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Project-Based Units for STEM

INTRODUCTION

The increased use of science, technologies, engineering and mathematics (STEM) in the primary classroom is an important step towards the goal of preparing our students for success in the 21st century. *Year Round Project-Based Activities for STEM* is a hands-on activity book that provides STEM-based projects for science, technologies and engineering, and mathematics. The primary classroom is the perfect place to introduce project-based learning because it incorporates both academic and technological skills that draw on students with different skill sets, backgrounds and ideas.

This book provides many opportunities to learn while doing. It also encourages students to think critically, and be proactive in their own education. We have seen that project-based learning tends to be a deeper learning experience, which is often more relevant to students and thus is more easily retained. Project-based learning and STEM dovetail perfectly, guaranteeing that 21st-century skills such as collaboration, communication, critical thinking, problem-solving and digital literacy are incorporated into the curriculum while supporting students' academic and socio-emotional growth. Further, project-based learning allows teachers to almost immediately conduct authentic assessments to gauge what students comprehend, helping them to adapt the curriculum accordingly. Most of all, project-based learning is fun!

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WHY PROJECT-BASED LEARNING?

Year Round Project-Based Activities for STEM presents 12 activities that can be easily implemented within Year 2 and Year 3 classrooms. The activities are divided to cover both the physical and biological sciences. Each activity in the book provides clear learning standards and objectives in science, mathematics, and technologies and engineering. The activities are designed for use in the classroom, with materials that can be easily obtained.

Each activity begins with background information, a materials list and a vocabulary list (with definitions pertinent to the specific activity) that will help prepare your students for the content of the lesson. Clear, step-by-step procedures are provided that can be used by both the students and the teacher. The activities in the book are centred around hands-on scientific investigations, which allow students to use the scientific method to answer questions about the living and non-living world. The activities also involve the applied use of mathematics, to help students solve problems.

The use of brainstorming sessions during the activities gives teachers and students the opportunity to incorporate more engineering (creative thinking) into the science curriculum. By posing "what if we tried …" and "how might we improve …" type questions, students are encouraged to think more deeply about the activities and to try different approaches. Students are also encouraged to design and build to turn their ideas into reality. It is not always about the right answer, but about the exploration.

All activities within the book culminate with the use of computer technology. Students take the data they have gathered from their scientific investigations and use common word-processing, drawing or spreadsheet software to analyse and present it. The computer technology portion of each activity also comes with clear, step-by-step procedures, including screenshots, making it very easy for students to work individually. The computer portion of each activity is designed to be done in a computer lab setting but can be done in the classroom using fewer computers and collaborating in small groups. The goal is to allow each student to have the opportunity to apply the use of technology to the project. Useful tables, diagrams and reproducibles are also provided where needed within each activity.

Teachers will find this book filled with many useful ways to engage students in learning about science, while also incorporating technologies and engineering, and mathematics into their Year 2 or Year 3 curricula.

WEATHERING ROCKS

STEM Project Overview

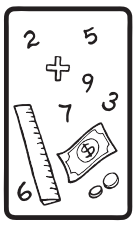
Students will collaborate to:

- observe how the weathering of rocks can occur by the process of abrasion in water (***Science/Mathematics***)
- enter the Weathering Rocks data collected during an experiment into a spreadsheet ***(Science/Technologies and Engineering/Mathematics)***
- display the data in the form of a line graph (***Technologies and Engineering/Mathematics***)
- evaluate their findings (***Science/Mathematics***)
- brainstorm to improve the experimentation process. (***Science/Technologies and Engineering***)

Science

Students will understand the Earth's composition and structure, including:

- knowing how features on the Earth's surface are constantly changed by a combination of slow and rapid processes, including weathering erosion and transport
- knowing that smaller rocks come from the weathering and breakage of larger rocks.



Mathematics

Students will use mathematical analysis to pose questions, seek answers and develop solutions, including:

- selecting the appropriate operation to solve mathematical problems
- applying mathematical skills to describe the natural world
- using appropriate scientific tools to solve problems about the natural world.

Engineering

Students will use engineering design to pose questions, seek answers and develop solutions, including:

- proposing alternative solutions for procedures
- using a variety of verbal and graphic techniques to present conclusions
- identifying simple problems and solutions
- understanding troubleshooting procedures.

