This course supports the assessments for Science Teaching and Learning. The course covers 8 competencies and represents 4 competency units.

Introduction

Overview
Science is a body of knowledge about our natural world and the processes by which we grow that knowledge.

This course focuses on how to teach science and on preparing pre-service and current science educators to teach science in a way that is accurate, current, and engaging. This happens when a proficient teacher prepares lessons that address key goals and objectives, when students' prior learning and current interests are tapped, and when new learning is put to work resolving meaningful issues and challenges. It is expected that as a result of completing this course you will have the skills to teach so that you and your students will enjoy your learning time together.

This course will cover the following topics:

- models for teaching science through inquiry and engineering/problem solving
- evaluation of alignment to national standards including Next Generation Science Standards
- integration of learning communities to foster understanding
- formative assessment strategies
- legal and ethical responsibilities of a science teacher
- science classroom organization, management, safety, and emergency plans

Competencies
This course provides guidance to help you demonstrate the following 8 competencies:

- **Learning Activities, Learning Communities, and Understanding**
  The graduate integrates learning communities that foster understanding into the design of learning activities and curriculum.
- **Learning Activities and Models for Teaching Science**
  The graduate integrates various models for teaching science through inquiry into the design of learning activities and curriculum.
- **Formative Assessment**
  The graduate integrates formative assessment strategies into the design of learning activities and curriculum.
- **Science Education Standards in Lesson Planning**
  The graduate evaluates the quality of a unit of study with regard to pedagogical strength and alignment to science education standards.
- **Legal and Ethical Responsibilities of the Science Teacher**
  The graduate integrates the legal and ethical responsibilities of a science teacher into the design of instruction.
- **Safety and Maintenance in the Classroom**

The graduate develops plans for the use, storage, and maintenance of science materials and safety equipment and the care of living organisms.
- **Emergency Response Plans**
  The graduate develops emergency response plans for the science classroom that account for various potential emergencies.
- **Communicating Safety and Emergency Procedures**
  The graduate creates appropriate resources for communicating safety and emergency procedures to students.

Teaching Dispositions Statement
Please review the Statement of Teaching Dispositions.

Course Instructor Assistance
As you prepare to demonstrate competency in this subject, remember that course instructors stand ready to help you reach your educational goals. As subject matter experts, mentors enjoy and take pride in helping students become reflective learners, problem solvers, and critical thinkers. Course instructors are excited to hear from you and eager to work with you.

Successful students report that working with a course instructor is the key to their success. Course instructors are able to share tips on approaches, tools, and skills that can help you apply the content you're studying. They also provide guidance in assessment preparation strategies and troubleshoot areas of deficiency. Even if things don't work out on your first try, course instructors act as a support system to guide you through the revision process. You should expect to work with course instructors for the duration of your coursework, so you are welcome to contact them as soon as you begin. Course instructors are fully committed to your success!

Preparing for Success

The information in this section is provided to detail the resources available for you to use as you complete this course.

Learning Resources

The learning resources listed in this section are required to complete the activities in this course. For many resources, WGU has provided automatic access through the course. However, you may need to manually enroll in or independently acquire other resources. Read the full instructions provided to ensure that you have access to all of your resources in a timely manner.

The following Learning Resource Navigation Video will show you how to access the learning resources embedded in this course.

Note: To download this video, right-click the following link and choose "Save as...": download video.

Automatically Enrolled Learning Resources

You can access the learning resources listed in this section by clicking on the links provided throughout the course. You may be prompted to log in to the WGU student portal to access the resources.

VitalSource E-Texts
The following textbooks are available to you as e-texts within this course. You will be directly linked to the specific readings required within the activities that follow.

- Lawson, A. E. (2010). *Teaching inquiry science in middle and secondary schools*. Thousand Oaks, CA: Sage Publications. ISBN: 9781412966658.

Note: These e-texts are available to you as part of your program tuition and fees, but you may purchase hard copies at your own expense through a retailer of your choice. If you choose to do so, please use the ISBN listed to ensure that you receive the correct edition.

Educational Impact
Educational Impact is an online resource of video training and related worksheets. Educational Impact's videos and worksheets provide information about several important facets of modern education; you can observe classrooms where specific practices are implemented and problems are addressed. You will be linked to specific modules within the activities that follow.

Teachscape
You will access video modules from Teachscape at the activity level within this course. The Teachscape modules include video lectures, exercises, and interactive elements.
Other Learning Resources

You will use the following learning resources for this course.

Earth System Science Modules
You will access modules from Earth Systems Science throughout this course. Each module includes background information on the topic, hypotheses to be explored, findings so far, and additional resources. This builds an understanding of science in action by investigating through a real-life science project. There are also sample investigations that you can use for science projects in your classroom. These projects include science content standards that are helpful in guiding you to age-appropriate projects and coverage in your own school curriculum.

Pacing Guide

The pacing guide suggests a weekly structure to pace your completion of learning activities. It is provided as a suggestion and does not represent a mandatory schedule. Follow the pacing guide carefully to complete the course in the suggested timeframe.

