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Introduction

This introduction offers information about format, layout, materials, grouping suggestions, instructional strategies, and the general nature of constructivist, open-ended, inquiry-based science. The activities are intended to be multi-directional and open-ended in their style. They are true exercises in learning science by doing science.

Format

Each activity in this book is four pages long and moves from simple, introductory projects to more complex ones. Every project has elements which encourage students to build upon previous learning and to develop creative and imaginative variations. Each unit has a concluding activity, open-ended in concept and designed to encourage creative energies and problem-solving skills. This concluding activity can also be used as an authentic assessment vehicle to determine how well students have learnt basic concepts and how well they can apply them.

Using the Book

These units can be used in whole-class instructional situations by two-person collaborative teams, by individuals or teams in centres, as project assignments, and in small group settings. Virtually all the activities require extended time and multiple periods to be done thoroughly.

Constructivist Science

The focus of this book is to provide long-term, inquiry-based science activities. The projects all involve a hands-on, problem-solving approach. Students start with relatively simple, introductory projects and progress to more involved activities which influence them to develop modifications, improvements, variations, and challenging levels of scientific sophistication.

Materials

Each activity indicates materials needed and optional materials that might be substituted. The materials are, in most cases, both easy to acquire and inexpensive. Many of the projects use inexpensive substitutes which make it possible for all students to do the activities on a very modest science budget. For example, wood doweling for building kites can be quite expensive and require other tools. However, the thin stirrers/straws used to make these kites cost only about $3 for over 2,000 straws at discount and wholesale stores.

Most of the materials detailed in the projects are available as general school supplies. Other supplies include common household items such as plastic garbage bags, food colouring, salt, ammonia, laundry bluing, vinegar, baking soda, vegetable oil, clear plastic water bottles, and similar items.

Introduction *(cont.)*

Materials *(cont.)*

Several items should be available in any school science kit. These include magnifying glasses, eyedroppers, graduated plastic measuring cups, batteries, bulbs, sockets, thin insulated wire, and some animal habitat containers.

A few disposable supplies used routinely include Styrofoam food trays, plastic and paper cups, several sizes of straws, coffee filters, manila folders or cardboard, and paper towels. These supplies can be purchased in bulk inexpensively.

The fishing line can be bought at sports and fishing sections of department stores for less than $2. You may want a few rolls for convenience. A few items are best purchased in hardware or home supply stores. The pipe insulation is about $1 a tube. Sand and gravel can also be purchased there.

Grouping Strategies

Most of these activities are ideally done by teams of two students working collaboratively. Putting more students at this age in a group usually leads to more socialising and less work, but the activities can be done by larger groups. The activities can also be done independently by individuals in classroom centres or as individual science projects done at home. You will want to see the final project and a science lab sheet for these if done at home.

Dispensing Information

The teacher is not supposed to explain everything that happens in an open-ended, diversity-rich class experience. Encourage students to find the common things which occur in all or most investigations. Condition the students in your classroom to value unique and unusual approaches to investigations. Provide the time and a forum for students to share opinions and the results of their individual or collective investigations.

Extensions

Many students will be inspired to search out more information and activities related to some of the projects and activities in this book. This is an ideal way to encourage students to access other research sources and to simply investigate on their own by making more kite variations, different types of paper planes, more involved circuits, or more unusual applications for the surface tension of water, for example.

Introduction *(cont.)*

Answers Will Vary

Students doing the same project will get a variety of results based on what changes each team or student made in the way they approached the problem. Skill in direction following, creative modifications, and individual differences in manual dexterity will often yield an interesting diversity of final results. This is quite acceptable and to be encouraged. In most of these activities, there is no one right answer and seldom one best way to do something. Creative students will instinctively make changes that improve or sometimes totally redirect the focus of the lesson. Bridges may end up with features that work but aren't specifically mentioned. Towers may have a unique combination of geometric figures. Circuit arrangements may suddenly have half the classroom teams connected to each other and developing their own codes. Students work at different speeds and surprisingly in depth with many of these projects.

