving time.

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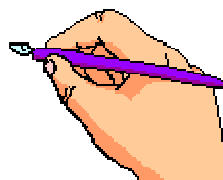
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## Activity 3: Temperature and Dissolving Time, Continued

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### Important Note

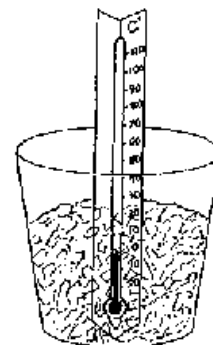
**3b.** Carefully read the **procedure** below. These are the steps you will be following with your group to complete this investigation. Once you have reviewed the procedure, decide who will do what part of the procedure. Make sure that everyone in the group gets an equal chance to participate in the activity. Use the materials you have been provided to complete the investigation and record your data in 3b on page 18 of the SDRB. Check off each step (below) as you complete it.



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### Procedure

1. Fill cup A with 200 mL of cold water.
2. Place the thermometer into the cup for 1 minute to take the temperature of the water and record the data in the table on page 10 of the SDRB.
3. Add one tablet to the cup of water. Start timing immediately!
4. Record the amount of time it takes for the tablet to dissolve completely in the cup. The water will still be bubbling but the tablet will have completely disappeared. Record the time (in seconds) on the data table on page 10 of the SDRB.
5. Fill cup B with 200 mL of room temperature water.
6. Repeat steps 2-4.
7. Have the teacher fill cup C with 200 mL of hot water.
8. Repeat steps 2-4.



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*Continued on next page*

## Activity 3: Temperature and Dissolving Time, Continued

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### Explain Your Findings

**3c-3f.** On pages 18 – 19 of the SDRB, answer questions 3c – 3f.

Note: The more times a variable is tested, the more reliable the results will be. A good scientific, engineering, or mathematics investigation should include repeated trials for data collection. Although it would be best for each group to do repeated trials to gather more data, because of time and cost of materials your class will share data.

### Arithmetic Mean

Arithmetic Mean Definition: Arithmetic mean is commonly called the average. Mean or average is defined as the sum of all the given data divided by the total number of data groups.



What the symbols mean: M = mean

$\sum d$  = sum of all data

/ = divided by

n = number of data groups (sample size)

Formula:  $M = \sum d / n$

Example: Find the mean of 3, 5, 7

Step 1: Find the sum ( $\sum$ ) of all data ( $3 + 5 + 7 = \underline{15}$ )

Step 2: Determine the number of data groups (sample size) = 3

Step 3: Divide 15 by 3 = 5

The mean of 3, 5, 7 = 5

---

### Calculate the Mean

**3g.** On page 20 of the SDRB record the dissolving times of all groups in your class in the data table in question 3g. Calculate the mean (average) dissolving time for each temperature (cold, room temperature, hot).

Now, add these mean data to your graph that you created in 3f. Compare the mean data to your group's data. How do they differ? Which data do you think is more accurate?

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*Continued on next page*

## Activity 3: Temperature and Dissolving Time, Continued

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### Write Your Conclusion

**3h.** It is time to write a conclusion. A conclusion is written when the experiment has been conducted, and all of the data have been collected and analyzed. A conclusion is a summary of your findings. In your conclusion be sure to include:



- Whether your prediction was supported by the results or not.
- An answer to the original question. (Does temperature have an effect on the dissolving time of an effervescent antacid tablet in water?)
- A reference to the data collected by you and your classmates' groups.
- Other things you might want to test about dissolving times of an effervescent tablet.

Space to write your conclusion (3h) can be found on page 21 of the SDRB.

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### Check Your Understanding

On page 22 of the SDRB, you will find five questions that will test your understanding of Activity 3.

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**CurrTech Integrations, LLC**  
2026 Russell Ave  
Baltimore, MD 21207

[www.currtechintegrations.com](http://www.currtechintegrations.com)  
Ph: 410-298-8806/ 886-366-0282