

Intel® Teach Elements

Inquiry in the Science Classroom

Action Plan: Jennifer Watson

Instructions: Click any of the activity names in the Contents to go directly to that section. On a PC, click or press Ctrl+click to make your selection. On a Mac, press Command+click. Type your notes in the sections indicated.

Contents

Module 1: Introduction to Scientific Inquiry	3
Lesson 1: Scientific Inquiry.....	3
Activity 2: Integrating Inquiry	3
Activity 4: Misconceptions and Challenges of Scientific Inquiry	3
Lesson 2: Scientific Inquiry in the Classroom	3
Activity 2: Pedagogical Approaches	3
Activity 3: Scientific Inquiry Continuum	4
Lesson 4: Module Review	4
Activity 1: Module Summary	4
Module 2: Phases of Scientific Inquiry	5
Lesson 1: The Nature of Scientific Knowledge	5
Activity 2: An Inquiry-Ready Mind.....	5
Lesson 2: Skills for Scientific Inquiry.....	5
Activity 3: Methodology Errors	5
Lesson 3: Scientific Inquiry Phases	6
Activity 2: Examples of Scientific Inquiry	6
Lesson 4: Module Review	6
Activity 1: Module Summary	6
Module 3: Instructional Design for Scientific Inquiry	7
Lesson 1: Standards and Objectives	7
Activity 2: Objectives	7
Lesson 2: Inquiry Projects	7
Activity 2: Project Introduction	7
Lesson 3: Assessment in Inquiry-Based Science Classrooms	8
Activity 3: Summative Assessment	8
Lesson 4: Module Review	8
Activity 1: Module Summary	8
Module 4: Science Inquiry in the Classroom	9
Lesson 1: Inquiry Learning Experiences	9
Activity 3: Fieldwork	9

Lesson 2: Environments that Support Inquiry	9
Activity 3: Self-Direction.....	9
Lesson 3: Scientific Discourse	9
Activity 2: Science Writing	10
Lesson 4: Inquiry Practices Instruction.....	10
Activity 3: Feedback	10
Lesson 5: Module Review	10
Activity 1: Module Summary	10
Module 5: Technology that Supports Scientific Inquiry	11
Lesson 1: Technology Tools for Exploration and Investigation	11
Activity 4: Intel Education Thinking Tools	11
Lesson 2: Technology Tools for Interpretation.....	12
Activity 2: The Right Tool for the Job	12
Lesson 3: Technology Tools for Presentation and Collaboration	12
Activity 1: Tools for Data Presentation.....	12
Activity 2: Tools for Data Collaboration.....	13
Lesson 4: Module Review	13
Activity 1: Module Summary	13
Course Wrap-Up	14
Summary	14

Module 1: Introduction to Scientific Inquiry

Lesson 1: Scientific Inquiry

Activity 2: Integrating Inquiry

Estimated Time: 10 minutes

What questions do you have about inquiry? List your questions below.

How can I do scientific inquiry with so many students? Will it be really chaotic?
How does scientific inquiry work with such a heterogeneous group of students? What are the main skills to teach in scientific inquiry?

Module 1: Introduction to Scientific Inquiry

Lesson 1: Scientific Inquiry

Activity 4: Misconceptions and Challenges of Scientific Inquiry

Estimated Time: 10 minutes

What aspect of scientific inquiry are you already doing or what appeals to you about scientific inquiry? Record your ideas below.

I like the idea of students taking more control of their learning by posing scientific questions and trying to answer their own questions. I also like that scientific inquiry is open-ended and would like to see my labs be more open-ended. I'm hoping to do more brainstorming of questions before beginning a lab.

Module 1: Introduction to Scientific Inquiry

Lesson 2: Scientific Inquiry in the Classroom

Activity 2: Pedagogical Approaches

Estimated Time: 10 minutes

List ideas that you have for adding scientific inquiry to a particular lab or activity that you already teach.

I want to incorporate scientific inquiry into a variety of labs and activities. I think I will start with a soils lab. Instead of telling the class what the hypothesis is, I would like them to come up with questions about soil.

