How to Use the Threads of Inquiry

As a teacher, you are probably wondering how to introduce this material into your existing classroom, how challenging it will be, or even how appropriate the material is under the nation's new education reform acts. We will try to address those concerns up front by explaining how the Threads of Inquiry are designed to integrate with your classroom on numerous levels.

First, this curriculum is designed to help your students acquire the skills and confidence needed for an inquiry-based curriculum to work successfully. Built into the curriculum are a number of tools for you to encourage inquiry in your classroom. You also will find sections and a companion document written by an education specialist on topics related to cognitive and social development and aspects of inquiry in the elementary school classroom.

Also, each Thread is broken down into grade ranges/levels of cognitive development, with our motives for the break down outlined in the text and based on fieldwork in partner schools around the country and on current research in education. This allows you to use this curriculum without the additional time factor of having to sort through it for age appropriateness. At higher grades, the age-appropriate sections introduce more abstract concepts and math skills into the students' learning. Simultaneously, the depth of knowledge explored by the Threads is increased. This allows teachers to create a science curriculum which is not only reinforced throughout the student's elementary school career, but which also allows teachers to subsequently re-engage students in these topics at a more intense and sophisticated level.

We have also constructed a set of outside resources related to the Threads for you to examine and possibly include in your classroom. These resources include Internet activities, children's books (both fiction and non-fiction), and folklore connections (including stories, historical features, and cultural activities for the class). Finally, let us stress again that we have designed the text to be flexible enough for you to integrate your own ideas into the framework of the curriculum — in essence, creating a personalized, multidisciplinary inquiry-based curriculum.

Role of Development in the Threads

The Threads are divided into different grade levels, K-2, 2-4, and 4-6. This breakdown respects the different capacities and motivations that children bring to their learning at different ages. The delineations are not rigid, but rather a device to help teachers quickly orient to and focus on concepts that are most resonant with the age group that they are teaching. Some teachers may want to read through the Threads as they are written at other levels to cull additional information and to provide a greater sense of the developmental trajectory of the concepts. Under each Thread there is a section on Developmental Issues. This section discusses how children are differentially motivated and how different ages bring varied developmental capacities to the understanding of every Thread.

The first part of the Developmental Issues section of each level in a Thread discusses developmental motivation. Developmental motivation refers to the best ways to invite learners of certain ages into the material. It suggests patterns for working groups, what angles students might find most appealing, and how children's mental development influences their motivation to learn the topic at hand.

The second part of the section mentions the developmental capacity of the age levels being discussed. Developmental capacity refers to the ways in which the particular content should resonate with and/or challenge different ages. A paragraph in the Developmental Issues section alerts teachers to challenges that children may need help thinking through as well as concepts that are particularly well-suited for this age level. It is important to realize that experience with concepts and ideas helps children learn to understand them. This suggests that teachers should not shy away from presenting concepts that are slightly beyond the developmental level of their students, but that they should support the students' developing understanding with other paths to grasping the concept.

General Developmental Issues and Challenges to Keep in Mind Throughout the ECT Program

Kindergarten to Grade 2

Understanding the patterns of the seasons and the "whys" behind those patterns is in some respects, a fitting task for students. In other respects, understanding the seasons is a challenging undertaking for young thinkers. Knowing how the inquiries presented in the ECT Program resonate with this age group, as well as where they extend beyond the reasoning abilities of this age group, will help teachers deal sensitively with issues of understanding as they arise.

Making observations using one's senses, attending to patterns in one’s environment, and detecting changes and continuity fit well, from a developmental standpoint, with learning in the early grades. Children are learning to reach out to a social and physical world. They are learning how to look carefully and delight in their discoveries. They are often eager to find out how things work in the natural world and ask many questions. They still look to adults to help them answer their

many questions. The ECT curriculum taps this natural curiosity and helps children seek patterns in their observations. The focus on learning from one's experience is a natural developmental fit for this age group.

From about age three to seven, children are learning about the appearance/reality distinction. Children learn that things are not always as they appear. Helping children make observations that eventually lead them to question appearance versus reality presents a good developmental fit.

Some of the larger understandings in the ECT curriculum present key challenges for the youngest learners. Understanding in a deep sense that the Earth is moving (not the Sun), and that the tilt of our planet causes the seasons, entails a number of distinct difficulties for young thinkers.

In order to deeply understand what is going on, children need to make a perspective shift. Children need to reason from a model and relate it to the world that they are standing on. They need to shift from what they see in the real world and relate it to a model.

Constructing the understanding that the Earth must be tilted requires reasoning in a "what if?" manner. One needs to hold in accessible memory information about possible scenarios and consider which of those scenarios makes a best match with the information one has observed and the data one has collected. This presents a cognitive load and a thinking challenge better suited to older students.

A challenge for this age group will be finding out that they observe many patterns that they cannot easily find answers to and that there will be many unanswered questions for now. However, this is an important lesson in learning to think as scientists do. There are many unanswered questions in the world and we continue to seek answers as we learn more and more.