Week 1

- Learning through Inquiry

Week 2

- Planning Instruction
- Complete and Submit Performance Task 3

Week 3

- Understanding Science
- Learning Communities
- Complete and Submit Performance Task 1

Week 4

- Assessment
- Complete and Submit Performance Task 2

Week 5

- Responsibilities
- Materials
- Maintenance

Week 6

- Emergency Procedures
- Safety Communication
- Complete and Submit Performance Task 4

Learning Activities and Models for Teaching Science

Science learning is an extension of questioning, exploring, record keeping, sharing, and analyzing real-world experiences. How can you teach science so that students develop scientific thinking skills and scientific literacy? This section begins with understanding how students learn, then utilizes that understanding to create lessons and activities that will engage students and help them develop scientific thinking skills.

Learning Through Inquiry

Learning through inquiry fosters an understanding of concepts instead of simply memorizing isolated facts. Students as active participants in the classroom will learn to ask and answer their own questions. Inquiry models are also adaptable to accommodate the multiple learning levels and styles of students.

How Science is Practiced

Science classrooms are simply formalized places and processes to respond to natural curiosity about how the world works. Consider the following science investigation:

Young salmon swim downstream to the Pacific Ocean where they grow and mature sexually. They then return to swim upstream, often jumping incredible heights up waterfalls to ultimately lay eggs or deposit sperm in the streams' headwaters before dying. By tagging young salmon, biologists discovered that mature salmon actually return to precisely the same headwaters where they were born some years earlier!

This discovery raised a very interesting causal question: How do salmon find their home streams? In other words, what causes them to end up in their home streams?

Make a list of possible explanations. How might you determine which of your explanations are possible?

Read the following pages in *Teaching Inquiry Science in Middle and Secondary Schools*:

- pages 3–18 of chapter 1 ("Educational Goals and the Nature of Scientific Inquiry")

As you read, consider the following questions:

- What are basic features of science investigation?
- What surprises you about the findings reported in this reading concerning the salmon study?

Description vs. Explanation

What is the difference between a description and an explanation?

Recall the reading regarding the feeding habits of giraffes from chapter 1 ("Educational Goals and the Nature of Scientific Inquiry") of *Teaching Inquiry Science in Middle and Secondary Schools*.

In your notebook, draw the flow chart on the following page of *Teaching Inquiry Science in Middle and Secondary Schools*:

- page 22 of chapter 1 ("Educational Goals and the Nature of Scientific Inquiry")

Complete the flow chart according to the instructions in the following question from *Teaching Inquiry Science in Middle and Secondary Schools*:

- question 5 on page 21 of chapter 1 ("Educational Goals and the Nature of Scientific Inquiry")

Guiding Students to Efficient Learning

In the Educational Impact Program Library, go to the following program:

- Adolescent Literacy

Complete the following clips. Look at the many strategies the teacher uses while teaching about reading (e.g., incorporating summaries, simple graphics, technology, polling):

- Module 4 Topic D, clips 1 and 2 (10 min.)

Consider the following questions:

- What additional skills did these videos show that you can implement in your own reading for this course?
- How can you use these strategies to improve learning in a science classroom?

To learn more about this topic, view the following Teachscape video:

- "Overview of Stage 3 (Planning Learning Experiences)" (5 min.) in the Stage 3: Learning Plan section of the lesson

Origins and Outcomes of Inquiry Instruction

Read the following sections in *Teaching Inquiry Science in Middle and Secondary Schools*:

- pages 89-97 of chapter 5 ("The Origins and Outcomes of Inquiry Instruction")

Study Figure 5.1 on page 92. Does this match up very well with how you learn hobbies and interests in your personal life?

As you read the chapter, answer the following questions in your notebook:

- What are the "5 Es" of the BSCS learning cycle?
- How do these principles fit with how you think you learn?
- How is inquiry instruction more engaging than a lecture?

Elements of Inquiry Instruction

The foundation of science is asking questions. Therefore, it makes sense to base the teaching of science around making inquiries.

Read the following pages of *Teaching Inquiry Science in Middle and Secondary Schools*:

- pages 99–108 in chapter 6 ("Inquiry Instruction")

As you read the pages, consider the following questions:

- What three types of learning cycles are described in this reading?
- How does each cycle begin?
- How do these cycles differ?
- What is the result of each cycle?

To learn more about this topic, view the following Teachscape videos:

- "Essential Questions" (7 min.) in the Stage 1: Desired Results section of the lesson
- "View Grades 9–12 Examples (Science)" (4 min.) in the Seeing the Strategies in Action section of the lesson

Science Standards in Lesson Planning

With the beginning of the space race, educators and policy makers across the United States began serious conversations about the need for improving science education. The outcome of those conversations includes standards documents, standardized assessments, and further research on student preparation for college and careers, as well as their ability to make scientifically informed decisions as knowledgeable citizens. The documents are periodically revised based on research and evolving societal needs.

