Teaching Science in the Inclusive Classroom

CEP 842

Melanie Burd
Courtney Foley
Jenny Luyckx

"All students with disabilities do have potential in science."

~Blueprints for Reform (American Association for the Advancement of Science, 1998)

Teaching Science in the Inclusive Classroom

This three day workshop will prepare lower elementary general education educators to teach science in the inclusive classroom by presenting research on the definition of science and science education, experiences and discussions to strengthen knowledge of the inquiry process, and strategies and techniques to improve student assessment. Educators will leave this workshop with the knowledge and tools necessary to help K-3 students of all abilities achieve success in the area of science.

**Prior to Day 1, teachers will be asked to read the article
Science Inquiry: The Link to Accessing the General Education Curriculum

Day 1: What is Science?

Science is a system of acquiring knowledge using observations and experimentation to describe and explain natural phenomena. It is a branch of knowledge or study dealing with a body of facts or truths systematically arranged and showing the operation of general laws.

Objectives:

- Complete a Science Experiment: Sink or Float?
- Discuss "What is Science?" and how does the definition tie into inquiry.
- Discuss Special Needs that may be brought to the classroom and how can science lessons be modified to meet the needs of all students.

8:30-9:00	•Coffee and Rolls, Introduction, and Overview of the Day
9:00-10:30	•Introduction of Science Experiment and Completing Experiment
10:30-10:45	•Morning Break
10:45-12:00	•Discussion of Results and Whole Group Conclusion
12:00-1:00	•Lunch
1:00-2:00	•Discussion of "What is Science?"
2:00-2:30	•Video - *Working Together: Science Teachers and Students with Disabilities*
2:30-2:45	•Afternoon Break
2:45-3:30	•Video Discussion
3:30-4:00	•Review of the Day and Wrap-Up

Segment 1

Rationale

Teachers need to evaluate what they consider to be a science lesson and see if it matches up to the definition of what science really is. If it does not, they need to decide how they can turn the lessons they think are science into ones that really are. They need to ask themselves if students are learning to think and solve problems while questioning as they perform experiments or are having discussions during science or are they just reading from a textbook to learn? One way teachers can ensure that students are not just reading from a textbook is to include inquiry into their science lessons." Inquiry is an interactive process that actively engages students in learning in meaningful ways. The process of inquiry is characterized by interactive, student-centered activities focused on questioning, exploring, and posing explanations. The goal of inquiry is to help students gain a better understanding of the world around them through active engagement in real-life experiences."

Teachers will discover that by offering students hands-on opportunities to complete experiments, they are allowed to think and learn like a scientist would and develop questions that perhaps never would have occurred if they were only reading from a textbook.

Science Experiment

The teachers will listen to the presenter read *Who Sank the Boat?* by Pamela Allen. Teachers will be asked to name some things that sink or float. The teachers will be divided into groups of 4. Each group will be given a bucket of water and a variety of objects in which they will test to see if they will sink or float. For each item, have the teachers:

1. Write or draw the item in column 1. (You may want to do this for younger students before you duplicate the test sheet.)
2. Predict whether it will sink or float and record their prediction in column 2.
3. Place the item in the water and observe what happens.
4. Record their results in column 3.
5. Repeat the procedure and record the results in column 4.
6. Place the items that sank in one pile and the items that floated in another pile.

After each group has finished testing their objects discuss the results using the following questions:

- How many of your predictions were correct?
- Did your predictions get better, worse, or stay the same?
- Look at the pile of objects that sank. Describe them. Do they have anything in common with one another?
- Look at the pile of objects that floated. Describe them. Do they have anything in common with one another?
- Compare the results for each group. Did everybody get the same results? If any of the results were different, ask students to replicate their trial.

Come to a whole group conclusion of which items sink and which items float and why they sink or float.

What could be some other questions that a teacher could ask their students? What extensions could be added to the lesson to expand upon the students thinking?

Name _____

SINK OR FLOAT?

Guess whether each object will sink or float when you put it in water. Circle your guess. Put the object in the water. Circle **float** or **sink** to show what happens. Put the object in the water again. Circle **float** or **sink** to show what happens the second time.

OBJECT	GUESS	1st TRY	2nd TRY
	float sink	float sink	float sink
	float sink	float sink	float sink
	float sink	float sink	float sink
	float sink	float sink	float sink
	float sink	float sink	float sink

What is Science?

As a whole group, read the definition provided at the top of the agenda. How did the experiment tie into the definition? Or did the teachers feel that the definition of science did not relate to the experiment? Which parts of the definition were suitable and which parts were not? How does the definition need to be changed to fit the experiment? Place the teachers back into their groups and have them discuss the questions and come up with possible solutions to them. Discuss the small group suggestions in a whole group setting.

Next, the article *Science Inquiry: The Link to Accessing the General Education Curriculum* will be referenced. Does the definition fit science inquiry? If not, how could it be changed to do so? Also, how could the lesson be modified in order to follow the guidelines of science inquiry?