Module 1: Introduction to Scientific Inquiry

Lesson 2: Scientific Inquiry in the Classroom

Activity 3: Scientific Inquiry Continuum

Estimated Time: 15 minutes

List recent inquiry-based investigations in your classrooms and identify where each is on the continuum.

Open	Guided	Structured	Limited
			Food chains- earthworm experiment
			Planet sizes—planet mobiles
			Circuits—conductors and insulators experiment

How does the continuum help you consider opportunities to build more inquiry into the curriculum?

I could see how I could move from Limited Inquiry to Structured by adding more student investigation into an open-ended inquiry question.

Module 1: Introduction to Scientific Inquiry

Lesson 4: Module Review

Activity 1: Module Summary

Estimated Time: 5 minutes

Reflect on your learning in this module.

I really liked seeing how I could take small steps to incorporate scientific inquiry into my labs and ultimately move up the continuum. I've done a lot of limited inquiry with my students, but I have gotten some new ideas for getting students more involved in scientific inquiry and helping them develop 21st century skills. I can imagine students ultimately coming up with their own investigation questions.

Module 2: Phases of Scientific Inquiry

Lesson 1: The Nature of Scientific Knowledge

Activity 2: An Inquiry-Ready Mind

Estimated Time: 10 minutes

What specific habits of mind and inquiry-based abilities do you want your students to learn first to help them be successful in scientific inquiry? Record your thoughts below.

Habits of mind: thinking flexibly, gathering data with all senses, thinking interdependently
Inquiry-based abilities: asking appropriate questions, using appropriate tools, designing and conducting investigations

Module 2: Phases of Scientific Inquiry

Lesson 2: Skills for Scientific Inquiry

Activity 3: Methodology Errors

Estimated Time: 15 minutes

Which skills will you focus on to help your students be successful in scientific inquiry? Identify skills and note which activities or units will emphasize these skills.

Skill	Activity or Unit
Measuring	Students will measure plant growth.
Observing	Students will make ongoing observations of the different types of soil.
Estimating	
Predicting	Students will make predictions about the soils.
Classifying	
Interpreting	Students will interpret data that they collect.
Inferring	
Communicating	Students will develop communication skills throughout every unit.
Asking inquiry questions	Students will ask questions about soil and investigate their questions.

Creating a hypothesis	
Designing procedures	With help, students will develop procedures for soil investigations.
Designing methods for documenting data	
Information literacy	

Module 2: Phases of Scientific Inquiry

Lesson 3: Scientific Inquiry Phases

Activity 2: Examples of Scientific Inquiry

Estimated Time: 10 minutes

What topics do you currently teach that would benefit from the Scientific Inquiry Phases? Brainstorm some activities, lessons, or projects in which you could incorporate the Scientific Inquiry Phases.

Topic	Activities, Lessons, or Projects
Soil	Exploration: Students examine 3 different soil samples using different tools, record observations, and come up with questions to investigate.
Soil	Investigation: Students come up with ways to gather evidence to answer their questions—test their predictions and hypotheses—decide how to organize their data.
Soil	Interpretation: Students analyze their data—they may need to return to the Investigation Phase for more experimentation and data collection.
Soil	Presentation: Students share their conclusions with each other, and ask each other questions.

Module 2: Phases of Scientific Inquiry

Lesson 4: Module Review

Activity 1: Module Summary

Estimated Time: 5 minutes

Reflect on your learning in this module.

I can see how the phases can be useful when planning scientific inquiry investigations. I like the idea of using the phases to organize an investigation. Students are doing investigations on soil and I am using the phases to plan and guide them through their inquiry.

Module 3: Instructional Design for Scientific Inquiry

Lesson 1: Standards and Objectives

Activity 2: Objectives

Estimated Time: 15 minutes

Select a topic from the brainstormed list you created in Module 2, Lesson 2, Activity 3 of your Action Plan. What standards and objectives would you address with that topic?

Standards	Objectives
Use scientific inquiry methods during field and laboratory investigations	Students will demonstrate their understanding of the properties of density, buoyancy, and displacement by building boats.
Know how to use a variety of tools and methods to conduct scientific inquiry	Students will determine the variables that affect the buoyancy of boats using scientific inquiry
Knows that matter has physical properties	Students will design their own boats that are buoyant and stable. They will also develop their own methods for testing and data collection.