Planning Instruction

Research shows that engaging pedagogy is a predictor of greater course success. Engaging pedagogy includes such things as

- a variety of teaching methods,
- meaningful class discussions,
- challenging assignments,
- productive use of classroom time,
- encouragement to speak in class,
- encouragement for students to work together, and
- meaningful homework.

The Next Generation Science Standards recommend an active inquiry approach to science instruction. As you complete the activities in this topic, think about how you can use this accumulated wisdom to assess and improve your science teaching.

Science Standards at a Glance

Investigate the resources offered on this site for your teaching. Select the educational level where you expected to be teaching. Find at least two resources on the NSTA website that you can use directly in a classroom.

Next Generation Science Standards (NGSS)

The Next Generation Science Standards (NGSS) were developed through a collaborative partnership among educators, scientists, industry experts, and states. They incorporate accurate and up-to-date science in a framework that provides flexibility to local jurisdictions and teachers while promoting commonality in achievement. As a science teacher, you might teach in a school that uses the NGSS. Even if your school does not use these standards, though, your students are best served if you strive to infuse these standards into your curriculum: many children will, at some point, change schools or education systems, and the standards might change—prepare *all* your students for success in an uncertain educational environment by ensuring they can perform at grade level within the NGSS.

The NGSS focus on three *dimensions*: practices (behaviors that scientists and engineers engage in); crosscutting concepts (recurring themes and ideas with broad applicability across all domains of science); and disciplinary core ideas (physical sciences; life sciences; earth and space sciences; and engineering, technology and applications of science). For many teachers and students, this represents a paradigm shift from how science has previously been taught—the focus on an engineering approach, in particular, is new for many—but the NGSS were carefully crafted for both relevance in contemporary society and flexibility for adaptation within diverse education systems.

Read the Executive Summary (pp. 1-3) of the Next Generation Science Standards Front Matter.
Standards for Professional Development and Science Teacher Preparation: The National Science Teachers Association (NSTA)

The National Science Teachers Association (NSTA) has established standards for professional development, and it recognizes schools, including Western Governors University, that meet their rigorous review of pre-service science teacher preparation programs. The NSTA has also been instrumental in helping shape and promote the NGSS.

The National Science Teachers Association (NSTA) is a large national professional organization of science educators. The NSTA establishes best practices for the teaching of science and the preparation of science educators. They also hold conferences and publish science teaching journals.

Explore the NSTA website. If you have not already done so, consider becoming a member of the NSTA.

Notice that each chapter in *Teaching Inquiry Science in Middle and Secondary Schools* begins with a statement of the NSES standard that the chapter relates to.
Inquiry Strategies to Use in Your Classroom

There are many organizations and learning communities that gather and share excellent resources to enhance teaching and learning science. The Earth System Science Education Alliance (ESSEA) is one such community that provides a collection of Earth system science modules.

Read about the background of ESSEA on the following web page:

- Background

What evidence do you have that this website and group will be a source of reliable scientific information?

ESSEA also provides guidance to teachers to make the best use of the resources on the website. Read the following web page:

- Inquiry Strategies to Use in Your Classroom

Compare the ESSEA description of inquiry strategies to what you learned in the National Science Education Standards document and in Teaching Inquiry Science in Middle and Secondary Schools. How can the ESSEA description help you to plan and prepare to use inquiry in your classroom?

Active Learning Strategies

There are many ways to implement inquiry strategies.

Complete the following module:

- Module 3, Topic A, clips 2-9 (17 min.)

As you watch the clips, answer the following questions in your notebook:

- What is active learning?
- Why should I seek to include active learning in my teaching?
- What are 5 active learning strategies?

After watching Clip 9: Unzip the DNA – A Classroom Example of Active Learning, answer the following questions:

- How did the teacher promote student thinking using an active learning activity?
- How does this enhance the learning environment?
- Which NSES Standards did this lesson incorporate?

Science Labs, Learning Cycles and NGSS Standards Integration

Examine the science lab lesson plan on the following pages of *Teaching Inquiry Science in Middle and Secondary Schools*:

- pages 135–138 of chapter 8 ("Technology, Labs, and Safety in the Inquiry Classroom")

Examine the organization and detail of the lesson plan for the way it incorporates learning cycles and NGSS standards. Consider the following:

- How does this lab plan match up with the "5 Es" of the BSCS learning cycle model?
- How does this lesson begin in a way that will engage and challenge students?
- How can the teacher determine if the lab activity generates the desired student learning?
- How does the lesson incorporate NGSS standards?

Evaluating Science Lessons

To efficiently use instructional time and to justify use to patrons, science teachers must double-check for alignment to applicable science standards, both in their own original lesson plans and in lesson plans they adapt from other sources. Review the EQuIP Rubric for Lessons & Units: Science, considering how it might guide you in evaluating lessons or units. You will be using an adapted form, Next Generation Science Standards: Lesson Rubric to evaluate a science lab lesson in Task 3.