Segment 2

Rationale

The National Science Education Standards clearly state that all students should experience quality science instruction rooted in authentic, inquiry-based experiences, specifically that "equity should pervade all aspects of science education" (National Research Council, 1996). With the current trends in academics having an emphasis on reading, writing and mathematics, science is often pushed to the side and only done in the elementary classroom, particularly the early elementary classroom, when there is time. This is happens even more in an inclusion classroom where there is multiple levels of special needs and disabilities. For teachers who try and make science an equal part of the curriculum, a lack of materials, adopted curricula, and background knowledge can provide obstacles and frustrations, which result in not teachers lowering the amount of time they teach science.

Teachers need to understand that there are simple ways, as well as complex ways, to modify lessons and experiments for students with special needs and disabilities so that the students are able to perform the expected tasks and can do so with the feeling of success. They also need to realize that a part of teaching is to provide all students with a fair and equal education and in order to do so they must modify lessons accordingly.

Video

Introduce the video to the teachers by telling them that they may have students with special needs/disabilities in their classroom and those students have the right to participate in all scientific activities. Inform them that this video will provide them with ways that they can modify lessons/activities for those students.

Video - *"Working Together: Science Teachers and Students with Disabilities"*
*(*This video is geared toward middle school-college science teachers)

Discussion of the video with small groups: *How can teachers in the K-3 inclusive classrooms adapt instruction for science? How can the experiment that the teachers did today be adapted for an inclusive classroom?*

Large group discussion sharing ideas for K-3 inclusive classroom adaptions

Return back to the small group. Each group will be given a situation that has a students with special needs/disabilities:

~Student with a Visual Impairment
~Student with a Learning Disability
~Student with a Mobile Disability
~Student with a Hearing Disability

Teachers will discuss ways that they could adjust the lesson for that student(s). Each small group will present the ways to the whole group and discuss any other possibilities for modifying the lesson for a student with those particular needs. Presenter will discuss how important it is to consider special needs when planning for science and how a teacher needs to have a variety of methods to conduct an experiment, record results, present results, and discuss further thinking. Some suggestions the presenter will give are:

~Students with a Visual Impairment: larger print, verbal descriptions

~Students with a Learning Disability: pictures, more time to conduct the experiments

~Students with a Mobile Disability: computers, lower counters to perform experiments

~Students with a Hearing Disability: computers, interpreter

Discussion of the Day and Wrap-Up

Discuss the Science Experiment and how lessons and experiments need to be modified in an inclusive classroom for students with special needs/disabilities from the examples given in the video.

Participant Assessment

Participants will be assessed several times during the presentation. One way they will be assessed will be during the large group discussions at the end of each section. How much they are answering questions within their small groups and within the whole group discussions will also be a way for the presenter to assess if they are learning from the presentation or if the presenter needs to modify the material they are presenting.

In segment one, after the teachers conduct the science experiment, they will be asked to come up with extensions for the lesson and other questions that they could ask their students. If they are able to come up with at least one extension or question for the lesson that has not been previously given by another participant, then it will be notes that they are able to expand upon the lesson and the students thinking. The second part of segment one discussed the definition of what is science and how does the definition relate to the experiment that the participants did. The participant is expected to give a logical reason why the experiment did or did not relate to the definition. If they are unable to give a logical reason, then it will be noted and further explanation will be given by the presenter so they are able to understand why or why not the lesson was considered science. The last part of the segment relates to science inquiry. If the participant is able to discuss with their group whether or not the experiment was science inquiry and give a verbal response to the large group, the presenter will make note of that. If they are unable to give a response, further explanation will be given by the presenter. Lastly, in segment one, the participant needs to tell if they think the definition of science fits in with science inquiry. If not, how can the definition be modified to do so?

In segment two, participants will watch a video and discuss ways to modify a lesson according to a given special need or disability. The participant will be assessed on whether or not they were able to come up with a way to modify the lesson according to the student's special need or disability. The presenter will record the responses. If a participant cannot give a response, whether it is correct or not, the presenter will further discuss ways that a teacher can modify a science lesson to meet all of the students in their classroom.

Participation and enthusiasm will greatly affect the way a participant is assessed. Correct answers are assessed as well, but effort is the key.

