Mixing it up

Integrated, Interdisciplinary, Intriguing Science in the Primary Classroom

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Leaders, Readers & Science

By Arlene G. Terrell

A terrific interdisciplinary, cooperative-learning science experience grew out of my Year 6 students' love of adventure. As an education specialist, I work with gifted students. During one project, Year 6 students were exploring the importance of leadership skills as they simultaneously read two books. *Shipwreck at the Bottom of the World* (Armstrong 2000) describes the 1914 transAntarctic expedition led by Ernest Shackleton that went awry as ice engulfed and slowly crushed the ship, leaving the crew of 27 with three lifeboats and only the necessities for survival to endure storms, icebergs and extreme cold before returning alive 19 months later in 1916. *Carry On, Mr. Bowditch* (Latham 1983) tells the story of Nathaniel Bowditch, a mathematician and astronomer, who in 1802 wrote a navigation manual, *The New American Practical Navigator*, that led to safer sailing practices.

It was students' fascination with the television show *Survivor* that led me to incorporate these books into the curriculum. Every day, I teach a two-hour reading and English class. For four and a half weeks, students read the books both in class and at home, did hands-on activities and kept journal entries related to their discoveries. Although the project began primarily as an English assignment to compare the leadership skills of two fascinating men, it grew to encompass an exploration of ice's properties and taught students important cooperative-group skills and science concepts.

Setting the Stage for Science

To begin, I introduced the assignment with a pre-reading activity: "Write a journal entry about the most dangerous situation you've ever endured. How did you deal with the situation, and what contributed to your survival?" The students shared their entries, noting common threads that made survival possible, such as remaining calm, assessing the situation, devising a plan of rescue, knowing first aid and having good communication skills. After that, students explored the conditions of the Antarctic through "Danger on the Ice" by Peter Tyson, which students accessed on the internet at *www.pbs.org/wgbh/nova/shackleton/surviving/danger.html*. We discussed what people would have to know, have and be able to do in order to survive there. A competent leader was at the top of the list. The list also included such items as knowledge

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of the Antarctic (weather, plants, animals, water, terrain, temperature); a plan; an understanding of the dangers and risks involved; monetary support to purchase supplies, boats and equipment for cutting through the ice; navigation skills and equipment (navigation charts, compass, sextant); an able crew; a sense of anticipation and an ability to plan for the unexpected; and a means of communication.

Students began the study by reading *Shipwreck at the Bottom of the World*. As they read the book, students were asked to record examples of Shackleton's leadership skills in a packet I had created for them. The packet contained guided questions about the reading, as well as information about 10 key leadership skills I had paraphrased from *Leading at the Edge* (Perkins et al. 2000). According to this book, an effective leader will:

- set long- and short-term goals
- provide distractions from problems
- celebrate successes
- maintain an optimistic outlook
- take informed risks
- deal with conflict head on
- keep enemies close by
- work in the trenches alongside those being led
- lead by example with strong communication skills
- find ways to deal with stress.

An Icy Experience

The challenge Shackleton faced in the Antarctic's icy climate inspired students to find out more about the Antarctic. Students wanted to know what it would be like to visit the Antarctic. They looked at various websites and read books and other materials I had gathered and made available in the classroom (see Resources).

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The Antarctic is often associated with ice and extreme cold. My students first became intrigued with the ice as they read about how it slowly crushed the ship, leaving the crew at the mercy of the ice. Many types of ice were discussed and described in the book:

- Firn – compressed snow with the air squeezed out, making it dense, heavy ice (this is what makes the ice appear blue).
- Nilas – a layer of thin, flexible ice.
- Pancake – nilas disturbed by the wind, forming rounded disks that look like white lily pads with their edges turned up.
- Ice field – pancakes packed together forming a single sheet.

The students' interest in ice led them to think about inquiry experiences to do with a block of ice. A few students wanted to hollow out an eggshell, label and name it, and test to see how much pressure or weight from the ice it would take to crush the eggshell just as Shackleton's ship Endurance was crushed. Other students wondered about different ways to melt ice. Would sea salt melt ice faster than table salt? Would vinegar melt ice faster than ammonia?

To explore some properties of ice, students

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conducted an observation laboratory (an opportunity for students to gather preliminary information prior to an organised investigation of a problem) with ice cubes using a variety of materials (wool cloth, salt, wooden rods, wood and nails). In this activity, students observed physical and chemical properties of the ice as they tested the effect of different materials and treatments of the ice.