Module 3: Instructional Design for Scientific Inquiry

Lesson 2: Inquiry Projects

Activity 2: Project Introduction

Estimated Time: 10 minutes

What areas in your curriculum would be appropriate for a scientific inquiry project?

Density

What level of inquiry will your students participate in?

Guided inquiry

What kind of investigation would students conduct?

Students would investigate buoyancy through designing their own boats.

How might you introduce the project?

Do a demonstration of water displacement—ask students to predict what happens when different items are placed in the water, then categorize them, and make generalizations.

Module 3: Instructional Design for Scientific Inquiry

Lesson 3: Assessment in Inquiry-Based Science Classrooms

Activity 3: Summative Assessment

Estimated Time: 10 minutes

Identify any assessments you have saved for use in your classroom. Describe how you will use these assessments.

Assessment	How You Will Use It
Collaboration Observational Checklist	This will help identify specific collaborative behaviors. I will point these out when I see them as models.
Reflective Journal Rubric	Students will be given this to help deepen and monitor their journal entries—it will be used for self- and teacher assessment.

Module 3: Instructional Design for Scientific Inquiry

Lesson 4: Module Review

Activity 1: Module Summary

Estimated Time: 5 minutes

Reflect on your learning in this module. What aspects of scientific inquiry are you most likely to use in your planning?

I'm getting a better feel for ways to incorporate scientific inquiry into my classroom. I can see how I can take what I already do with the students and adapt it to incorporate scientific inquiry. I've gotten a lot of good ideas for ways to engage students in the Exploration phase of inquiry. I think involving students from the beginning will make them more engaged throughout the investigations.

Module 4: Science Inquiry in the Classroom

Lesson 1: Inquiry Learning Experiences

Activity 3: Fieldwork

Estimated Time: 15 minutes

Describe a scientific inquiry activity that you can use to address one or more objectives you developed in Module 3.

Objective

Students will design their own boats that are buoyant and stable. They will also develop their own methods for testing and data collection.

Scientific Inquiry Activity

Once students come up with the variables that affect density, they consider the features that will make their boats buoyant and stable and design their own ways for testing the features and planning how they will record their data.

Module 4: Science Inquiry in the Classroom

Lesson 2: Environments that Support Inquiry

Activity 3: Self-Direction

Estimated Time: 15 minutes

What goals can you set to make your classroom more of a learning community?

Students develop interdependency by working in small groups.
Students collaborate with experts outside the classroom.

What collaborative activities will you design for your students?

Students will work in small groups to create their boats.

How could you help your students be more self-directed?

I will establish clear expectations, provide instruments for self-assessment such as rubrics, have student journals, and encourage students to get help from their peers when they confront issues.

Module 4: Science Inquiry in the Classroom

Lesson 3: Scientific Discourse

Activity 2: Science Writing

Estimated Time: 10 minutes

Describe ways you can include more scientific discourse in your classroom. How can you add or modify speaking and writing activities to support scientific inquiry practices?

I could be more aware of the type of questions I ask. I'd like to pose more questions that engage curiosity and prompt scientific inquiry. I also want to make sure all students engage in discussions and will provide more instruction on discussion skills.

Module 4: Science Inquiry in the Classroom

Lesson 4: Inquiry Practices Instruction

Activity 3: Feedback

Estimated Time: 10 minutes

What scientific inquiry practices will you target with instruction? What teaching strategies will you use?

Inquiry Practice	Teaching Strategies
Designing procedures	Mini-lesson
Collaboration	Checklists, and self-assessment in journals, peer feedback
Predicting	Modeling throughout the unit

Module 4: Science Inquiry in the Classroom

Lesson 5: Module Review

Activity 1: Module Summary

Estimated Time: 5 minutes

Reflect on your learning in this module.

This module helped me think through many of the details of scientific inquiry. I realized that a more collaborative classroom will help ensure that scientific inquiry is more successful. I got a lot of good ideas for making my classroom a more collaborative learning community.