Task 3 Performance Task

Complete Task 3 in TaskStream:

For details about this performance assessment, see the "Assessment" tab in this course.

Learning Activities, Learning Communities, and Understanding

Memorizing a collection of isolated facts cannot be considered understanding. A full, well-rounded understanding of science requires not only that students hear or read about a topic, but that they ask questions that are meaningful to them, investigate in multiple ways to find answers, relate what they learn to previous knowledge, revise what they previously believed to be true, and test their knowledge by interacting with others.

This section also introduces several activities that direct you to finding resources outside of your text book and communities outside your immediate classroom.

Understanding Science

This topic will help you clarify several teaching approaches that you can use in your science classroom. You will also investigate rich resources that you can mine for activities for your classroom. There is no need to invent it all yourself. The community of science educators willingly shares things that work for students, and research institutions are anxious for students to be involved with the latest scientific information and discoveries.

Writing Lesson Objectives

The primary task of creating a lesson plan is determining the main goal of the lesson. When you know the main goal, all the other components that you include need to be designed to move you and your class toward that goal.

First, you'll break down the main goal into lesson objectives. Study the following resource and consider what the three components of a lesson objective are:

- Establishing Science Learning Objectives

Write a lesson objective including all three parts described in this reading. Did you use any of the suggested words to write this objective?

What is missing from the following lesson objective?

- "At the end of this lesson, students will be able to write a complete lesson plan."

How Students Think

Read the following pages of *Teaching Inquiry Science in Middle and Secondary Schools*:

- pages 47–57 of chapter 3 ("How Students Think")

Consider the following questions about Piaget's theory of intellectual development:

- What four stages of development did Piaget propose?

- In your experience, on which level is most classroom instruction focused?
- Select an excerpt from Teaching Inquiry Science in Middle and Secondary Schools that you feel is written on the concrete level. Pick another that you feel is written on the formal or post-formal level. How do these excerpts differ from each other? How do you feel as you read and think about them?
- How can you help your students move beyond the concrete stage of thinking?

To learn more about this topic, view the following Teachscape videos:

- "Hear from the Experts" (2 videos, 5 min.) in the Reflection: Keep It Going section of the lesson

Good Questioning Skills

You know what you are going to teach and who you are going to teach. Now, how will you communicate with your students? Good questions are an integral part of good instruction. How can you ask questions that will promote student thinking?

Review what you read about questioning techniques by rereading the following questions in *Teaching Inquiry Science in Middle and Secondary Schools*:

- questions 18–25 on pages 117–118 of chapter 7 ("Planning for Inquiry")

Complete the following module:

- Module 3 Topic A, clips 3 & 4 (9 min.)

As you watch the videos, answer the following questions:

- What does effective communication between teachers and students look like?
- How can I use questions to engage students and help them learn?
- What do learning-promoting questions look like?
- What is wait time, and why is it important?

Using Models in Your Teaching

A variety of models are used in teaching and doing scientific investigations. Reflect on what science is and how science is conducted. Models are often used to support scientific investigation. Models engage the visual part of the brain. Models include pictures, physical models, tables and graphs for presentations of data, and even mathematical equations that describe the behavior of data.

Find a depiction of DNA online or in a textbook. Cut straws of varying length and build a short section of the DNA strand. Twist you model to show the three-dimensional DNA structure.

Consider the following questions:

- What did you learn making the model versus looking at a depiction?

- What other examples of modeling can you identify that assist in science investigation? List them in your notebook.

Planning Engaging Classroom Demonstrations

Using models and demonstrations requires advance planning to ensure that all materials needed are on hand. It also requires a clear plan of the demonstration's sequence.

Read the following section in *Teaching Inquiry Science in Middle and Secondary Schools*:

- "Demonstrations" (pp. 149–152) in chapter 9 ("Demonstrations, Lectures, Discussions, and Field Trips")

Consider the demonstration presented in the reading. Answer the following questions in your notebook:

- Why is (b) the best option of this demonstration?
- How can you involve students to make a demonstration engaging and fun?
- What are key steps in selecting and presenting demonstrations in ways that challenge students and encourage participation and learning?

Presenting Effective Lectures

There are times when a lecture is the most effective way to communicate information that supports student learning.

Read the following section in *Teaching Inquiry Science in Middle and Secondary Schools*:

- "Lectures" (pp. 152–156) in chapter 9 ("Demonstrations, Lectures, Discussions, and Field Trips")

Answer the following questions in your notebook:

- What are 5–7 keys to making lectures effective and engaging?
- What skills and unique attributes do you bring to this part of your teaching?
- How can a sense of humor be used to enliven lectures?

To learn more about this topic, view the following Teachscape video:

- "View a Teaching Example (Guiding Student Learning)" (6 min.) in the first part of the Interactive Direct Instruction section of the lesson

Classroom Discussions

During a lecture, the teacher is the only one speaking. But students like to talk, too. Keeping the talk focused on the lesson takes skill and practice.