Technologies

Students will know the characteristics, uses and basic features of computer software programs, including:

- knowing the common features and uses of spreadsheets
- using spreadsheet software to update, add and delete data, and to produce charts.

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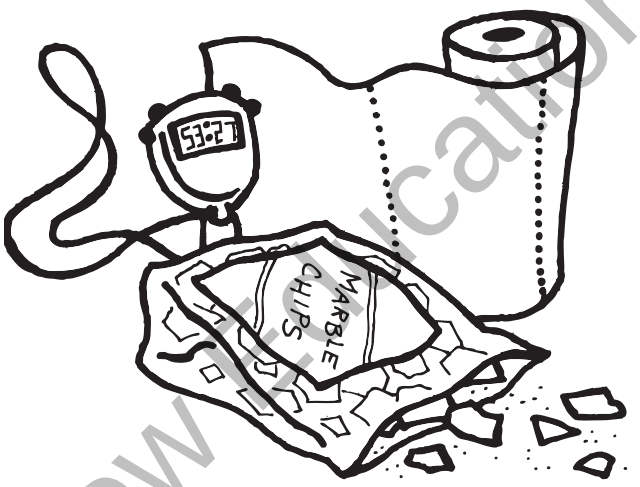
WEATHERING ROCKS *(CONT.)*

Materials

- marble chips (per group) can be purchased at home-and-garden or hardware stores
- paper towels
- scale or balance (per group)
- sink or large bucket
- small, plastic 250ml jar with lid (per group)
- stopwatch (per group)
- strainer or sieve (per group)



Vocabulary

abrade – to wear away by scraping or erosion

mass – the amount of matter an object contains

gram – a metric unit for mass

weathering – the breakdown of rocks into smaller pieces

Background

Before beginning this experiment, soak the marble chips (rocks) in water. Since this activity involves the use of water to ***abrade*** the marble chips, it is important to start with wet ones. This is because water has ***mass*** and can affect the results when the marble chips are weighed.

Science Experiment Procedure

1. Use a balance or scale to weigh out approximately 20 grams of damp marble chips.
2. Lay out a paper towel and carefully pour out the marble chips onto it. Use the paper towel to dry off the marble chips as much as possible.
3. Weigh the marble chips once again and record the start mass at time zero in your Weathering Rocks data table like the one shown below. Also record the appearance of the water in your data table. See page 13 for data table templates.

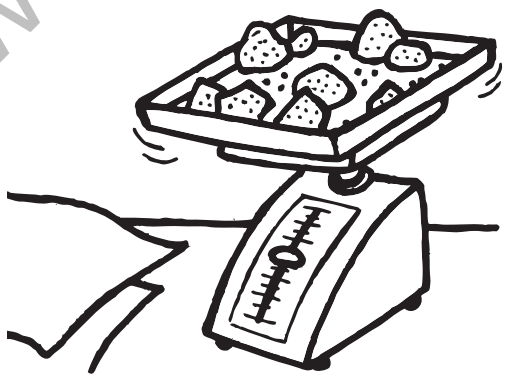
Weathering Rocks

Time (minutes)	Mass (grams)	Observations
0	21 grams	Water is clear.
3		
6		
9		
12		
15		
Total Mass Lost		

WEATHERING ROCKS *(CONT.)*

Science Experiment Procedure *(cont.)*

4. Pour the marble chips into a plastic jar. Add just enough water to cover them.
5. Screw the lid onto the jar tightly.
6. Begin to shake the jar vigorously and start the stopwatch. Shake the marble chips for 3 minutes.
7. After 3 minutes, stop shaking the jar. Observe the appearance of the water and record it in your data table.
8. Open the jar. Pour the marble chips into the strainer over the sink or a bucket.
9. Lay out a dry paper towel and carefully pour the wet marble chips onto it. Use the paper towel to dry off the marble chips.
10. Weigh the marble chips and record their mass under Mass in the Time column for 3 minutes, in your data table.
11. Pour the marble chips back into the jar and add just enough water to cover them.
12. Place the lid on the jar tightly and begin to shake them again for another 3 minutes.
13. After 3 minutes, repeat steps 9, 10 and 11. Continue the same process every 3 minutes until you have shaken the marble chips for a total of 15 minutes.
14. Record the mass at each 3-minute interval.
15. Now that your experiment is complete, you will determine the total mass of rock that was lost by the weathering process. To do this, subtract the mass of the marble chips at 15 minutes, from the mass of the marble chips at the start of the experiment. Then record the Total Mass Lost in your data table



Brainstorming

Once the class has completed the activity, ask students if they can think of any ways that the experiment could be improved. For example, is there a way to make the process of shaking the marble chips more efficient? What about a different way to strain or dry the marble chips? Can students devise a different system for weighing the chips?