Module 5: Technology that Supports Scientific Inquiry

Lesson 1: Technology Tools for Exploration and Investigation

Activity 4: Intel Education Thinking Tools

Estimated Time: 15 minutes

What data collection tool(s) would you like to investigate for your students to use?

Online Tool	Web Address	Possible Use
Virtual microscope	www.udel.edu/biology/ketcham/microscope/scope.html	Students explore the structures of various plant cells and investigate the relationship between cell structure and growth rate. They use a virtual compound microscope to compare the structures of onion and elodea cells.
Simulations	www.mhhe.com/biosci/genbio/biolink/j_explorations/ch09expl.htm	Students use a photosynthesis simulation to investigate how light color, light intensity, and carbon dioxide levels affect a plant's production of oxygen and rate of photosynthesis.
Online surveys	SurveyMonkey.com	Students investigate when spring flowers first appear in schools across their city and beyond. They create and distribute an online survey to collect data about the weather, bulb locations, and appearance dates of the first daffodils on school grounds.
Online communication tools	Skype.com	Students investigate the effects of music on plant growth. They videoconference with a botanist to understand his experiment on the effects of classical music on plant growth. In the classroom, they design a similar experiment with rock music following his advice on experimental design.

Module 5: Technology that Supports Scientific Inquiry

Lesson 2: Technology Tools for Interpretation

Activity 2: The Right Tool for the Job

Estimated Time: 15 minutes

What online data interpretation tool(s) would you like to investigate for your students to use?

Online Tool	Web Address	Possible Use
Data map	www.maps4kids.com	View distribution of data over a geographic area
Seeing Reason	http://educate.intel.com/en/ThinkingTools/SeeingReason	Cause and effect of water quality and the habitat

What skills will your students need to develop in order to choose the best tool for their purpose and type of data? Choose two or three thinking skills below, and briefly describe why you think each one would benefit your students when selecting tools for scientific inquiry.

Thinking Skill	Role in Inquiry Tool Selection
Refine	Compare: Students need to be able to compare similar tools in order to determine which tool would best meet their needs.
Compare	
Clarify	
Analyze	Evaluate: Students need to evaluate tools when selecting a tool—they should develop evaluation criteria for their selection process.
Evaluate	
Question	
Connect	
Reason	
Examine	

Module 5: Technology that Supports Scientific Inquiry

Lesson 3: Technology Tools for Presentation and Collaboration

Activity 1: Tools for Data Presentation

Estimated Time: 10 minutes

Consider the types of data your students will collect for their inquiry investigations.

What technology tools might be the most useful and relevant for your students to present their data?

I like Many Eyes—this seems to be a useful tool, especially for fourth graders. I could imagine students presenting their data in a variety of ways that are supported by Many Eyes.

Module 5: Technology that Supports Scientific Inquiry

Lesson 3: Technology Tools for Presentation and Collaboration

Activity 2: Tools for Data Collaboration

Estimated Time: 10 minutes

Which type(s) of collaborative Internet projects would you like to investigate?

Project Type	Possible Use
Global water project	I could incorporate this into the water quality project that students already do.

What guidelines for online collaboration will you follow to ensure a successful project experience?

I'll make sure to teach students safety precautions.

Module 5: Technology that Supports Scientific Inquiry

Lesson 4: Module Review

Activity 1: Module Summary

Estimated Time: 5 minutes

Reflect on your learning in this module. How will you successfully incorporate technology tools to support each phase of scientific inquiry in your classroom?

I was amazed at how many online tools would be useful in scientific inquiry. I could see uses for many of these tools—they would be helpful, considering we don't have much science equipment but we do have computers.

Course Wrap-Up

Summary

Estimated Time: 15 minutes

How will you use the ideas presented in the course?

I have a much better understanding of scientific inquiry. I will definitely use the Phases to plan scientific inquiry investigations as I try to move up the continuum and infuse more inquiry into my science lessons. I will also experiment with some of the online tools. I have some good ideas on how I can make my soils unit a science inquiry unit, and also density. I'm excited to try out these ideas with my classroom.