Resources

The Access Center: Improving Outcomes for All Students K-8. *Science Inquiry: The Link to Accessing the General Education Curriculum.* Retrieved from http://www.k8accesscenter.org/training_resources/ScienceInquiry_accesscurriculum.asp

Education Development Center (2003). *Insights: an elementary hands-on inquiry science curriculum: teacher's guide.* Retrieved from http://books.google.com

Science NetLinks. Retrieved from http://www.sciencenetlinks.com/lessons.php?BenchmarkID=4&DocID=164

Working Together: Science Teachers and Students with Disabilities. Video. Retrieved from http://www.washington.edu/doit/video/wt_sci.html

Day 2: Inquiry based learning

9:00-10:30	• Introduction and overview of the day • What is inquiry? • Inquiry Fact or Myth game • Why teach science through inquiry?
10:30-10:45	• Morning break
10:45-12:00	• Steps of the inquiry process • Small group work on types of inquiry
12:00-1:00	• Lunch break
1:00-2:30	• How do LD students benefit from inquiry based teaching? • Video http://www.youtube.com/watch?v=XEnrDXPxFo4&feature=related • Video discussion
2:30-2:45	• Afternoon break
2:45-3:30	• Supporting LD students and helping them to be successful through inquiry based learning.
3:30-4:00	• Conclusion

Presenter Notes

Segment 1
- Introduction and overview of the day
- What is inquiry?
- Inquiry Fact or Myth? game
- Why teach science through inquiry?
- Steps of the inquiry process
- Group work – types of inquiry

Objectives
- To understand what inquiry based learning and the inquiry process are.
- To understand the benefits of inquiry based teaching.

What is inquiry?

Ask participants for definitions of inquiry. State that there are many different definitions and share those below discussing briefly where they are from.

"Tell me and I forget, show me and I remember, involve me and I understand."

According to the National Science Education Standards:
"Inquiry is a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations." (Center for Science, Mathematics, and Engineering Education, 1996, p. 23)

"Inquiry helps us connect our prior understanding to new experiences, modify and accommodate our previously held beliefs and conceptual models, and construct new knowledge. In constructing newly formed knowledge, students are generally cycled back into the processes and pathways of inquiry with new questions and discrepancies to investigate." Exploratorium (1998). *Inquiry Descriptions.*

How children learn science should resemble what scientists do.

"The scientific process of active exploration by which we use critical, logical, and creative thinking skills to raise and engage in questions of personal interests." Exploratorium (1998). *Inquiry Descriptions.*

Fact or Myth game

Hand out index cards with the following statements to small groups. Have participants decide if they are facts or myths then share as a whole group and sharing below information.
Information from: Exploratorium (1998). *Inquiry Descriptions.*

Doing hands-on science is the same as doing inquiry. (MYTH)

Providing students with an opportunity to do hands-on science does not necessarily mean they are doing inquiry. Many science activities are very structured. They tell the students what questions to answer, what materials to use, and how to go about solving the questions or problems. In most cases, they even provide charts or tables to record the observations, measurements, or data. This type of cookbook activity provides step-by-step procedures and follows a linear path to a solution. Although most inquiry activities are hands-on, not all hands-on activities are inquiry oriented.

Inquiry is using the scientific method. (MYTH)
As stated by the AAAS (1993), doing inquiry does not necessarily imply following the steps of the scientific method. Inquiry uses the logic of problem solving that comes from the scientific method but does not necessarily use the delineated, specific steps of the scientific method. The scientific method does have a role in the inquiry-based process; however, there is more to inquiry than a sequential set of procedures.

Inquiry is unstructured and chaotic. (MYTH)
In some schools, the sign of a good teacher is one who keeps a classroom quiet and under control. Classroom management skills are essential for inquiry learning, but an active, child-centered classroom should not be equated with chaos or unstructured instruction.

Inquiry is asking students a lot of questions. (MYTH)
A common misconception held by science teachers is that inquiry teaching requires asking a lot of questions. They may have sat in many science classrooms where teachers fired off question after question. Asking a lot of questions does not necessarily make an inquiry lesson. In inquiry-centered classrooms, teachers provide open-ended experiences that lead students to raise their own questions and design investigations to answer them.

If I let my students do inquiry, I have to be ready to answer all the questions they raise. (MYTH)
This is a response of many teachers. Inquiry-based instruction does not just mean finding the right answers, it means seeking the right questions. As you become more confident in using inquiry, you will find yourself less a source of information and more a facilitator of learning. That does not mean that good inquiry teachers do not concern themselves with content. Understanding content and scientific concepts are fundamental to inquiry. Doing inquiry empowers the students to answer their own questions. The teacher becomes the guide and mentor for that process.

You can't assess inquiry-based learning. (MYTH)
Inquiry-based learning can be assessed like any other concept or topic in science. To assess student progress in inquiry-based learning, however, teachers need to use alternative methods of evaluation. For inquiry-based learning, popular objective-type multiple-choice questions do not adequately assess inquiry-based learning. Inquiry-based teachers often rely on portfolios, writing journal entries, self-evaluations, and rubrics in conjunction with objective-type questions to assess students' academic progress.

Inquiry and discovery learning date back to 350 BC. (FACT)
Those who have studied the history of science education know that questioning, discovery learning, and inquiry date back to the early days of the Greek scholar Socrates. The progressive education reformer John Dewey is credited as being one of the first American educators to stress the importance of discovery learning and inquiry (Dewey, 1900, 1902, 1916). In his early work, Dewey proposed that learning does not start and intelligence is not engaged until the learner is confronted

with a problematic situation. Inquiry was also the basis for several elementary science programs funded by the National Science Foundation in the mid-1960s. During this "golden age" of science education, programs such as Science—A Process Approach (SAPA), Elementary Science Study (ESS), and Science Curriculum Improvement Study (SCIS) were all based on the philosophy of integrating inquiry teaching and learning with science process skills.