After the introductory exploration, I challenged students to come up with their own investigation with a larger, 12 centimetres by 15 centimetres block of ice using a variety of materials and tools, including different types of salt; different types of cloth to test effects of friction; materials to make an electrical circuit; acids (vinegar) and bases (ammonia); different types of metal; and dials made of wood, plastic and Teflon. Students were also allowed to bring in items from home with teacher approval.

Since the class was reading about leadership skills, the group activity was a chance to put some of the ideas they were reading about in action. Each student chose one person they wanted to work with, and then, if possible, I paired teams of two males and two females to form cooperative groups of four. Once the groups were formed, each student wrote a brief assignment stating why they should be the leader of their group; I chose a leader for each group based on these assignments. Students used the "four-question strategy" (Cothron, Giese and Rezba 1989) to identify independent and dependent variables needed to come up with questions to investigate:

1) What materials are available for conducting experiments on ice? (ice, substances or conditions that can change or alter the ice block)
2) What does ice do? (melts, changes states, is cold, wet, hard)
3) How could we change any of the materials used to change the ice to affect what ice does? (ice: size, pH of liquid, thickness, texture, weight, state of matter; changeable applications: temperature, amount of pressure, metals, acids and bases, length of time, salts) These are independent variables.
4) How could we measure or describe the response of the ice to the change? (the amount of time it takes to completely dissolve the ice; the time it takes to bore a hole through the ice; the "weight" of ice needed to crush an eggshell) These are dependent variables.

Let the Investigations Begin!

Each student came up with a question to investigate, and the group voted on which one to tackle.

One group investigated the question, "What effect does the number of D-cell batteries have on the time it takes wire to slice through the block of ice?" This group hypothesised the greater the number of batteries, the quicker the wire will slice through the ice.

In this experiment, the leader assigned two

students to set up the circuit, one student to create a chart on which to record the data, and a third student to record with the stopwatch the time it takes the wire to melt the ice. As the teacher/facilitator watched, the students, wearing thick gloves and safety glasses, set up the circuit using six D-cell batteries, a battery holder, uninsulated copper wire and alligator clips. Students recorded their observations in their journals. They observed that the wire melted the ice faster when a greater number of batteries was in use. Initially, these students used insulated copper wire before realising that the ice might melt quicker if they removed the insulation from the wire. They were able to conclude that the stripped copper wire melted the ice faster than the insulated wire, but the insulated wire did give off enough heat to slowly melt the ice. Students in this group generated the following questions for further study: "What effect does the kind of wire have on the time that it takes the wire to slice through the block?" and "What effect do different types of batteries have on the time that it takes the wire to slice through the ice?"

Another group of students investigated the question, "Which substance will melt ice quicker, vinegar or ammonia?" The group hypothesised that vinegar, an acid, would melt the ice faster than the same amount of ammonia. Wearing gloves and safety goggles and using measuring cups, students conducted their activity. Students placed two blocks of ice in identical containers, labelling one container A (ammonia) and the other one B (vinegar). Next, they poured 480 millilitres of ammonia in container A and the same amount of vinegar in container B. The students recorded their observations for each container of ice every 30 minutes and measured the amount of liquid in each container, recording that figure in a data chart. When they were done with their measurements, students returned the liquids to containers A and B to continue the process. They continued this process until the class ended. Students observed that the ammonia melted the ice faster than the same amount of vinegar. Since the liquids covered about 2/3 of the ice blocks, the 2/3 were affected by the chemicals changing their shape. At the end of one hour, approximately 1/3 of the block using ammonia was melted and the block using vinegar was approximately 1/4 melted. Students were surprised to find that the ammonia melted the ice faster than the vinegar. One group member wondered, "How can this be, when I thought acid 'ate through' things?"

Their questions for further research included: "What effects do different amounts of vinegar and ammonia have on the time it takes to completely melt a block of ice?" and "What effect do different acids or bases have on the dissolving rate of a block of ice?"

A third group of students investigated the question, "What effect does the size of the ice block (or container) have on the pressure needed to crush the hollow eggshell?" These students brought in hollow eggshells from home.

The night before class, students obtained two

Connecting to the Curriculum

This article relates to the Australian Curriculum: Science Year 6 achievement standards.

"By the end of Year 6, students compare and classify different types of observable changes to materials … Students follow procedures to develop investigable questions and design investigations into simple cause-and-effect relationships." (ACARA, 2014).