Including Students with Disabilities in General Education Science Class

March 26, 2013
1:00p.m.
Today’s Objectives

- Review critical research findings to guide educators to design science instruction for all students
- Explore instructional design approaches that will promote inclusive practices
- Examine ways to integrate strategies that allow access to science curriculum for students
- Introduce a strategy and resource for collection of progress monitoring data

www.hdc.lsuhscl.edu
Among students receiving services under the Individuals With Disabilities Education Act (IDEA) in public schools, more than two thirds receive their science instruction in general education classrooms.

(National Center for Education Statistics, 2011).
Research concludes...

Students with disabilities benefit educationally and socially when they are educated with typical peers.

However.....

Designing and delivering instruction to students with disabilities in general education classes is challenging for practitioners.

Polychronis, et. al. (2004)
Shift from traditional textbook-based instruction in science to more of an inquiry-based approach leads to improved science education and increased inclusion for students with disabilities. Teachers are encouraged to adopt this innovative approach to science instruction.” The National Research Council (NRC, 1996)

The National Science Teachers Association encourages teachers to use inquiry-based and innovative instruction that focuses on learning for all students. The National Science Teachers Association (2011)
Inquiry-Based Instruction

Different meanings for different people...

Pure (Open) Inquiry
- No teacher feedback
- Students decide how to set up investigation
- Students determine problem to investigate

Structured (Guided) Inquiry
- Specific Feedback
- Teacher structures investigation
- Teacher creates problem for investigation

(NRC, 1996)
INQUIRY-BASED LEARNING
Consider the Comparisons ..... Which do you think would be most effective approach for educating students with disabilities?

**PURE (OPEN) INQUIRY**
- Student may become overwhelmed with information
- Students may have errors within the investigation/experiment
- Create misleading conclusions

**STRUCTURED (GUIDED) INQUIRY**
- Provides specific feedback
- Provides teacher directed learning
- Allows freedom for students to investigate and discuss while providing organization and supports
Most effective strategy for instructing students with disabilities

“A more structured inquiry approach that utilizes explicit enhancements has been found to be the most effective strategy for instructing students with disabilities.”

(Therrien, Taylor, Hosp, Kaldenberg, & Gorsh, 2011).

Structured (Guided) Inquiry

- Provides specific feedback
- Provides teacher directed learning
- Allows freedom for students to investigate and discuss while providing organization and supports
Common Components of Inquiry-Based learning

1. Students conduct investigations and experiments within lessons

2. Students inquire through problem solving and negotiation

3. Teachers extend student learning beyond a set level of standards
Designing Instruction using evidence based Practices

Content should be designed to:

Engage students

Provide opportunities for discovery and exploration.

Allow students opportunities to experience something in order to make sense of it

Scruggs et al. (2008)
Struggle to find ways of providing both functional instruction and ensuring that students with disabilities have access to the same curriculum as their peers.

Although a student’s curriculum does not have to be limited to grade-level standards, it must be linked to standards to be included as participation and progress towards Adequate Yearly Progress.

Ayers et al. (2011); Yell et al., (2005)
Educators must be familiar with state and national standards.

For example, National Science Education Standards (NSES)
Focus on scientific literacy.

The way to ensure that all students are successful in science is to focus on designing structured lessons based on experiential learning principles.

Therrien et al. (2011)

a shift from memorization and mastery of scientific content and facts

... to a more general understanding of scientific knowledge

DeBoer (2000); NRC (2000)
Adapt to Incorporate Individual targets

To meet the unique needs of the child which result from the child’s disability; and to ensure access to the general education curriculum ....IEPs serve to “adapt”

- Content
- Methodology
- Delivery of instruction

(34 C.F.R. § 300.39[3])
Approach to Instruction

Curricular - We change WHAT we teach
A *curricular approach* treats thinking skills as an explicit curriculum and it demands we develop new content and teach new lessons.

Instructional - We can change HOW we teach.
The *instructional approach* treats thinking skills as a process and it demands we teach existing content and lessons using instructional strategies that foster thinking.
Universal Design means PROVIDE...

Multiple Means of Representation
LAQI 21
In general education settings, the teacher provides all students various ways of acquiring information and knowledge (e.g., auditory, visually, through text, etc.).

Multiple Means of Engagement:
LAQI 22
In general education settings, the teacher promotes student engagement by using student areas of interest, offering choice in activity, providing reinforcement (e.g., UDL).

Multiple Means of Expression
LAQI 20
The teacher provides all students alternatives for demonstrating what they know. (e.g., presentations, visual displays, pen/paper activities, etc.)
Figure 1. Standard instructional delivery components essential to all explicit instructional episodes (Hall, 2002).
What Individualization is Needed?