Read the following section in *Teaching Inquiry Science in Middle and Secondary Schools*:

- "Discussions" (pp. 156–160) in chapter 9 ("Demonstrations, Lectures, Discussions, and Field Trips")

As you read this section, consider the following questions:

- What makes a class discussion work?
- Which of the discussion formats described appeal to you?
- When do you see yourself employing these?
- How can they support inquiry learning?
- How are discussion formats similar to, and different from, questioning techniques?
- How do they complement and build on each other?

To learn more about this topic, view the following Teachscape videos:

- "View a Teaching Example (Maintaining Student Focus)" (5 min.) in the second part of the Effective Group Management section of the lesson

Field Trips

Science is about the real world, and sometimes it is good to get out of the classroom. Field trips present management issues while you are teaching content.

Read the following section in *Teaching Inquiry Science in Middle and Secondary Schools*:

- "Field Trips" (pp. 151–163) in chapter 9 ("Demonstrations, Lectures, Discussions, and Field Trips")

Consider the following questions:

- What are the essential elements of planning and conducting field trips?
- What alternatives are there to actual field trips?
- How can a teacher provide inquiry learning experiences through field trips?

Homework That Helps Students Learn

Read the following section in *Teaching Inquiry Science in Middle and Secondary Schools*:

- "Using Homework Problems to Encourage Self-Regulation" (pp. 238–244) in chapter 13 ("Assessing Student Progress")

Consider the following questions:

- Why is homework sometimes ineffective as a learning activity?
- Do your observations agree with what Lawson suggests in this reading?
- What are five guidelines you are comfortable following to make homework an engaging and profitable learning activity for your students?

Learning Communities

Learning doesn't happen in isolation. Learning how to cooperate, listen to others' ideas, build on those ideas, and communicate understanding are just a few skills that can result from establishing learning communities. The science community includes the whole world. With electronic communications technology, students in your classroom can extend their learning community far beyond their physical surroundings. Your teaching style will also affect whether students are isolated receivers of information or participants in a broader community.

Building a Community of Learners

How can you build in your classroom a positive learning environment that focuses on learning and student success? How will doing this make your teaching more effective and enjoyable?

Read the following about what a professional learning community is and why we as educators should work to build one:

- What Is a Professional Learning Community?

How can building the community feeling in your classroom help you to meet the needs of learners at all levels?

Adapting Instructional Practices for Group Work

In your notebook, write how each of the following instructional practices can work for students in groups vs. working individually. Be creative!

- creating lesson objectives specifically to encourage group work
- encouraging higher level thinking skills
- questioning techniques
- using models
- classroom demonstrations
- lectures
- class discussions
- field trips
- homework

Observing Classroom Learning Communities

Watch the following video from Annenberg Learner:

- "Exploring Mars" video (44 min.) on the bottom of the "Teaching High School Science" web page

Observe how this teacher encourages and supports the classroom learning community. Consider the following questions:

- How does the teacher use communities of learners effectively?
- What types of questions does she ask the class?
- How do the groups facilitate community learning?

Science Fairs

As a teacher, you model appropriate science practices. Your students have an opportunity to demonstrate those practices and communicate to a wider community through science fairs. You can expand your students' opportunities by preparing and encouraging them to participate in science fairs.

Conduct an internet search to find

- science fair venues,
- entrance and project requirements,
- project ideas, and
- helpful websites or resources.

Create a checklist in your notebook about how to prepare your students to participate in science fairs. You should include the following items:

- timelines
- skills needed for students to do projects
- lesson topics and notes to help students acquire needed skills
- ideas for giving students opportunities to share their work within the classroom and build their presentation skills
- ideas for integrating student projects into the curriculum (e.g., let them be the teacher, new topics to study)

ESSEA Inquiry Module Integration Activity

In this activity, you will examine a complete ESSEA module and see how this learning community resource can be used in your classroom.

Scan the following ESS module:

- Coral Reefs

Consider the following questions:

- How is the module set up?
- What are students asked to do?
- What information is provided to students to help them meet their task?
- How do students report their conclusions?
- Do you think this activity is an effective learning resource? How does this module address the key steps of an inquiry investigation?

Go to the list of ESS modules:

- ESS Modules by Topic

Select a topic of interest. For example, since you have just completed a couple of activities about Mars, you might try "Terraforming Mars: The Poles and Beyond."

Create a lesson plan to complete an investigation from the ESS modules. Choose one of the "Sample Investigations" at the bottom of the page.

Divide your class (or prospective class) into groups so that each group will contribute something unique to the investigation. Plan to have groups research the resources listed or search for other reliable, recent resources. Plan how to build the investigation through the following stages:

- introduction and establishing interest
- group organization and working together
- guiding investigations
- project presentations

Task 1 Performance Task

Complete the following task in TaskStream:

- Task 1

For details about this performance assessment, see the "Assessment" tab in this course.

