MODELS IN TECHNOLOGY AND SCIENCE (MITS)

***Models in Technology and Science (MITS)* is a module-based program designed for students in grades 5–8, with a focus on physical science and technology. The series has 11 modules designed to last six to eight weeks. The modules can be sequenced over grades 5–8 and combined with other instructional materials in order to build a comprehensive middle school program. Each module is a carefully sequenced, age-appropriate set of hands-on experiences that are student-centered and provide a context for constructing basic science concepts.**

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Grade Levels: 5–8
Scientific Domains: Physical, technology
Web Sites: www.pitsco.com

CONTENT Each module is an extended investigation of a basic phenomenon or technological artifact that acts as a context for introducing basic science concepts and scientific processes.

GRADE LEVEL	MODULE	STANDARDS AND CONCEPTS	DESCRIPTION
5–6	Mirrors	Transfer of energy: reflection	Students explore the reflective property of light in a series of games and special devices using regular, transparent, and curved mirrors.
	Mobiles	Motion and forces: equilibrium	Students construct and explore the balancing of toys and mobiles.
	Inks and Papers	Properties of matter: solubility, physical and chemical change	Students explore the properties of water-based and permanent inks using the techniques of chromatography.
	Shadows and Lenses	Transfer of energy; properties of light refraction	Through a series of games with a modified cardboard box, students discover properties of shadows and lenses.
	Air and Water Movement	Motion and forces: convection, turbulence, and laminar flow	Students map indoor and outdoor air currents and investigate patterns of water movement with food color in water, relating these patterns to atmospheric circulation.
	Waves	Transfer of energy Motions and forces	Students investigate wave movement in water, soap film, solid materials and experiment with a special wave device and pendulums.
6–7	Tops and Yo-Yos	Motion and forces: circular motion, torque	Students design and construct tops and yo-yos from simple materials while attempting to maximize their spinning time.
	Structures	Motion and forces: tensions and compression	Students are challenged to design and build drinking straw houses, bridges, and towers
	Ice Cream Making	Transfer of energy: conduction, convection, radiation	Before making ice cream in a can, students test different containers and different kinds of cooling environments.
7–8	Salad Dressing Physics	Properties of matter; density, solubility	Students carry out a series of tests to determine what is in a set of mystery bottles.
	Water Wheels	Transfer of energy: work, power	Student design and construct a model water wheel out of plastic plates and cups and attempt to maximize its efficiency

FORMAT Each module includes a Teacher's Guide and a kit.

Teacher's Guide: The Teacher's Guide begins with an overview providing a rationale, general goals, and general suggestions for assessment.

Each of the activities has a section for students and a section for the teacher suggesting ways of guiding the students during their explorations.

A typical activity description includes:

- *Rationale and Goals*: Description of how the activity provides a context for developing a specific concept and scientific skills. Also, provides continuity relating each activity to the overall investigation.
- *Materials List:* Specific materials needed for the investigation. Most materials are common, everyday items.
- *Preparation Ahead:* Materials and arrangements needed to be done by the teacher.
- *Introducing the Activity*: Suggestions for placing the activity in the flow of the whole investigation and ways of helping students plan procedures and report their results.
- *Leading the Activity*: Suggestions of ways that the teacher can monitor student progress as well as make observations that will help with conducting the follow-up discussion and assessment.
- *Reporting About the Activity*: Specific ways that observations or collected data can be solicited from students
- *Interpreting and Processing the Results*: Guidance on how to conduct a sense-making discussion using the results of the activity in a way that challenges students to develop explanations and ways that formal scientific concepts can be introduced.
- *Assessment*: Suggestions and criteria in the form of questions, which can help the teacher gauge student progress during the activity and the discussion.

Science content background is given that relates to the concepts being developed. In most guides, this is integrated into the development of each activity where it is directly connected to the observations and data that students generate during the activity.

INSTRUCTIONAL DESIGN The modules were designed to be student-centered in the sense that the phenomenon or technological artifact is intrinsically interesting. The activities were designed to promote learning based on the following pedagogical principles:

- Each phenomenon or technological artifact can act as an implicit model for representing and understanding other related phenomena and technologies.
- Each topic is an extended and thorough investigation so that students can master the skills and concepts introduced.
- Activities are sequenced to lead students from a concrete, everyday acquaintance to a more abstract scientific understanding.
- Problems and questions are a natural outgrowth of the properties of the materials and the students' interest.
- Concepts and process developed in the investigation of one phenomenon or technology are reapplied in the investigation of a second, related one.

ASSESSMENT

This program takes the approach of integrating assessment into the flow of the investigation, assuming it to be integral to the student's explorations and discussions.

Suggestions are given for using the first activity as a pre-assessment t0o determine what prior knowledge students bring to the investigation. The teacher uses this information to address misconceptions and as a reference point for comparison at the end of the investigation.

Because the activities in most of the modules build upon one another, students continually need to apply their recently gained knowledge and understanding to the next activity. In each guide, some activities are designated as a type of embedded assessment where the teacher can determine how students are progressing in their understanding of the targeted concepts.

In the Teacher's Guide, suggestions are given in some of the activities for observing specific kind of behaviors and listening for specific kinds of verbal comments, which are indicators of student learning.

The combination of the pre- and post-assessment and ongoing monitoring of students allows the teacher to assess what students have learned in the specific activity and what they have gained from the whole investigation.

OTHER RELEVANT INFORMATION

This program is unique in its attention to acknowledging the aesthetic appeal of the phenomena being investigated. There are possibilities for a close integration with a school's art program.

Also built into some of the activities are opportunities for students to practice qualitative proportional reasoning. In some cases, this also can be explored in a quantitative manner.