

# ***BSCS Science Tracks:***

## ***Connecting Science and Literacy, 2<sup>nd</sup> Edition***

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***BSCS Science Tracks*** is a comprehensive, modular, kit-based elementary school science program that includes a full-year of instruction at each grade level, K-5. At each grade level, 1-5, there are four modules, one each in physical science, earth and space science, and life science. A full-year kindergarten program is integrated in one *Teacher's Guide*. Because of its hands-on, collaborative structure, the program is appropriate for students of all ability levels.

In *BSCS Science Tracks* students learn basic science concepts and inquiry skills, as defined by the content, teaching and assessment standards from the *National Science Education Standards* (National Research Council) and the benchmarks from *Benchmarks for Science Literacy* (American Association for the Advancement of Science). The curriculum presents the concepts and skills through engaging experiences that involve students in the processes of scientific inquiry and technological design. Each module clearly defines the standards that students are to meet and provides a sequence of age-appropriate, constructivist learning experiences organized according to the 5E learning cycle.

Tracks includes everything the busy teacher needs to help students meet high standards, including complete lesson plans, continuous assessment strategies, a structure for collaborative learning, learning experiences that are conceptually connected, background information about the science content, a *Teacher's How-To Handbook* and kits of hands-on materials.

Tracks also promotes science and literacy through its use of a student guide and support in the teacher's edition using embedded literacy strategies. The student guide provides support for guided or directed reading and writing, shared reading and writing, independent reading and writing, reading and following procedural text, listening and speaking skills, journal writing, record keeping, margin notes and reading in the content areas. The teacher's edition supports a variety of vocabulary and reading comprehension strategies that are embedded into the science activities.

### **Key Features:**

- Standards-based in content, teaching and assessment
- "Doing Science"
- Embedded Literacy Strategies
- Activity-based lesson plans using common, readily-available materials
- Conceptual understanding
- 5-E learning cycle
- Guided inquiry
- Collaborative learning
- Continuous assessment
- Personal journals
- Scientific conversations

### **Components:**

- Student guide, one per module at grades 1-5
- *Teacher's Edition*, one per module at grades 1-5
- *Teacher's Guide* at kindergarten (full-year program)
- *Teacher Handbook*
- Kits of hands-on materials (one per module in grades 1-5; comprehensive at kindergarten)

### **Content:**

The science content in Tracks is organized in three strands-physical science, earth and space science, and life science. The modules incorporate the abilities and understandings of scientific inquiry.

**Pedagogy:**

Tracks is student-centered with a focus on learning. To help teachers create classrooms in which students construct their understanding of concepts over time, the curriculum incorporates built-in structures that promote learning, specifically the 5-E learning cycle, collaborative learning and continuous assessment.

In each module, students "do science" by investigating objects, organisms and events in their environment; interacting with their classmates; and reflecting on their experiences in journals, through presentations and otherwise sharing their ideas with others.

**Collaborative Learning**

Collaborative learning is a central feature of *BSCS Science Tracks* because of its power in promoting student learning and conceptual development. We use the term "collaborative learning" rather than "cooperative learning" because students develop the skills of true collaboration—discussion, debate, constructive critique, building on others' ideas, writing, drawing and otherwise representing thoughts and ideas—as well as the social skills associated in "getting along with others." (We acknowledge that true cooperative learning includes the elements of collaboration listed above, but it is often misrepresented as emphasizing social behavior at the expense of cognitive development.)

**Continuous Assessment**

In *BSCS Science Tracks*, assessment looks a lot like instruction. If assessment is continuous, it flows easily back and forth with instruction as students encounter new phenomena or information, reflect on their experiences and demonstrate what they know and can do as a result of those experiences. To help teachers incorporate assessment into daily instruction, Tracks includes the following types of formative and summative assessments:

- Journals and folders
- Projects and performance tasks
- Observations
- Illustrations and drawings
- Charts and graphs
- Interviews with students
- Self-reflection and self-assessment
- Essay-type questions
- "Checking Understanding" exercises at the end of each lesson
- "Evaluate" lessons at the end of each module

**Guided Inquiry**

Within the science education community, there is debate about whether students should be encouraged to engage in primarily independent inquiry, following their own interests and questions, or whether students should experience "guided inquiry" with their classmates. We take the view that there is merit in both, but have structured *BSCS Science Tracks* primarily around "guided inquiries" with opportunities for students to pursue their own questions through a section titled, "How Could You Find Out?"