Formative Assessment

How do you know if your students have learned what you intended? Assessment needs to happen throughout the learning process so you can ascertain student understanding and adapt as you go. Formative assessment ensures that you teach at a level and pace that ensures that students learn.

Assessment

Formative assessment is an example of how you can employ scientific learning as you teach. You will ask questions, use several modes to find answers, and adjust your investigation (and teaching), all for the purpose of ensuring that your students achieve a solid understanding of science concepts. This topic will provide several strategies that you can use to make formative assessment an integral part of your teaching.

Formative Assessment

How can a teacher use formative assessment to monitor and adjust teaching? Read the following article and list 5 ways to do formative assessment:

- Formative and Summative Assessments in the Classroom

Types of Assessment

Read the following pages in *Teaching Inquiry Science in Middle and Secondary Schools*:

- pages 221–231 in chapter 13 ("Assessing Student Progress")

In your notebook, draw a concept map for the reading. Use your map to respond to the following questions:

- What is authentic assessment? What is the difference between formative and summative assessment? Give two examples of each type of assessment.
- What are gender and cultural bias? Have you experienced these in exams you have taken? How can these be avoided in the assessments you prepare?
- Consider an exam you have recently taken. Were the questions fair and well written? How did you feel as you began and then proceeded through the exam? How can you help your students to do well and feel confident about an exam you give?

Read the following pages in *Teaching Inquiry Science in Middle and Secondary Schools*:

- pages 234–237 in chapter 13 ("Assessing Student Progress")

To learn more about this topic, view the following Teachscape video:

- "Assessment as Motivation" (4 min.) in the Formative Assessment in Context section of the lesson

Note: To view the videos, you must first select "View Videos" within the Formative Assessment in Context section.

Using Graphic Organizers in Formative Assessment

Mind maps and graphic organizers can assist in clarifying relationships between concepts or components. In science classes, the graphic organizers students create can be used both to solidify what is being learned as well as provide an opportunity for teachers to assess fuzzy thinking about a science concept.

Watch the following:

- Module 4 Topic A, clip 6 (5 min.)

Use the following resource as quick guide to using a variety of graphic organizers:

- Graphic Organizer Examples

Task 2 Performance Task

Complete the following task in TaskStream:

- Task 2

For details about this performance assessment, see the "Assessment" tab in this course.

Legal and Ethical Responsibilities of the Science Teacher

Science classrooms require strong management skills. The combination of students actively involved with intricate equipment and potentially dangerous substances can be daunting, especially to new teachers. Your responsibility for the safety of students must be taken seriously and planned for completely.

Responsibilities

This topic will cover general safety issues in science classrooms. Establishing your classroom safety routine is only the beginning. These rules and routines must be communicated to students and reinforced regularly, especially immediately before every activity that has the potential for accident or danger. Planning ahead and preparing an environment to prevent hazards is the best insurance against accidents and mishaps.

Classroom Technology

Read the following pages of *Teaching Inquiry Science in Middle and Secondary Schools*:

- pages 129–133 of chapter 8 ("Technology, Labs, and Safety in the Inquiry Classroom")

Consider the following question:

- Why does technology need to be included in your lesson planning and your classroom?

Compare the ideas you came up with those addressed by the Edutopia team in Why Integrate Technology into the Curriculum?: The Reasons Are Many.

Legal Duties of Science Educators

Read the following pages in *Teaching Inquiry Science in Middle and Secondary Schools*:

- pages 141–143 of chapter 8 ("Technology, Labs, and Safety in the Inquiry Classroom")

Explain what is meant by the following primary legal responsibilities of teachers. What is involved in each?

- instruction
- supervision
- maintenance

Do you feel that you can satisfy these three legal duties in your professional work as an educator?

Note: Joining a professional organization like the NSTA will provide you with legal support. Go to the NSTA *website for details*.

Safety in the Science Lab

Read the following pages in *Teaching Inquiry Science in Middle and Secondary Schools*:

- pages 138–140 of chapter 8 ("Technology, Labs, and Safety in the Inquiry Classroom")

Consider the following questions:

- What can you do to make the science lab a safe place to learn?
- If you could display a classroom sign listing only five safety rules, what would they be, and why?

Field Trip Safety

In your notebook, make a plan for a science field trip. Imagine yourself in the following instructional scenario:

You are preparing a field trip proposal to take one of your classes off campus for a half-day learning activity. You want this to be a safe learning experience for your students. Answer the following questions:

- What do you need to do to make this happen?
- What hazards might be encountered?
- What instructions do students need prior to this experience?

Read the following article:

- Field Trip Safety

Answer the following question in your notebook:

- What should you include in your proposal that will convince school administrators and parents that your trip will be a safe experience for your students?

Read the following document:

- Field Investigations and Activities

Supplement your answers to the previous questions with information from this document.

What had you not considered before this reading?