Students with disabilities

- Often have skill challenges in the areas of **Social**, **Communication**, and **Behavior**
- Students may tend to have difficulty with inductive and deductive thinking skills, these skills are associated with scientific reasoning
- Independent reading levels are often below grade level
- Have limited knowledge of independent study strategies
- Require explicit instruction on how to study and review for tests and quizzes.
- They need significant practice, repetition, feedback, and reinforcement in order to retain information and generalize skills and concepts

Mastropieri, Scruggs, Boon, & Carter (2001)
Cawley, Parmar, Foley, Salmon, & Roy (2001)
Selecting Individualized Targets

- Identify skills that facilitate the participation of the student with disabilities in routine daily activities with typically developing children (LAQI 9);

- Identify skills that build upon the student’s strengths and interests (LAQI 22);

- Identify skills that will increase opportunities to participate in future activities (LAQI 30, 40, 67)
How can teaching strategies be developed that will allow students with disabilities to receive effective, individualized instruction that fits the typical organizational structures of general education classes and instructional routines?
Teachers can blend science curriculum with IEP goals

For example, address individualized Social skill instruction ...

- Student can use scientific information to make daily choices
- Engage student in discussions about issues related to science and technology
- Create opportunities for sharing and expression through personal enjoyment and excitement of understanding the natural world
- Challenge student to undertake activities that increase in skill requirements
  - reasoning
  - thinking
  - creativity
  - decision making
  - problem solving

(DeBoer, 2000; NRC)
## Embedding *Into* Activities/Routines

Instruction that occurs within on-going naturally occurring activities or routines without breaking the flow of the routine

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Functional Skills</th>
<th>National Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finding the Factor: Ultra Violet (UV) Protection and Solar Energy</td>
<td>- Hygiene skills&lt;br&gt;- Fine motor skills&lt;br&gt;- Purchasing skills&lt;br&gt;- Comparison skills&lt;br&gt;- Writing skills&lt;br&gt;- Weather identification skills&lt;br&gt;- Communication skills&lt;br&gt;- Cleaning skills</td>
<td>Earth and Space Science:&lt;br&gt;- Energy in the Earth System (9-12)&lt;br&gt;- Physical Science:&lt;br&gt;- Matter, energy, and organization of in living systems (9-12)</td>
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<td>Science in Personal and Social Perspectives:&lt;br&gt;- Personal Health (all grades)&lt;br&gt;- Natural Hazards (all grades)&lt;br&gt;- Nature of Scientific Knowledge (9-12)</td>
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<td></td>
<td>Science as Inquiry:&lt;br&gt;- Abilities necessary to do scientific inquiry (all grades)&lt;br&gt;- Understanding about scientific inquiry (all grades)</td>
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<td>Writing: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information</td>
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<tr>
<td>Brushing Teeth Investigations</td>
<td>- Oral hygiene&lt;br&gt;- Problem solving&lt;br&gt;- Fine and gross motor skills&lt;br&gt;- Purchasing skills&lt;br&gt;- Domestic skills (cooking, cleaning up)</td>
<td>Physical Science: Properties of Objects and Materials (9-12)</td>
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<td></td>
<td></td>
<td>Science in Personal and Social Perspectives: Personal and community health (9-12)</td>
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<td></td>
<td>Science and Technology:&lt;br&gt;- Understanding Science and Technology (All grades)&lt;br&gt;- Technology Design (All grades)</td>
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<td></td>
<td></td>
<td>Language Arts: Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes.</td>
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<tr>
<td></td>
<td></td>
<td>Language Arts: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade’s topics and texts, building on others’ ideas and expressing their own clearly.</td>
</tr>
<tr>
<td>Cooking up Science from the Past: Fossils</td>
<td>- Cooking skills&lt;br&gt;- Procedural skills&lt;br&gt;- Measuring skills&lt;br&gt;- Fine motor skills&lt;br&gt;- Cleaning skills</td>
<td>Live Sciences:&lt;br&gt;- Interdependence of Organisms (9-12)&lt;br&gt;- Behavior of Organisms (9-12)&lt;br&gt;- Biological Evolution (9-12)</td>
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<td></td>
<td></td>
<td>Physical Science:&lt;br&gt;- Properties and changes of matter (9-12)</td>
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<td></td>
<td>Mathematics: Know relative sizes of measurement units within one system of units</td>
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<td>Unifying Concepts and Processes:&lt;br&gt;- Change consistency and measurement (All grades)</td>
</tr>
</tbody>
</table>

Scaffolding

Scaffolds can be viewed as bridges that support the learner:

- Determine the learner understanding and knowledge of topic
- Determine what support is needed

WHERE THE LEARNER IS \textarrow{\rightarrow} WHERE THE LEARNER NEEDS TO BE
By providing just the right level of support, students can move from their current understanding to higher levels of understanding (Vygotsky, 1978).