The authors relied on the Standards and Benchmarks for the selection of concepts that students should develop. To ensure conceptual development, the program frames its "guided inquiry" within the 5-E learning cycle, so that students can share their experiences and their thinking about the concepts. When students have common experiences related to a few major concepts, they and the teacher can enrich all students' understanding of those concepts as they discuss and debate the results of those common experiences. Although students can and do develop concepts through independent inquiries, it is much more difficult for the teacher to manage and to evaluate students' learning. We hope that as teachers and students become more comfortable with scientific inquiry in the classroom, they will include independent investigations as a larger part of students' science experiences.

**Literacy Component**

The primary focus of the literacy component of Tracks is to increase student understanding of science content. Merging science and literacy can increase that understanding. Some connections with reading, writing, listening, and speaking are so transparent that it is difficult to distinguish whether we are "doing science" or "doing literacy." However, at times, specific strategies have been inserted to increase

vocabulary, reading comprehension, or conceptual understanding. The literacy strategies are intended to be taught explicitly to students with the hope that students will adopt the strategy as a tool to help them learn science more effectively. The strategies are embedded in the activities themselves and are expected to help students understand, discuss, and apply scientific concepts and processes. Literacy outcomes are included in the outcomes chart at the beginning of each lesson.

### **Vocabulary Strategies**

Students need many opportunities to learn science vocabulary. These opportunities include discussing terms as they are experienced during science activities, reading content information, and writing about what students have learned. There is better retention of terms when the terms are used in a multitude of situation using different learning styles. Developing a scientific vocabulary does not mean “looking up” words, it involves creating opportunities for students to continue to develop their knowledge of terms and concepts after activities and reading.

We have incorporated the following vocabulary strategies in some of the revised modules.

- The **Four Square Chart** (Eeds & Cockrum, 1985) makes visual connections for students to the concept they are learning. It is a beginning vocabulary strategy that can also be used by English Language Learners. Teachers can have students make 4-Square Charts on index cards. These cards can then be fastened together with a ring. The collection of cards is an easily accessible visual glossary for the learners that need more experiences with words.
- The **Verbal and Visual Word Association** (Monroe and Pendergrass, 1997) graphic organizer is much like the Four Square Chart. It incorporates nonlinguistic representations to help learners to construct meaning, deepen understanding, and recall knowledge for later use. This strategy challenges students to write the term, define the term, draw a picture that will help them to remember the term, and write or draw a personal association or characteristic that will help them to connect the term to their life.
- The **Framer Model** (Framer, Frederick, and Klausmeier, 1969) helps students organize their thoughts and make self-connections to the term/concept. This is done by generating examples (and in some cases, non-examples) of the concept from their experiences. The structure and thinking processes used help to build understanding of the concept.
- The **Semantic Feature Analysis** (Johnson & Pearson, 1984) is a grid that helps students to learn the meaning of special vocabulary. Students define individual terms/concepts within a broader concept by analyzing the terms on a chart. Along the left side of the grid members of the category are listed. Along the top of the grid attributes (features) common to the broader concept are listed. An example of this would be types of vertebrates would be listed down the left side of the chart, while characteristics of vertebrates are listed across the top. Students examine attributes (features) common to the broader concept while looking at members. By checking off features found only in that member, students are able to see how this member is similar and different from the other members of the category.
- The **Concept-Definition Map** (Schwartz, 1988) is best used with key concepts. The term being defined is connected to a broader concept or topic in science. Properties and/or characteristics, as well as examples, are used to help students explain their understanding of the term. Students write a definition using their experiences, examples, and properties they listed.