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WEATHERING ROCKS *(CONT.)*

Technologies and Engineering Learning Objectives

At the end of this lesson, students will:

1. Know the various terms associated with spreadsheets including, rows, columns and cells.
2. Enter data into a spreadsheet.
3. Adjust the width of a selected column.
4. Change the alignment of data within a cell.
5. Change the style of data within a cell.
6. Create and format a line chart from data entered within a spreadsheet.

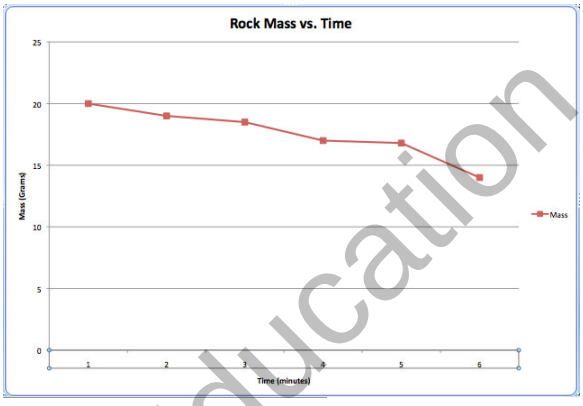

Figure 1-9

Teacher Note

The technology portion of this activity is written for MS Excel 2010 but can be completed using most spreadsheet and word processing software versions like Open Office, Google Sheets and iWork with minimal modification.

Technologies and Engineering Procedure

1. Open a new spreadsheet document. Spreadsheets are made up of *columns* that are identified by letters (A, B, C, etc.) and *rows* that are identified by numbers (1, 2, 3, etc.).
2. The location within a spreadsheet where a column meets a row is called a *cell*. It is identified by both a letter and number (Figure 1-1).

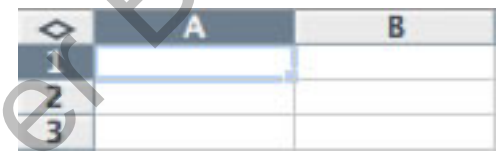

Figure 1-1

3. Click into cell **A1** and type in the following label, “Time (minutes)”. Hit the **Tab** key on your keyboard to bring you over to cell **B1** and type in the label “Mass (grams)”.
4. Next, click and drag over the two column labels. Use the **Bold** button on your toolbar to make your column titles bold (Figure 1-2).

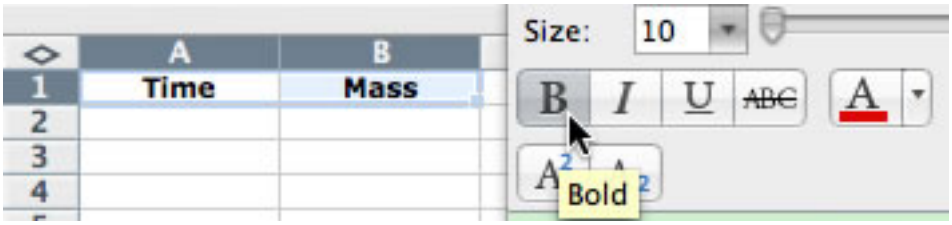

Figure 1-2

5. Now fill in the data into your spreadsheet.

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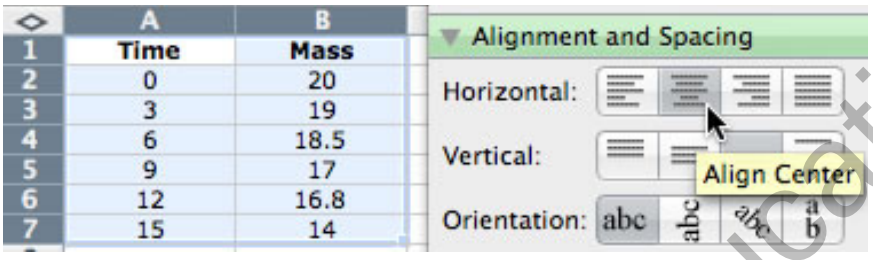
WEATHERING ROCKS *(CONT.)*

Technologies and Engineering Procedure *(cont.)*

6. Next, you will centre your data in your cells. To do this, click and drag over all of the data in your spreadsheet to highlight it. Then use the **Align Center** button on your toolbar (Figure 1-3).