What Essential Knowledge:

- How do substances combine or change (react) to make new substances?
- How does a scientist characterize and explain these reactions and make predictions about them?

Build the Scaffolding for Students:

- Building on prior knowledge
- Experience: students need a concrete experience that does not involve a color change—this is often mistaken for “chemical change.”
- Cooperative learning strategies
- Graphic organizers
Ask yourselves these questions to help determine if you have a chemical change:

<table>
<thead>
<tr>
<th>Question</th>
<th>What You Might Have Observed</th>
<th>What Is Going On</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did you see the production of a gas?</td>
<td>Bubbles from mixing</td>
<td>The gas is a product formed from the two substances reacting.</td>
</tr>
<tr>
<td>Did you feel or collect a temperature change?</td>
<td>The container got warm or if a temperature probe was used there was a change in reading.</td>
<td>Chemical energy is being released (in the form of heat) or being removed (cold)</td>
</tr>
<tr>
<td>Did you see a precipitate form?</td>
<td>Clear liquid would become cloudy. In the case of two liquids, a solid suddenly formed.</td>
<td>Two things come together to make something that is not able to be dissolved in the liquid.</td>
</tr>
<tr>
<td>Did you see a color change?</td>
<td>Color appears when two colorless liquids were mixed or colored materials become colorless or one color changes to another.</td>
<td>Materials are combining in such a way that it affects how much energy it takes to move electrons around.</td>
</tr>
</tbody>
</table>

*Note.* Not the best indicator.
Sort Clothes
This activity includes vocabulary and a sorting board. Get the student to sort clothes based on weather. Some clothes can be worn in cold or warm weather. You may wish to limit vocabulary for a beginning student.
Strategy instruction is well supported by research.

Some examples are:

**Teaching students self-monitoring and self-regulation**
- self-scoring problems
- charting daily scores
- setting goals
- monitoring progress

**Self-questioning** (asking, “Does this make sense?”)

**Main idea and summarization strategies**

**Repetitive reading**

**Mnemonics** (highly effective devices for helping students recall difficult-to-remember facts)

(Santangelo, Harris, & Graham, 2008)
Provide opportunities to Experience Learning

<table>
<thead>
<tr>
<th>Function</th>
<th>Selected Structures</th>
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<tbody>
<tr>
<td>Set</td>
<td>Mix-Pair-Share</td>
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<td></td>
<td>Single RoundRobin</td>
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<td></td>
<td>Continuous RoundRobin</td>
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<tr>
<td>Processing</td>
<td>RallyRobin</td>
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<tr>
<td></td>
<td>Timed Pair Share</td>
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<tr>
<td></td>
<td>RoundRobin</td>
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<tr>
<td>Teambuilding</td>
<td>Team Interview</td>
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<td></td>
<td>Three-Step Interview</td>
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<td>Classbuilding</td>
<td>Corners</td>
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<td></td>
<td>Similarity Groups</td>
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<tr>
<td>Peer Tutoring</td>
<td>Team Pair Solo</td>
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<td></td>
<td>Numbered Heads Together</td>
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<tr>
<td></td>
<td>Jigsaw</td>
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<td></td>
<td>Sage-N-Scribe</td>
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<tr>
<td>Authentic Assessment</td>
<td>RallyTable</td>
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<tr>
<td></td>
<td>Instant Star</td>
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<td></td>
<td>Show Me</td>
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<td></td>
<td>One Stray</td>
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<tr>
<td>Review</td>
<td>Pairs Compare</td>
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<tr>
<td></td>
<td>AllWrite RoundRobin</td>
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<td></td>
<td>Trade-a-Problem</td>
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<td></td>
<td>Stir-the-Class</td>
</tr>
<tr>
<td>Closure</td>
<td>RallyTable</td>
</tr>
<tr>
<td></td>
<td>Dueling Flipcharts</td>
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<tr>
<td></td>
<td>Mix-Music-Meet</td>
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<td></td>
<td>Give One, Get One</td>
</tr>
</tbody>
</table>

(Kagan, 2002)

http://www.kaganonline.com/index.php
Cooperative Learning

• Small teams
• Different levels of ability
• Variety of learning activities
• Role responsibility
Examples of Cooperative Learning

- Group Investigations
- Student Teams - Achievement Divisions
- Jigsaw II

http://artofteachingscience.org
What do these approaches look like?

**GROUP INVESTIGATIONS**

- Learning teams are formed
  - New unit or chapter
    - Identify topics
      - Coordinator, Resource x 2, Recorder
  - Learning team
    - Team project
  - Learning team
    - Team project
  - Learning team
    - Team project

**STUDENT TEAMS-ACHIEVEMENT DIVISION**

- Team study
  - Individual test
  - Team Recognition
  - Individual test
  - Team Recognition
  - Individual test
  - Team Recognition
Students are assigned to work in main idea or focus groups related to the content. In this group the goal is to discover and record information about the specific topic -- becoming an "expert". Then they will share that knowledge with others.