### **Reading/Comprehension Strategies**

Santa, Havens, and Harrison (1996) state, “Most students arrive at the science teacher’s classroom knowing how to read, but few understand how to use reading for learning science content.” Much of their background has involved how to read fictional text. Students need opportunities to develop “reading to learn” strategies.

We have incorporated the following reading to learn strategies in some of the revised modules.

- **Read-aloud/Think-aloud** provides the students with modeling of the behaviors of effective readers. They read along as the teacher interacts with the text by looking for what they know and don’t know, questioning what is meant by phrases and passages, looking for connections, making and adjusting predictions, inferring what is meant during and after reading, adjusting the pace of reading, and monitoring their understanding of what is being read.
- The **Anticipation Guide** (Duffelmeyer and Baum, 1992) is a strategy that helps students to activate prior knowledge. The strategy also focuses and motivates student reading. Four to six sentences are created around major concepts in the reading. The reading selected supports what the students are learning or review what students have already learned in class. Some of the statements are changed and made false. A worksheet is created with the statements and columns for student responses before and after the reading. Students read with a purpose of finding out

- what the author says about each statement. A discussion is held about what students learned from the reading and how their prior knowledge was supported or changed by the reading.
- **Graphic Organizers** such as the **Herringbone Graphic** are designed to help students focus on important information and illustrate key ideas. The Herringbone graphic has been used to capture important details when reading biographical information. The **Venn Diagram** is a graphic organizer that helps students organize compare/contrast information.
  - **Summary Charts** challenge students think about what they have read and to summarize what they have learned their own words.
  - The **RAFT** strategy (Santa, 1988) is a way for students to demonstrate their understanding of informational text in a nontraditional format. RAFT is an acronym for *Role of the writer* (the role the writer will assume), *Audience* (who will be reading the writing), *Format* (how the writing will be presented), and *Topic* (the subject of the writing). Students are able to add a creative twist as they reflect of what they know about a topic.
  - **Discussion webs** are designed to encourage all students to be actively involved in a discussion. The discussion involves a question about a controversial issue. Students provide *yes* and *no* evidence based on their investigations, readings, personal experience. It provides time for independent thinking before sharing ideas with others which promotes total class involvement. Students look at both sides of the issue before coming to a conclusion which is shared with the whole class.

### Student Guide

Tracks includes a comprehensive student guide and resource book for every module in grades 1-5. The student guide is not a "read-about-science" book; rather, it serves as a guide to help students learn to do the following things:

- Conduct scientific inquiries within a collaborative team and on their own
- Become more responsible for their own learning
- Manage hands-on activities themselves
- Structure collaborative learning tasks
- Reflect on their learning and assess their own conceptual and skill development
- Conduct independent inquiries related to questions or topics of personal interest
- Follow and interpret directions
- Make decisions about how to complete scientific investigations and technological design projects

In addition, the student guides reinforce components of basic literacy, including shared reading and writing, guided reading and writing, continuous assessment, skills instruction, opportunities to respond to reading and writing in a social context and the use of reading and writing strategies across the curriculum. By using their guides, students learn to rely on themselves, their teammates and their classmates, not solely on the teacher, for information, assistance and guidance. The student guide helps the teacher become a facilitator of learning instead of the sole dispenser of knowledge and information.

### Teacher Handbook

The *Teacher Handbook* contains a series of essays that provide for the successful implementation of *BSCS Science Tracks*. The *Teacher Handbook* is an essential component of the Teacher's Edition because it is the only place teachers can find the complete program overview and specific information about such essential topics as how to assess students, how to establish collaborative groups and how to help students construct understanding of scientific concepts. Each teacher needs only one *Handbook*, whether she or he teaches from one or three of the *Teacher's Editions* at each grade level. Also, the *Teacher Handbook* is the same for teachers at all grade levels, K-5. There is not a separate handbook for grade 1, grade 2 and so on.