Compare your plan with checklists on the following pages of *Teaching Inquiry Science in Middle and Secondary Schools*:

- page 162 of chapter 9 ("Demonstrations, Lectures, Discussions, and Field Trips")

Safety and Maintenance in the Classroom

Many of the materials used in a science classroom may be considered temporary or disposable as compared to the equipment and reusable supplies. These are things that will be specific to a topic or have limited shelf life. This subject will address the issues you must prepare for when dealing with live organisms or chemicals in your classroom.

Materials

Handling chemicals is an integral part of an active science classroom. This includes not only specific chemistry experiments, but also cleaning supplies and preservatives. Safe storage, inventory records, handling, and disposal are part of a general chemical safety plan. You must also be prepared with protective equipment and plans for accidents. There are clear guidelines for use of all science lab substances.

NSTA Position Statement on Safety

The NSTA recognizes the issues surrounding safety in the classroom. The following position paper provides general guidance on this topic:

- NSTA Position Statement: Safety and School Science Instruction

Consider the following questions:

- What items are you directly in control of as the classroom teacher?
- Which items require additional support from school administration?

Safety Data Sheets (SDS)

In your notebook, list what you think a teacher needs to know about a chemical that is to be used in an upcoming lab.

Read the following article to see if an SDS sheet provides this information:

- OSHA Brief – Hazard Communication Standard: Safety Data Sheets

Choose a chemical that you know is used in your field of study. Use the site above to find the SDS sheet for this chemical and see if the needed information is provided.

Chemical Storage

Write the following list of chemicals in your notebook:

- potassium dichromate
- zinc
- Gram stain
- acetic acid
- sucrose
- bottled oxygen (under pressure)

Use the following document to determine to which chemical storage category each chemical belongs:

- Appendix 3.2: Chemical Storage

Write the storage code that you would assign to each chemical on the list in your notebook.

Explain how each of these chemicals should be safely stored.
Effective and Ethical Use of Organisms

Read the following pages in *Teaching Inquiry Science in Middle and Secondary Schools*:

- pages 143–144 of chapter 8 ("Technology, Labs, and Safety in the Inquiry Classroom")

Consider the following questions:

- How would you care for a gerbil kept in the lab area?
- How would you care for an aquarium of fish?
- How would you communicate to students the proper care of these animals?
- What would you do to prepare students to treat dissection specimens appropriately?

Suppose you plan to keep living rabbits and butterflies in your classroom. What considerations might influence your decisions to maintain these creatures in your classroom?

Read the following article:

- Handling Live Animals in the Classroom

Consider the following question:

- What other issues might influence your decisions to maintain these organisms in your classroom?

The NSTA has carefully considered the issues surrounding animals in the classroom. Read the following position paper:

- NSTA Position Statement: Responsible Use of Live Animals and Dissection in the Science Classroom

Prepare a care plan for the following hypothetical situation:

- A student brings a snake into class and asks if you can keep it as a classroom specimen.

Explain how your care plan would change for the following situation:

- During parent-teacher conferences, a patron brings a lush flowering plant and presents it to you to keep in your classroom.

Laboratory Safety

- Skim through the front page of this document to see what it has to say about safety issues of special concern to you right now: Laboratory Safety

California Science Safety Standards

Read the following section of the Science Safety Handbook for California Public Schools:

- "General Laboratory Safety Precautions" in chapter 3 (pp. 17–20)

Consider the following questions:

- Is this information clear, comprehensive, and easily implemented in a chemistry classroom?
- If not, what more is needed?

California Science Safety for Chemistry

Read the following section of the Science Safety Handbook for California Public Schools:

- "Safety in the Chemistry Laboratory" in chapter 5 (pp. 29–45)

Consider the following questions:

- Is this information clear, comprehensive, and easily implemented in a chemistry classroom?
- If not, what more is needed?

Obviously, the level of detail you will need in safety guidelines depends on the grade and maturity level of the students you are teaching and the types of chemicals you will be using.

There are also some virtual chemistry labs online where students can see consequences without endangering themselves and others.

Appropriateness and Disposal of Chemicals in the Science Lab

It is important that a science teacher not use chemicals that are toxic, and that all chemicals be properly disposed of or stored when not in use.

Look through the following article to see how lab chemicals should be disposed of after use:

- How do I dispose of laboratory chemicals?

Chemical Reactions

Watch the following video from Annenberg Learner:

- "Chemical Reactions" video (46 min.) on the bottom of the "Teaching High School Science" web page

Consider the following questions:

- How comprehensive was the lesson plan?
- What has the teacher taught the students prior to this lesson so that they are capable of

success?
- How were safety procedures taught and reinforced?
- Can you determine the border between discovery learning and preparing students for hazardous situations?

Maintenance

People who work in situations of high potential danger (e.g., airline mechanics, pilots, surgeons) follow checklists to ensure that critical steps are not overlooked. There is potential danger in science classrooms.

Science departments often have a separate budget for equipment and supplies. This budget also needs to include safety and protective equipment. When you plan lessons, you must check that all necessary supplies are available and ready. Having a general, overall classroom maintenance plan that you always follow simplifies planning for specific lessons. This topic will focus on that general, daily, overall plan.