Timing

Students often develop a pace entirely their own. Some students will spend an inordinate amount of time on one section and deal only superficially with another. Expect most of these projects to occupy approximately a week with 45-minute daily periods. Some teachers may choose to do them in two or three longer periods. This has advantages for efficient cleanup and storage.

Enjoy

Enjoy the time and the learning experiences that are occurring. Give some direction and help where you have to, but generally circulate among the teams to offer ideas, suggestions, and encouragement. Keep students focused on the main concept and demonstrate how to do things which individual children may find new or unfamiliar. Help the class draw closure on the final discoveries. Provide opportunities for writing and research after each unit. Suggest extensions that students can do. Remind students that science is doing, that scientists fail far more often than they succeed, and that persistence is more valuable than inspiration. (Edison said that "Genius is 99% perspiration and 1% inspiration.") Finally, help students recognise the joy that accompanies successful and challenging learning experiences. Their motto should be "Go for it!"

Roller Derby

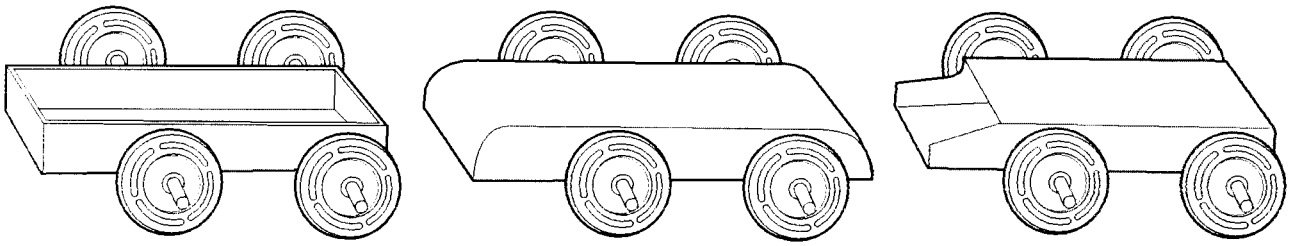
Concepts: *motion, momentum, and friction*

Materials: straws (two diameter sizes), small box or food tray, four to eight coffee jar lids, two large lids, tape, pins, small paper clips, cups, two AA batteries, balloons, cardboard, icy pole stick, scissors

Optional: margarine tubs and lids, wood skewers or pencils, clothespegs, large paper clips, straight pins

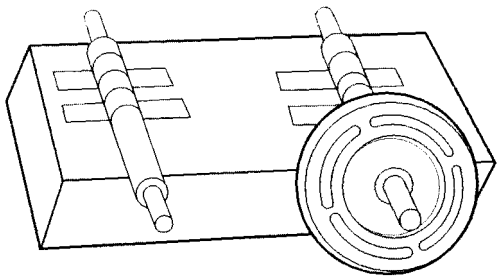
Roller Car

Study the roller derby models shown here. Choose one model to make. Use coffee jar lids for the wheels and a straw for the axle. A small box or Styrofoam tray will work for the body of the car.



Speedy Axles

You can make a better axle by placing a long, thin straw inside a short, wide straw. Tape the short, wide straw to the bottom of the box. Thread the thin straw through the wide one. Stick each end of the thin straw through a coffee jar lid. Make sure the thin straw turns easily inside the larger straw.



Wild Wheels

You can make the wheels faster and stronger in several ways.

1. Insert one lid inside another and tape them together.
2. Cut a piece of cardboard the same size as each wheel and tape the circular piece inside of each lid.
3. Face two lids next to each other and tape them together.
4. Split the ends of the straw axle that extend beyond the lids and tape these ends securely to the outside of the wheel or use straight pins in the straw axle on each side of the wheel to keep the wheel from bending.
5. Improve the speed and durability of your vehicle by replacing the straw axles with wooden skewers or round pencils. You could also slip these or similar materials into the straws to reinforce the straw axle.