Figure 1-3



7. Now you are going to use your data to create a chart. First, highlight all of your data in both columns, including the labels. Choose the **Insert** menu, choose **Chart** and click on **Line Chart or Line** (Figure 1-4).

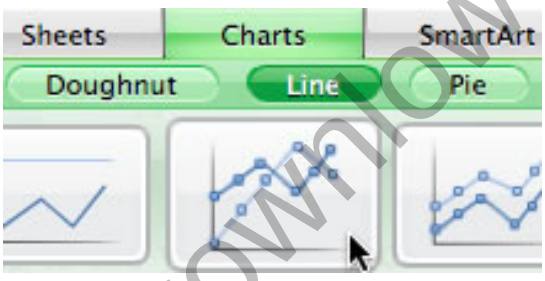
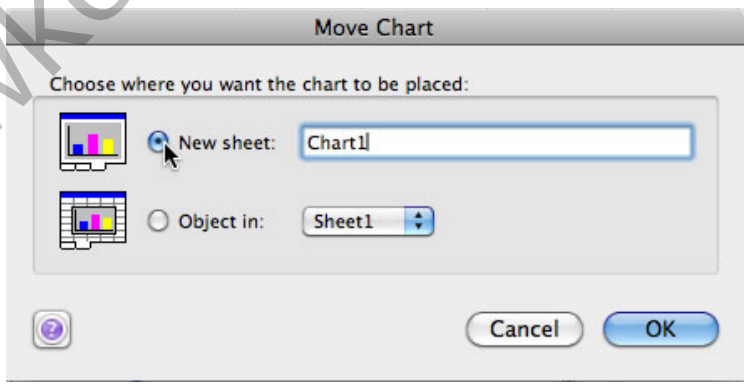


Figure 1-4

8. Your chart should now appear within your spreadsheet.
9. Go to the **Chart** menu, select **Move Chart**, choose **New Sheet** and click **OK**. (Figure 1-5).

Figure 1-5



10. Your chart should now take up the entire page.

WEATHERING ROCKS *(CONT.)*

Technologies and Engineering Procedure *(cont.)*

11. Right click (Control-click on a Mac) on the blue line for **Time** and select **Delete** from the drop-down window. This will remove the time data from your spreadsheet (Figure 1-6).

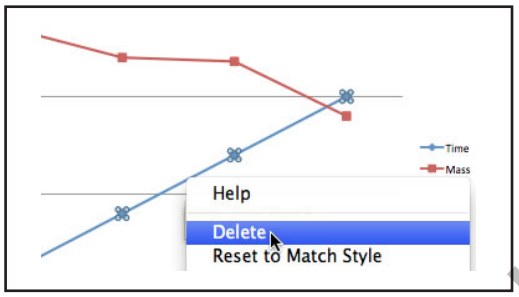


Figure 1-6

12. Next, under chart options in the **Chart Titles** box, type in: "Rock Mass vs. Time" (Figure 1-7).

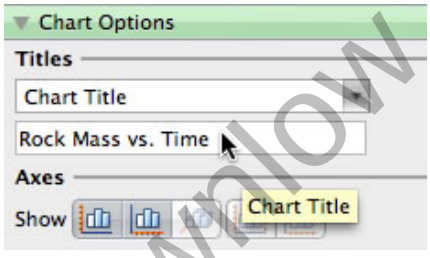


Figure 1-7

13. Under **Chart Options**, click on the **Chart Title** drop-down menu and select **Horizontal Category Axis**. Type in the following label for the horizontal axis: "Time (Minutes)" (Figure 1-8).

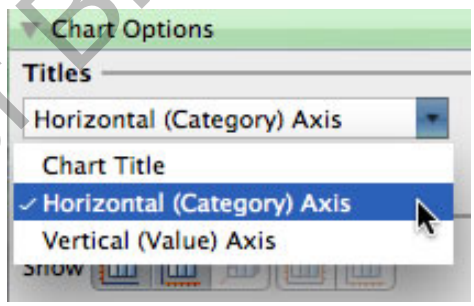


Figure 1-8

14. Next select the **Vertical Category Axis** from the **Titles** drop-down menu and type in: "Mass (Grams)".

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WEATHERING ROCKS *(CONT.)*

Technologies and Engineering Procedure *(cont.)*

15. **Save** and **Print** the *Rock Mass vs. Time* chart. It should look similar to the one in Figure 1–9.

