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Best Practices for Inclusive Science Instruction

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Best Practices for Inclusive Science Instruction

Jenny Sue Flannagan, Ed.D.
Regent University

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Liberty University

Getting to know you

- Participant inventory
  - Teaching background
  - Reason for attending session

Significance of this session

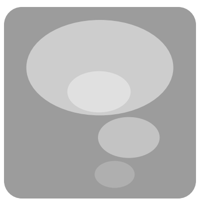
- Only 6% of students with disabilities are at or above levels of proficiency in writing (Nation's Report Card: Writing, 2007)
- Science instruction is often secondary to improving literacy and math skills (Scruggs, Mastropieri, Okolo, 2008)
- However, NCLB (2001) and IDEA (2004) stipulate that students with disabilities must have access to the general education curriculum, and hold schools responsible for assessment.
- But most importantly . . .

The **opportunity** to learn!

Basic skills versus content area instruction for students with disabilities: Is there time for both?

- We will demonstrate that through (a) *successful collaboration*, (b) *effective planning*, and (c) using *research based instructional strategies*, general education and special education teachers can facilitate the acquisition of science skills and knowledge while also teaching and reinforcing literacy skills.

Essential Questions for Today's Session



- How can special education and general education teachers *collaborate* to effectively include students with disabilities in the general education curriculum?
- How can teachers *effectively plan* to ensure all students succeed in science?
- What are *research based best practices* for teaching science?
- How can teachers *reinforce literacy skills* in science and *integrate science concepts* across the curriculum?

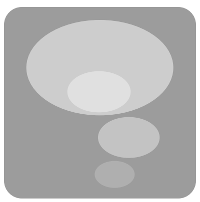
K-U-D for Session

- **Know**
  - Strategies for including students with LD in the general education science curriculum
- **Understand**
  - What the research says about effective instructional practices
- **Do**
  - Develop lessons that are based on best practices so *all* children learn science

Part 1: Successful Collaboration

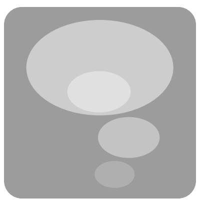
- Collaborative Teaming:
  - “Two or more people working together toward a common goal” (Snell & Jannney, 2000, p. 3)

Characteristics of collaborative teaming:



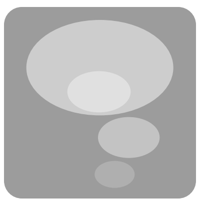
- Collaboration
  - is based on mutual goals
  - Requires parity among participants
  - Depends on shared responsibility for participation and decision-making
  - Requires shared responsibility for outcomes
  - Requires that participants share their resources
  - Is a voluntary relationship

Collaborative teaching strategies:



- Complementary instruction
- Team teaching
- Supportive learning activities
- Parallel teaching
- Alternative teaching
- Station teaching

Part 2: Effective Planning



- "An ongoing challenge for inclusive classroom teachers is meeting the instructional needs of all learners, especially when content is challenging and when students are diverse" (Mastropieri, Scruggs, Boon, & Carter, 2006, p. 136).

Research on inclusion

- "evidence from inclusive classroom ecologies suggests that individualized instruction for students with disabilities is infrequent and often provides more to accommodate teachers than learners" (Crockett & Kauffman, 1999, p. 148)
- Summarizing a meta-analysis (Kavale &Forness, 2000) on inclusion:
  - The inclusion classroom is generally viewed as "a setting essentially devoid of special education" (p. 283).
  - "Given the magnitude of associated effects, it was evident that placement per se had only a modest influence on outcomes" (p. 282).

Inclusion

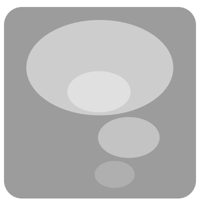
- Simply placing students with special needs in a general education setting *is not* inclusion.
- Inclusion is *educating* students with special needs in a general education setting.

Backward Design
(Wiggins & McTighe, 2006)

- 1) Identify learners
- 2) Identify curricular priorities
- 3) Design assessment framework
- 4) Create learning activities

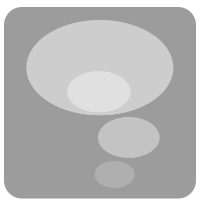
(See also Childre, Sands, & Pope, 2009)

1) Identify learners



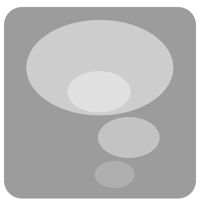
- Identify classroom needs
  - Socioeconomic level
  - Prior experience
  - Percentage of students with disabilities
- Identify individual student needs
  - IEPs
  - Learner interest inventories
  - Student records
  - Observation
  - Other sources?