Why teach science through inquiry?

Explain, drawing on information below:

Inquiry allows students to learn and experience science firsthand, by taking on the roles of scientists. Like scientists, students use the inquiry process to develop explanations from their observations (evidence) by integrating what they already know with what they have learned. They learn discrete science concepts and skills, and how to solve problems using practical approaches—the goal of science education.
Incorporating inquiry into science classrooms empowers students. They play an active role in their learning rather than the passive role commonly seen in traditional science classrooms. This self-empowerment positively affects students' perceptions about science. According to the Institute for Inquiry (2005), students doing inquiry-based science:

- View themselves as scientists in the process of learning
- Accept an "invitation to learn" and readily engage in the exploration process
- Plan and carry out investigations
- Communicate using a variety of methods
- Propose explanations and solutions and build a store of concepts
- Raise questions
- Use observations
- Critique their science practices

Opportunities to think and behave as scientists provide relevancy and credibility to students' understanding of science. They learn that it is appropriate to ask questions and seek answers. In addition, students learn the challenges and pitfalls of investigations. (The Access Center, 2007, p. 7)

"Discovery science is a major part of the curriculum, building on children's natural interest in the world. Science projects are experimental and exploratory and encourage active involvement of every child. The science program takes advantage of natural phenomena such as the outdoors, and the classroom includes many plants and pets for which the children may provide care daily. Through science projects and field trips, children learn to plan; to dictate and/or write their plans; to apply thinking skills such as hypothesizing, observing, experimenting, and verifying; and many science facts related to their experience." (NAEYC, 1988, p. 74)

Science teachers generally like the inquiry process because it targets the eight science process skills that all students are expected to master in science classrooms. These skills include: (a) make observations; (b) conduct experiments; (c) collaborate with others about investigations; (d) take measurements; (e) sort and classify (i.e., organisms, types of substances, etc.); (f) compare and contrast; (g) record findings; (h) analyze findings; and (i) share their results with others. To ensure that students develop these skills, science lessons often focus on a specific science process skill. For instance, students may spend an entire class period learning to classify different types of rocks.

Another science lesson may require students to analyze a graph depicting monarch butterfly migratory patterns. (The Access Center, 2007, 3)

According to the National Science Education Standards:
"Students in all grade levels and in every domain of science should have the opportunity to use scientific inquiry and develop the ability to think and act in ways associated with inquiry, including asking questions, planning and conducting investigations, using appropriate tools and techniques to gather data, thinking critically and logically about the relationships between evidence and explanations, constructing and analyzing alternative explanations, and communicating scientific arguments." (Center for Science, Mathematics, and Engineering Education, 1996, p. 105)

Inquiry based learning empowers students with the skills and knowledge to become independent thinkers and lifelong learners.

The process of inquiry not only enhances students' understanding of natural phenomena, but also develops students' science process skills. (The Access Center, 2007, p. 2)

-Morning Break-

Steps of the inquiry process

What is the scientific method? Have participants list steps aloud and I record.

Scientific Method
Question or problem
Hypothesis
Experiment
Record
Data analysis
Conclusion

List steps of inquiry process

Inquiry Process
Inquiry or problem
hypothesis
data collection and analysis
Conclusion and explanations

Explain difference between scientific method and inquiry process.

The inquiry process is a nonlinear variation of the scientific method. Composed of the same basic components, both scientific method and the inquiry process require students to conduct research investigations by formulating a question, developing a hypothesis, conducting an experiment, recording data, analyzing data, and drawing conclusions. (The Access Center, 2007, 2)

The major difference between the scientific method and the inquiry process is that the inquiry process provides more opportunities to move within and among the phases of the inquiry (problem-solving

process). Students can enter the inquiry process at any of the four phases. (The Access Center, 2007, 2)

Generally, students new to this process begin at the inquiry phase. They use teacher-guided questions and investigation protocols to develop their questions and inquiries. Students more familiar with the process are able to extend learning by beginning their inquiry at other phases. For example, these students may begin the process by reviewing data (data gathering phase I - hypothesis)—for example, a bar chart on weather patterns or population genetics—and then, based on the data, identifying a research question or inquiry for further investigation (inquiry phase - inquiry or problem). (The Access Center, 2007, 2)

Inquiry is an approach to learning that involves a process of exploring the natural or material world, that leads to asking questions and making discoveries in the search for new understandings. Inquiry, as it relates to science education, should mirror as closely as possible the enterprise of doing real science.

The inquiry process is driven by one's own curiosity, wonder, interest or passion to understand an observation or solve a problem.

The process begins when the learner notices something that intrigues, surprises, or stimulates a question - something that is new, or something that may not make sense in relationship to the learner's previous experience or current understanding.