In order to accommodate both the readiness and the challenges that the ECT curriculum poses for the youngest learners, the focus in the Threads is on observing patterns in the world around them, connecting to their own experiences, and beginning to learn how recording information can help them extend their thinking about what they see. You will see this focus play out in a variety of ways throughout the threads as written for K-2. In addition, you will also see instances where information is recorded on paper, so that young learners have less to hold in their heads and also become familiar with forms of representation for the concepts being discussed. Downloading (or recording our experiences for deeper learning) some of what needs to be remembered helps young learners make better sense of the concepts in question.

Grade 2 to Grade 4

By second to fourth grade, students are increasingly able to think about abstractions and different perspectives. They can reflect on their thinking and can consider whether their reasoning follows well from the evidence that they have collected. They have already learned a lot about the world in which they live and can use this

knowledge to support their reasoning about what the world is like and why things are the way they are. Sometimes their observations lead them to knowledge that fits with scientific views of the world and sometimes it leads them to unscientific views.

By second and third grade, children are increasingly able to use representations and models to reason from. They are still helped by downloading information to external sources so that they are able to focus on thinking, rather than trying to both remember and think about the concepts.

By this age, children are moving out into a broader social world and the world of peers is becoming very important. They begin to question adults and rely on their own observations and inferences to a greater extent. Some children go through a phase where they secretly believe that no one knows quite as much as they do (particularly adults) and may challenge what adults tell them.

The ECT curriculum invites 2nd to 4th graders to explore puzzles and patterns in their world and to make a purposeful link between their own learning and school learning. It encourages them to reason from the evidence that they collect and to come up with their own explanations. This is a good developmental fit for this age. Making a purposeful link between home and school learning is very important at an age when so many children begin to create “boxes” for their knowledge, holding separate their school learning and their own everyday experiences. The ECT curriculum invites them to use their increasing ability to abstract and consider logical alternatives.

At the same time, second through fourth graders will need guidance in reasoning about the puzzles that they find. While they may be able to make predictions and detect certain discrepancies between the data and what they predict, they don't always resolve the discrepancies as a scientist would. They are just learning about how a scientist thinks and so they don't hold the same assumptions in their heads. For example, they might create a customized theory to explain one instance of a phenomenon and a different theory to explain another instance that scientists would consider contradictory to the child's initial theory. Helping students to see how scientists would reason about the event helps them learn not only content, but what it means to be a scientist.

While these students will be able to answer more of their questions than younger students, they , too, will be learning that science is a continuing process of seeking answers. This is an important understanding about the nature of science and is helped when children see that scientists have questions that they cannot presently answer, but seek to answer.

Grade 4 to Grade 6

By fourth to sixth grade, students have gained a great deal of knowledge and ability to reason in a logical, hypothetical manner. They are coming to understand many of the "tools" that scientists use, such as the importance of trying to isolate and control certain variables. They are able to hold more information in their heads

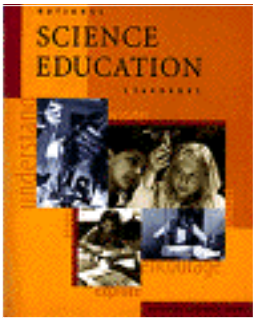
and while downloading information can still be helpful, they depend less on doing so than younger children.

Fourth to sixth graders are also growing into a time when they are establishing a firm sense of self. They often compare themselves to others, are becoming more introspective, and are developing an understanding of their own uniqueness. With these developments comes an increased concern for risk-taking and standing out as well as wanting one's own forms and instances of expression to be validated. Therefore, teachers need to be particularly sensitive to risks that they ask students to take and to enable multiple forms of expressing ideas and understandings.

The ECT curriculum invites students to use their logical, deductive reasoning to make sense of their experiences and the related data that they have collected. It invites them to make sense of the world and its mysteries by collecting clues and reasoning about them--an activity that is highly developmentally resonant with this age group.

The ECT Curriculum encourages students to put forth their understandings and theories and signals to students that science is making sense of one's experiences, that theories evolve, and that the process of seeking theories that explain more is valuable. It separates the value of theory and ideas from the person by stressing the process more than whose idea it was. This is a message that is particularly important for fourth to sixth grade teachers to convey to their pupils.

Role of the National Science Education Standards



With education reform happening at so many levels, you may wonder whether or not it makes sense to learn a new curriculum; will it survive? Our research shows that for those states which have reformed their curricula standards, on the whole their standards are reflections of the National Science Education Standards. Therefore, each Thread of this curriculum begins by showing how the National Standards are incorporated. Through this feature, we hope to allow you new freedom in your science curriculum, while assuring you that our program fulfills requirements you are being asked to meet in your school district.

What does a typical Thread look like?

Each Thread has a name and its own icon from the set above. An icon appears as a side tab at the beginning of each Thread.

You will need: There is a grey box on the right side of the Introduction to each Thread. The first paragraph lists the materials you will need.