Maintenance Plan

Scan the following document:

- Standard Operating Procedures: Science Classroom Safety

Consider the following questions:

- What supplies should you have on hand to teach your subject?
- What safety equipment should be available in your science classroom, and how often should it be checked?

Emergency Response Plans

Accidents happen. Because they happen unexpectedly, you must prepare in advance. This section will help you plan and prepare for an emergency.

Emergency Procedures

Some emergencies are more predicable than others. In a science classroom that involves glassware, flames, chemicals, or a lot of student movement, accidents are almost inevitable. Specific locations are also susceptible to particular natural disasters. Emergency supplies and practice exercises help prepare for such emergencies.

Identifying Hazardous Situations

Choose the grade level or specific science discipline that you expect to be teaching. Sketch the classroom arrangement in which you expect to work. In your sketch, identify

- where breakable items will likely be during a science activity,
- where spillable items will likely be during a science activity,
- dangerous situations unique to specific areas (e.g. flames, hazardous chemicals, sharp objects),
- potential accidents that may occur in these dangerous locations, and
- the specific emergency supplies necessary to respond to accidents.

Answer the following questions:

- Are the emergency supplies easy to retrieve in an emergency situation?
- Could/should they be relocated during a specific activity?
- Do you and your students know how to use the emergency supplies?
- Do you have the necessary skills to use the emergency supplies?
- How can you teach your students to use emergency supplies?
- How will you practice emergency responses?

Emergency Numbers

Sometimes an emergency is more than you can handle alone. In your notebook, prepare a list of emergency numbers.

Use the following document from the Science Safety Handbook for California Public Schools to help you get started:

- School District Emergency and Safety Procedures (p. ix)

Exit Plan

In any public building, floor plans of exit routes should be posted in frequent and conspicuous places.

Think of a school you attended or one that you are currently familiar with. Draw out a simple floor plan of the science wing or the part of the school where your science class was located. Now draw arrows to show the quickest escape route from the classroom to a safe area outside the building. Consider the next best (i.e. alternative) route.

Consider the following:

- Do you know when to evacuate?
- What do the emergency alarms sound like?
- How do you identify an emergency that requires evacuation of only your room (e.g., a single student's health event, a science accident)?
- What needs to be secured before you exit (e.g., doors closed or open, science equipment turned off)?
- How will you prepare students to move calmly out of your classroom?
- How can you instruct students about the best and next-best evacuation routes out of the building?
- Do students know where the safe area is where they should assemble outside?
- How can you ensure that all students make it to the safe area?
- What will you do if a student is not identified in the safe area with the rest of the class?

Consider your responses to these questions as you read the Emergency and Evacuation Planning Guide for Schools.

Communicating Safety and Emergency Procedures

You may know all the safety procedures, but you need to also ensure that students know them. How will you make safety instruction an integral part of your lesson plans and presentations? How will you ensure that students know what to do? How can you enforce compliance with safety rules?

Safety Communication

Obviously, you cannot teach safety procedures all at once at the beginning of the year and expect students to know and comply with them all. The best time to teach a concept is when it is needed. How can you address the critical safety issues for a science classroom in a way that is relevant, integrated, and remembered?

Helping Students Comply With Safety Rules

Read the following article:

- Helping Students Comply With Safety Rules

Which of the strategies mentioned in this article would you feel comfortable using in your teaching to emphasize safety in your classroom? In your notebook, write three "Must Do" strategies and three "Could Do" strategies.

Safety Contracts

Having students sign a safety contract is one way to impress upon them the seriousness of safety practices. However, even a safety contract cannot be a one-shot deal.

Look at a sample safety contract provided by NSTA:

- Safety in the Science Classroom

Analyze how to communicate this safety contract in parts as needed, instead of all at once. Brainstorm ways to separate this document into chunks that can be presented individually as parts of relevant science lessons.

Visual Reminders

Even if you've taught all the content in the student contract, students have signed the contract, and students pass frequent quizzes on the content, visual reminders in the classroom are useful. A poster of the student contract contains too much detail for it to be attended to in an emergency. A poster usually just contains key words or phrases to remind students of important content.

Consider creating a poster to hang in the lab area that identifies general guidelines for students to follow when working in the lab. You might want to use the Safety in the Science Classroom document as a guideline. Your poster can be created as a word processing document to be included in your notebook, which can later be reproduced as a poster-size visual aid.

For example, you may want to create separate posters for actions to take in case of

- chemical spill,
- clothes catching on fire,
- acid spill on desk/skin, or
- base spill on desk/skin.

Task 4 Performance Task

Complete Task 4 in TaskStream:

- Task 4

For details about this performance assessment, see the "Assessment" tab in this course.

Final Steps

Congratulations on completing the activities in this course! This course has prepared you to complete the assessment associated with this course. If you have not already been directed to complete it, schedule and complete the assessment now.