The next step is to take action - through continued observing, raising questions, making predictions, testing hypotheses and creating theories and conceptual models.

The learner must find her or his own pathway through this process. It is rarely a linear progression, but rather more of a back and forth, or cyclical, series of events.

As the process unfolds, more observations and questions emerge, giving occasion for deeper interaction and relationship with the phenomena - and greater potential for further development of understanding.

Along the way, the inquirer collects and records data, makes representations of results and explanations, and draws upon other resources such as books, videos and the expertise or insights of others.

Making meaning from the experience requires reflection, conversations and comparison of findings with others, interpretation of data and observations, and the application of new conceptions to other contexts. All of this serves to help the learner construct new mental frameworks of the world.

Teaching science using the inquiry process requires a fundamental reexamination of the relationship between the teacher and the learner whereby the teacher becomes a facilitator or guide for the learner's own process of discovery and creating understanding of the world. (Exploratorium, 2011)

What is the role of science teachers in inquiry-based classrooms?

Teachers serve as "facilitators of learning" in inquiry-based classrooms, guiding students through the inquiry process. To foster this type of learning environment, teachers use three types of inquiry in science: structured, guided, and open (see Table 3). There is debate as to which type of inquiry is best. The general consensus is that any form of inquiry (structured, guided, or open) can be useful to students when taught appropriately and well.

*Structured inquir*y is the most teacher-centered of the three types of inquiry. This type of inquiry is commonly seen in science classrooms in the form of laboratory exercises. The teacher provides fairly structured procedures for the inquiry activity, and students carry out the investigations. Structured inquiry could be described as the most traditional approach to inquiry.
On the far side of the spectrum is *open inquiry*. This type of inquiry requires the least amount of teacher intervention and is student led. Students often work in groups and plan all phases of the investigations. This is the purest form of inquiry conducted in science classrooms (see Table 3).
Guided inquiry falls in the middle of the inquiry instructional spectrum. This approach is commonly used when students are asked to make tools or develop a process that results in a desired outcome. For example, a science teacher gives her seventh grade middle school students materials to create a rocket but no instructions for designing the rocket. The students must use their own knowledge and creativity to design the rocket so that it will launch properly, fly a certain distance, and land without becoming disassembled. The teacher provides the problem and materials and the students develop the rocket using their own scientific process or procedure.
Teachers and classrooms new to inquiry often begin with structured inquiry activities and transition to more open inquiry activities. Moving gradually from structured classrooms to open-inquiry classroom environments is often less overwhelming. Radical changes can be frustrating and upsetting to some students, particularly because inquiry-based classrooms are typically more student centered. Students in inquiry-based settings are more actively involved in their discovery and subsequently more responsible for their learning. Teachers using inquiry-based instruction play more of a "facilitator of learning" role than teachers in traditional settings. Teachers and students may need practice to get comfortable with learning experiences that require less guidance and fewer teacher interventions. (The Access Center, 2007, p. 4-5)

Group Work

Have participants break off into small groups, preferably new groups. Hand each group a card with explanation of one type of inquiry. Each group needs to come up with and share an example of their type of inquiry.
Make multiple copies of cards containing the following information.

- Structured- Teacher gives students problems to investigate during hands-on activities, as well as procedures and materials. Students must determine the outcome.
- Guided- Teacher gives students the problem or question and materials. Students have to determine the process and outcome.
- Open- Students determine the problem, investigation, procedure, and outcome.

-Lunch-

Segment 2

- How do LD students benefit from inquiry based teaching?
- Video http://www.youtube.com/watch?v=b133AGFclCY&NR=1
- Video discussion
- Supporting LD students and helping them to be successful through inquiry based learning.
- Conclusion

Objectives

- To understand the challenges that LD students may face when learning through inquiry.
- To understand how to support LD students and help them to be successful through inquiry based learning.

How do LD students benefit from inquiry based teaching?

Discuss below quotes and information along with their sources.

"Science is for all students**.** This principle is one of equity and excellence. Science in our schools must be for all students: All students, regardless of age, sex, cultural or ethnic background, disabilities, aspirations, or interest and motivation in science, should have the opportunity to attain high levels of scientific literacy." (Center for Science, Mathematics, and Engineering Education, 1996, p. 20)

According to NSES, "Given this diversity of student needs, experiences and backgrounds, and the goal that all students will achieve a common set of standards, schools must support high-quality, diverse, and varied opportunities to learn science" (NRC, 1996, p. 221). The ability to think creatively and critically is not solely for the high-achieving student. Inquiry-based instruction can and should be done equitably at all levels.