The second paragraph lets you know the sort of time requirement you will need to investigate this topic thoroughly. This section describes everything we can think of which will take time in or out of your classroom to fit this curriculum into your classroom time. These include: Does this require a sunny day? Repeated observations on an hourly, daily, or monthly scale? What is the materials-gathering time? Computer time?

Purpose: Each Thread begins with a section describing its purpose. The goal of this section is three-fold. First, it provides an introduction concerning how the Thread fits into the overall scheme of the curriculum. It pinpoints the reasons why it is important for students to understand what is happening around them with regards to the Thread topic. Next, this section informs you of how this Thread fits into your classroom with regards to the National Science Education Standards. Finally, this section of the introduction suggests how the Thread can help you introduce vocabulary words which are related to your discussions and which are mentioned in NSES documents as useful for the science curriculum.

Teacher Background: Each Thread contains background information. The background information is *not intended for the student*. It is meant to provide you with data about the topic you are about to explore. Although the Threads are not designed to be vessels of content, it is often necessary for an educator to have a fair grasp of the geometry, physics, astronomy, or other disciplines relevant to the inquiry before feeling comfortable about facilitating the Thread in a classroom. We hope that this section will help you respond to questions from students by prompting other questions of your own geared to stimulate deeper understanding of the basics of the problem. We also would like this section to aid you in designing your own experiences for the students based on how you and they understand the content. With the information in the Teacher Background section, we hope you will be able to seek related themes and connected activities for your class.

This book also offers a list of children's books suggested by K-6 teachers and folklore materials designed specifically for this curriculum. You will find other supplementary activities and assessment strategies located throughout the curriculum. **The Keys to Inquiry**, an important resource on constructivism and inquiry-based learning, can be found in the Additional Resources section of this book.

Grade Level

A grey box denotes the grade level of the Thread you are reading. Lightest gray is Kindergarten through second grade, medium gray represents second through fourth grades, and dark gray stands for fourth through sixth grades.

Developmental Issues

The Threads are divided into the grades kindergarten through second grade, second through fourth grade, and then fourth through sixth grade. This is not a rigid delimitation. Teachers of students on the borders of these groups, (i.e. second and fourth grades), should read both sections of the Threads which apply to their grade. Decide, based on your knowledge of your classroom, which version of the Thread you feel is more appropriate for your students, or you may wish to integrate the two versions.

As described previously, the Developmental Issues section explains our rationale for how the concepts are approached for each grade division, pinpointing how the physical and mental characteristics of children in the age group determine the level at which you would like to pursue this Thread.

Inquiry Introduction

The Thread then poses some introductory discussion questions for teachers to ask their students to get the inquiry ball rolling. The questions suggested in this portion of the Thread guide the class towards thinking about the topic and the set of experiences the topic will provide. It invites teachers and students to reconsider what they know from past experiences and observations.

Inquiry Investigation

Here, the Thread gets into full swing. Students explore the topic through observation, experiences, and analysis of their own experiences. The teacher is there as a guide to their discoveries and to move the students through the different arenas of learning. The text of this section is the most lengthy, as it offers questions, suggestions, and hands-on activities to bring students towards a deeper understanding of what they are exploring.

The use of student journals is highly encouraged for the upper grades, and places where we feel a journal entry should be made during the investigation have been noted in the text.

The Everyday Classroom Tools project utilizes the theories of inquiry-based learning through *constructivism*, which bases students' learning on past experiences and theory building. The National Science Education Standards also stress that the inquiry method be the backbone of science teaching for educational reform. Therefore, the text reads very much like a dialog between teachers and students which

emulates an inquiry-based classroom. In the inquiry sections, any text you see in this font is directed towards the teacher. The text in this font is in the form of specific directions, examples of how students might respond to certain queries, or suggestions for further inquiry or projects. Think of this text as the author-teacher dialog, whereas this text is the teacher-student dialog.

We understand this classroom method may be new for some teachers, and so we provide an additional text guide to using inquiry in the elementary school classroom. Please read **The Keys to Inquiry**, an in-depth look at the practices of constructivism and inquiry in the elementary school classroom. This piece is written by Tina Grotzer, a research associate of Project Zero at the Harvard Graduate School of Education. Her work details the research regarding cognitive development of children, offering techniques for bringing out the best in your students' question asking and answering skills, observation and recording abilities, while its text provides key classroom examples for different grade levels.

The Scientific World View:

- The world is understandable.
- Scientific knowledge is subject to revision.
- Scientific knowledge is durable.
- Science cannot provide complete answers to all questions.
- Science is inquiry.
- Science demands evidence.
- Science is a blend of logic and imagination.
- Science explains and predicts.
- Scientists try to identify and avoid bias.
- Science is not authoritarian.
- Science is a complex social activity.
- There are generally accepted ethical principles in the conduct of science.
- Scientists participate in public affairs both as specialists and as citizens.

— Rutherford and Ahlgren, *Science for All Americans*