When students return to home group the expert members share and develop together to create a project that reflects the unit summary.
Supports within Cooperative Learning

**Computer aided instruction** - use of computers to teach academic skills and to promote communication and language development and skills

**Peer Mediated Instruction and Intervention** - peers are systematically taught ways of engaging learners with ASD in social interactions in both teacher-directed and learner-initiated activities

**Reinforcement** - Positive reinforcement refers to the presentation of a reinforcer after a learner uses a target skill/behavior

**Self-management** - taught to discriminate between appropriate and inappropriate behaviors, accurately monitor and record their own behaviors, and reward themselves for behaving appropriately

http://autismpdc.fpg.unc.edu/content/briefs
Task analysis - process of breaking a skill into smaller, more manageable steps

Visual supports – any tool visually represented, such as pictures, written words, objects within the environment, arrangement of the environment or visual boundaries, schedules, maps, labels, organization systems, timelines, and scripts
Materials Adaptation

The Periodic Table of the Elements, in Pictures

Name________________________
Number__________

1. Locate the following pictures and highlight them on the periodic table, then write the name and symbol for each element.

1. balloons _________
2. trumpet(horn) ______________
3. sun ________________
4. clouds and sky ______________
5. a weight - dumbbell _________
6. thermometer ______________
7. bulldozer ________________
Asking a Question

Sometimes I have questions during science class.

I might be wondering about group work or maybe I just have a question about life.

When I ask questions, I try to get the person’s attention by making eye contact and saying his or her name. I try to speak loud enough for people to hear me.

If I mumble or speak too softly, my question may not be heard by people.

Sometimes when I ask a question, people may not answer me. It might be that they did not hear me.

It is okay to ask questions. New questions are better than questions that have been asked and answered many times.

If there is something I don’t know, I can ask a question and I will learn the answer. Sometimes I might not like the answer. Many people ask questions and get answers they do not like. Sometimes I will like the answer.

Questions are important. Without questions we could not have answers. And answers, whether we like them or not, can be quite helpful.
<table>
<thead>
<tr>
<th>Co-Teaching Approach</th>
<th>Class Design</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Teach/One Support</td>
<td>Whole class</td>
<td>One teacher leads instruction in front of the class while the other provides purposeful support (e.g. classroom management, setting up labs). Both are actively engaged.</td>
</tr>
<tr>
<td>Team teaching</td>
<td>Whole class</td>
<td>Both teachers work together in providing instruction at head of class. Examples might be role-playing, modeling note-taking, or debates.</td>
</tr>
<tr>
<td>Parallel teaching</td>
<td>Regrouping</td>
<td>The class is split in half in order to reduce student: teacher ratio. Each teacher provides instruction which can occur in the same or different setting with same or different content present in the same or different ways.</td>
</tr>
<tr>
<td>Co-Teaching Approaches</td>
<td>Class Design</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Station teaching</td>
<td>Regrouping</td>
<td>Three or more groups of students rotate through centers or stations. Teachers either facilitate at centers or circulate among all centers.</td>
</tr>
<tr>
<td>Alternative teaching</td>
<td>Regrouping</td>
<td>One teacher works with a larger group of students while the other provides a smaller group reteaching or enrichment. New instruction is not presented to larger group during this time and smaller group rejoins when finished.</td>
</tr>
</tbody>
</table>
Progress monitoring is a formative process to assess student academic performance and evaluate the effectiveness of instruction.

(National Center on Response to Intervention [NCRTI], 2010).

Progress Monitoring

Challenge

Variable content

Variable probes

Solution

Key word vocabulary
1. **Identify key words by unit and cross-referencing with state standards and end of course exams.**
   - May be available as electronic files from text publisher
   - Can be done over course of year in prep for next year
   - Collaborate with other teachers to divide and share probes

2. **Create fill-in-the-blank database.**

3. **Randomly select 15-20 questions from database.**

The Science Key Vocabulary Assessment (SKeVA) is a free online progress monitoring system with over 2,000 validated items.
Progress Monitoring Example

Test summary bar graph example
Provide Meaningful Outcomes

Teachers need to know how to:

- Provide functional experiences.
- Integrate content through inquiry approaches.
- Incorporate standards through authentic application.
- Introduce science content throughout the functional curriculum

A balanced curriculum promotes meaningful outcomes and a higher quality of life post-school.

(Ayers et al., 2011)
Science Resources for Educators

http://www.pbs.org/teachers/stem/

http://skeva.tamu.edu/index.php

http://BSCS.org

http://artofteachingscience.org

http://www.kaganonline.com/index.php
QUESTIONS?

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