There is a small body of research on students with LD in an inquiry classroom. A study by Scruggs, Mastropieri, Bakken, and Brigham (1993) suggests that students with LD who learn through an inquiry-oriented approach, rather than through a textbook-based approach, perform better on unit tests. Bay, Staver, Bryan, and Hale (1992) compared the effectiveness of direct instruction and discovery teaching, where students were actively engaged in gathering data, generating and implementing solutions, and observing their consequences with the science achievement of students with mild disabilities and students without disabilities. The researchers found that students' retention after 2 weeks was higher for those who received discovery instruction. Results also indicated that students with learning disabilities who received discovery instruction outperformed students with learning disabilities who received direct instruction. Evidence also exists suggesting that this approach leads to higher achievement for students with learning disabilities than an activity-based approach alone (Dalton & Morocco, 1997).
Researchers have examined the characteristics of students with learning disabilities, and connections can be made between these characteristics and strategies that may help students access an inquiry-based curriculum. In addition, the student-centered nature of inquiry allows teachers the flexibility to tailor instruction to meet the diverse learning needs that students with LD bring to the classroom. (The Access Center, 2007, p. 8)

"Young children with disabilities are best served in classrooms where they are involved in science processes along with typically developing peers."(Ritz, 2007, p. xii)

"Every child regardless of gender and ability needs to have equal access to science experiences." (Ritz, 2007, p. xii)

"Science activities can often be door openers for children coping with learning challenges. The open-endedness, inquiry-based, student centered environment that is at the heart of rich science learning offers children to be themselves while exploring and learning science concepts." (Ritz, 2007, p. xxvii)

"Teachers who celebrate what children think, what they question, and what they wonder about are wonderful facilitators of all children, especially those with cognitive and socioemotional challenges." (Ritz, 2007, p. xxvii)

Video http://www.youtube.com/watch?v=XEnrDXPxFo4&feature=related

Tell participants they will be asked to share what they see and tell them to pay special attention to the students' enthusiasm.

Discussion of video in small groups, then quick sharing as large group.

What did you see?
Common practice with own classroom?
Different practice from own classroom?
Think individually, what could be challenging for a special needs student in your class?

-Afternoon Break-

Supporting LD students and helping them to be successful through inquiry based learning

Go through "Table 4 - Strategies to Support Students With Learning Disabilities During Phases of Inquiry" from The Access Center, US Office of Special Education Programs. (2007). Science *Inquiry: The Link to Accessing the General Education Curriculum.*

Discuss below:

Modify lessons in order to support exploration based on student's strengths. (Ritz, 2007, p. xxvii)

Make sure all lessons take into account the various ways of learning, increase the number of ways directions are given (verbal, written, images, sign language, Braille), modify ways children are asked to interact with one another. (Ritz, 2007, p. xxvii)

Allergies and Asthma – be aware of foods, plants, manufactured products. Have alternatives ready for these children such as wearing latex gloves, using alternative foods, eliminating cleaning products and odors from classroom, class pet without dander, plan outdoor activities taking into consideration environmental allergies, etc.
Vision impairment – Enlarge printed text and pictures
Physical disabilities – enlarge pathways, tables and materials easily accessible to all,
Cultural and linguistic special needs – use multiple languages, use pictures, encourage students to use language, drawing and manipulatives (Ritz, 2007, p. xxvii)

Conclusion
What did you learn that you plan to try in your classroom? Which form of support will you try for learning disabled students? Think individually then share and discuss in a small group. (5-7 people)

Resources

Center for Science, Mathematics, and Engineering Education. (1996). *National Science Education Standards.* Retrieved from: http://www.nap.edu/openbook.php?record_id=4962&page=23

Doris, Ellen. (1991). *Doing What Scientists Do – Children Learn to Investigate Their World.* Portsmouth, NH: Heinemann.
-Includes a wonderful bibliography with resources sorted into categories and summarized, including a section with books for teaching science to students with special needs.