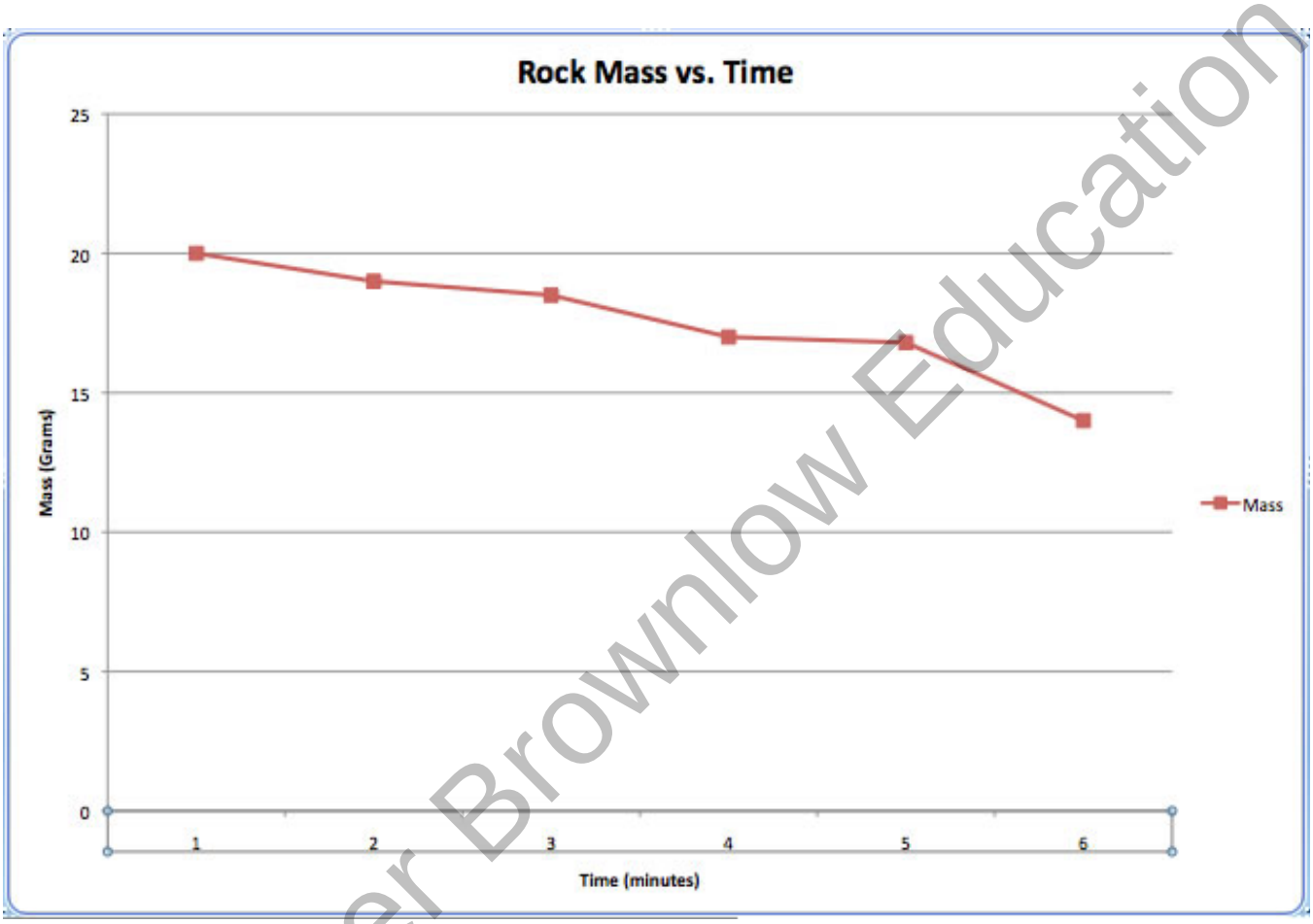

Figure 1-9