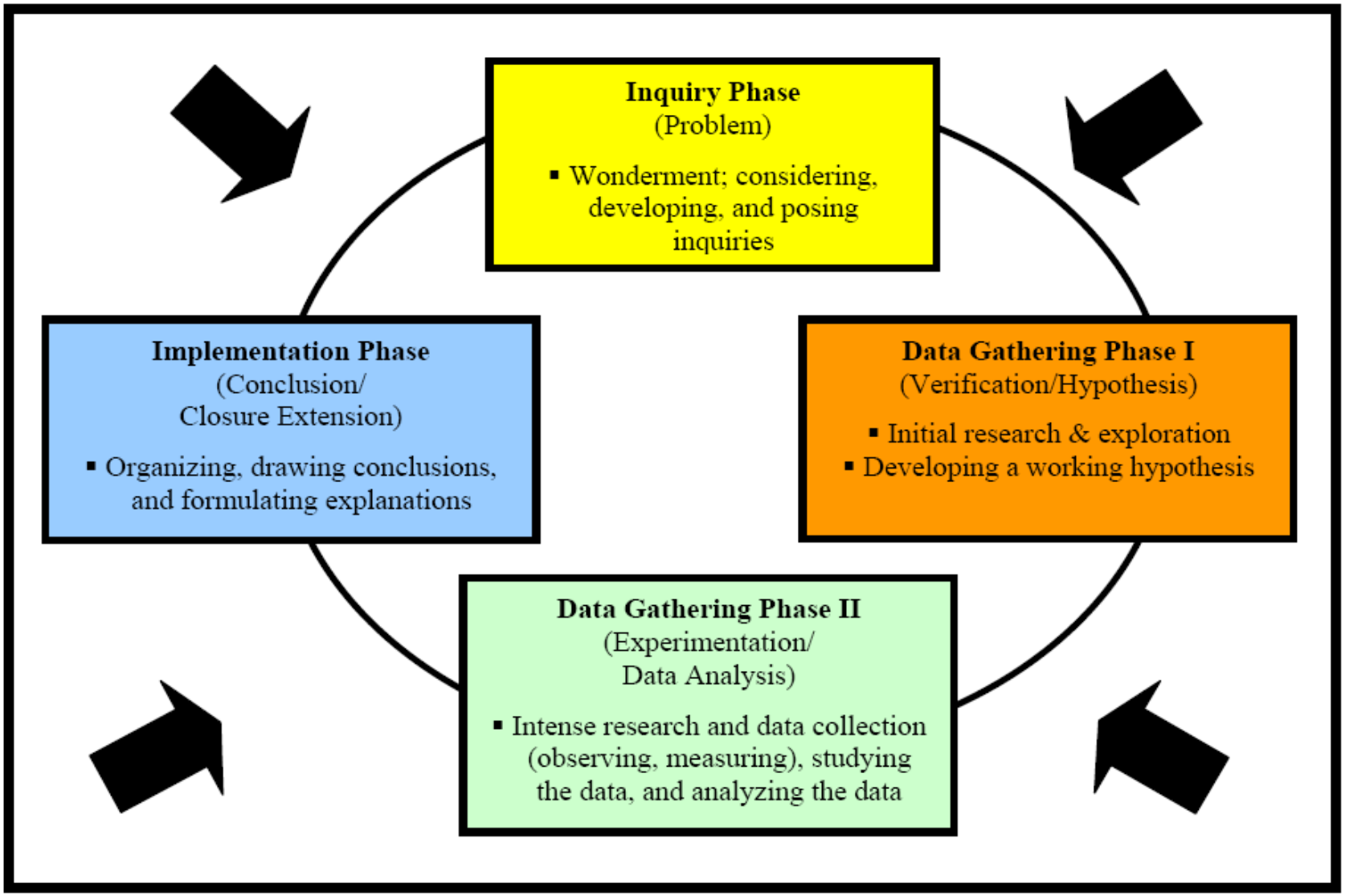
Exploratorium. (1998). *Inquiry Descriptions.* Available at: http://www.sagepub.com/upm-data/6833_llewellyn_ch_1.pdf

Exploratorium. (2011). www.exploratorium.edu

Ritz, William C. (Eds.). (2007). *A Head Start on Science – Encouraging a Sense of Wonder.* Arlington, VA: National Science Teachers Association.
-Includes a section describing how to face various disabilities in the science.

The Access Center, US Office of Special Education Programs. (2007). *Science Inquiry: The Link to Accessing the General Education Curriculum.* Retrieved from: http://www.k8accesscenter.org/training_resources/ScienceInquiry_accesscurriculum.asp

Handout 2


Inquiry Phase
(Problem)
▪ Wonderment; considering, developing, and posing inquiries
Data Gathering Phase I
(Verification/Hypothesis)
▪ Initial research & exploration
▪ Developing a working hypothesis
Data Gathering Phase II
(Experimentation/
Data Analysis)
▪ Intense research and data collection (observing, measuring), studying the data, and analyzing the data
Implementation Phase
(Conclusion/
Closure Extension)
▪ Organizing, drawing conclusions, and formulating explanations

"Table 4 - Strategies to Support Students With Learning Disabilities During Phases of Inquiry" from The Access Center, US Office of Special Education Programs. (2007). *Science Inquiry: The Link to Accessing the General Education Curriculum.* Retrieved from: http://www.k8accesscenter.org/training_resources/ScienceInquiry_accesscurriculum.asp

Day 3: Assessments in Science

"How will I know what they've learned?"

*Prior to Day 3, teachers will be asked to watch the video "Will this be on the test? The difference between knowing and understanding"

8:45-9:00	• Introduction and overview of the day
9:00 – 11:30	• Review of video • Read NSES Chapter 5 • Review of disabilities present in the classroom • Read and view Working Together Article by Sheryl Burgstahler, Ph.D
11:30 – 12:15	• Lunch break
12:15 – 1:45	• Constructing authentic assessment
1:45 - 2	• Afternoon break
2:00 – 2:30	• Create assessment for experiment from Day 1
2:30 – 3:00	• Evaluate assessments • Whole group discussion of assessments
3:00 – 3:45	• Create a lesson and assessment with differentiation and accommodations for special needs present in their classroom
3:45 – 4:00	• Discuss Assessments • Conclude

Segment 1

- Introduction and Overview
- Review of video
- Read NSES Chapter 5
- Review of disabilities present in the classroom
- Read and view Working Together Article by Sheryl Burgstahler, Ph.D

Objectives

- Teachers will use a variety of resources to learn about and gain an understanding of the function of assessments, possible accommodations to use in the classroom, and the role of assessment in science teaching

Overview

Now that we've discussed the definition of science and the inquiry process, it's time to devote some time to assessment and its role in the science classroom. In addition, we need to address how to develop assessments that will address the special needs of the students in the classroom.

Review of video

The first video which was assigned for homework at the end of day 2 addresses the need for teachers to distinguish between knowing science and understanding science. It is a video that helps teachers focus on assessing a student's understanding. This focus sets the stage for assessing student learning with special needs in mind. Teachers should focus on sharing the important points they gained from the video and be ready to use the knowledge to create assessments that measure understanding later on in the day.

Read and Discuss NSES chapter 5

From here, teachers use audio tapes and small group read alouds to read Chapter 5 of NSES. This chapter focuses on the role of assessment in the national science standards and also serves as a foundation for creating and using assessments in the science classroom. It will serve as a resource for teachers during the day's activities and later in their classrooms. Teachers should be ready to use this chapter as a basis for their classroom assessments.

Students with disabilities in the science classroom

Then, teachers will turn their attention to special needs students in their classroom. First, they'll make a list of the specific learning disabilities (or difficulties if there are no students with specific labels). Next, they'll view the video from the ANGEL website, entitled Working Together: Science Teachers and Students with Disabilities. Coupling this video with the article will help teachers see the possibilities that are available to create assessments with their needs in mind.

-Lunch Break-

Segment 2

- Constructing Assessments
- Assessments for Day 1 Experiment
- Review of Teacher Created Assessments

Objectives

- Teachers will use the plethora of resources acquired in segment 1 to create assessments that address different special needs that are present in their classrooms.

Constructing Assessment Video

After lunch, teachers delve right back into assessments with a professional development video to outline how to construct authentic assessments. In addition, this presentation includes information on the importance of including students in the assessment process. This video is the final informational presentation.

Creating an assessment

Now, it is time to assess whether teachers can use these resources to actually create an assessment that measures student understanding and includes the appropriate accommodations for the special needs present in their classroom. Teachers will focus on the experiment from day one when creating their assessment. In small groups, teacher will create an assessment that meets the above criteria. Then, each group will present their assessments to the whole group. Teachers will use their resources to question the assessments of others and defend their own assessment strategies during this group presentation.

Segment 3

- Program Assessment

Objectives

- Teachers will utilize their knowledge of assessments and accommodations to create a science lesson and assessment. This task should reflect an understanding of the definition of science, the inquiry process, possible accommodations, and authentic assessments.

Creating a Lesson and Assessment including appropriate accommodations

The final activity of Day 3 is an assessment for the full three day program. Teachers will work in small groups to create a lesson and assessment that not only fits within the inquiry model and definition of science presented in Day 1 and 2, but also addresses the needs of the special needs students in their classroom. Once complete, teachers are encouraged to share their lessons and assessments with the group for critique.

This assessment will allow teachers to demonstrate the ability to create lessons plans that reflect an understanding of the meaning of science. They will also be given the opportunity to create a lesson plan that addresses the needs of the students within the classroom by including accommodations and differentiated instruction. In addition, the creation of the lesson plan will also reflect the teachers' understanding of the inquiry process presented in the program. Finally, the assessment portion of the assignment will reflect the teachers' understanding of the assessment process and their ability to accommodate the special needs of the students in their classroom.

Conclusion

At the conclusion of the program, teachers will have a variety of resources to use in creating science lessons and constructing science assessments within the inclusive classroom. In addition, by incorporating small group work and whole group discussions during the three day professional development program, we are helping teachers create a professional learning community to support them in their future science teaching.

Resources

Burgstahler, S. (n.d.). Working Together: Science Teachers and Students with Disabilities. *University of Washington - washington.edu*. Retrieved April 11, 2011, from http://www.washington.edu/doit/Brochures/Academics/working.teachers.html

Discipline. (n.d.). Resource: Assessment in Math and Science: What's the Point? . *Learner.org*. Retrieved March 29, 2011, from http://www.learner.org/resources/series93.html#program_descriptions

National science education standards (4.print. ed.). (1996). Washington DC: National Academy Press.

Vandervelde, J. (n.d.). Rubrics for Assessment Online Professional Development - UW Stout, Wisconsin's Polytechnic University. *University of Wisconsin-Stout - UW Stout, Wisconsin's Polytechnic University*. Retrieved April 13, 2011, from http://www.uwstout.edu/soe/profdev/rubrics.cfm

Resources Kit

https://docs.google.com/leaf?id=0B95h-g8PjW72ZTc5ZGMxNWYtYjY5My00YTEzLWI0M2EtNDJmM2Y4NGMyZTI4&hl=en