Characteristics of students with LD:



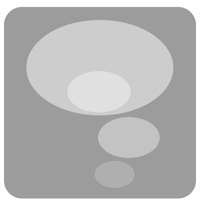
- Difficulty with inductive and deductive thinking skills (which are associated with scientific reasoning)
- Often reading below grade level (and therefore below the level of the textbook)
- Require significant practice, repetition, feedback, and reinforcement
- Limited independent study strategies
- Other characteristics?

2) Identify curricular priorities



- State and local standards:
  - "The standards serve as the learning goals that will shape the instructional unit" (Childre, Sands, & Pope, 2009, p. 8)
- Create essential questions
- Asses prior knowledge and skills

3) Design assessment framework

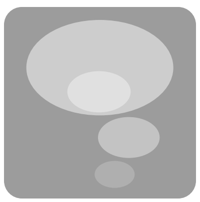


- Performance tasks or projects
- Oral or written prompts
- Tests or quizzes
- Informal assessments
  - Observations
  - Activities
  - Discussions
  - Questions

4) Create learning activities

- Design and sequence learning activities
- Check for integration of accommodations

A final point about *Backward Design*



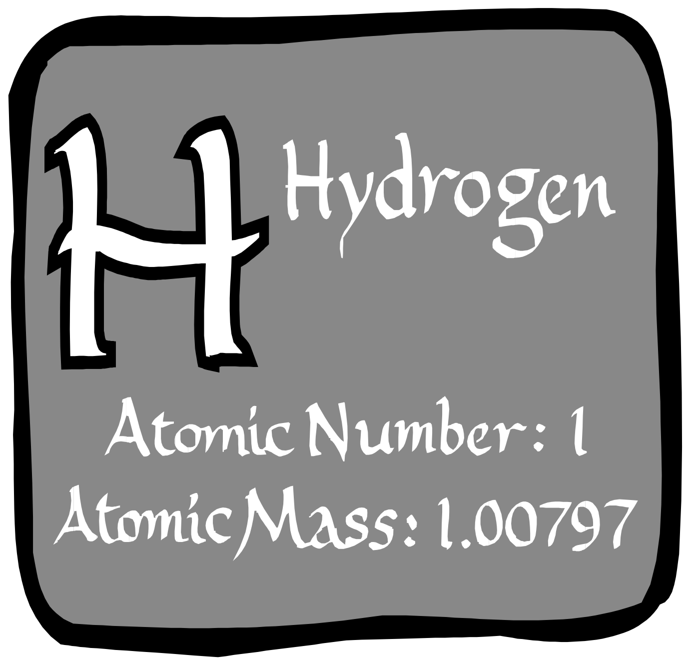
- “The process is not completely linear. Once you have the general framework for the information generated from the steps, you may find that it is necessary to move back and forth within the steps as you further conceptualize your instructional unit” (Childre, Sands, & Pope, 2009, p. 10)

Part 3: Research based instructional strategies

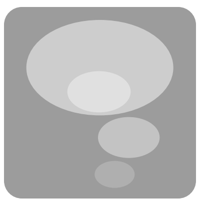
LET'S DO SOME SCIENCE!

(*Backward Design* Step 4: Create Learning Activities)

Establishing Learning Partners



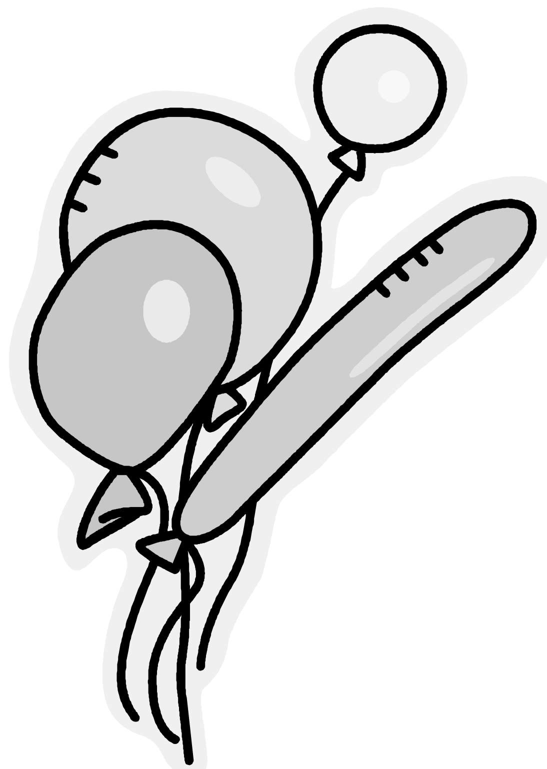
Is it Magic or Science?

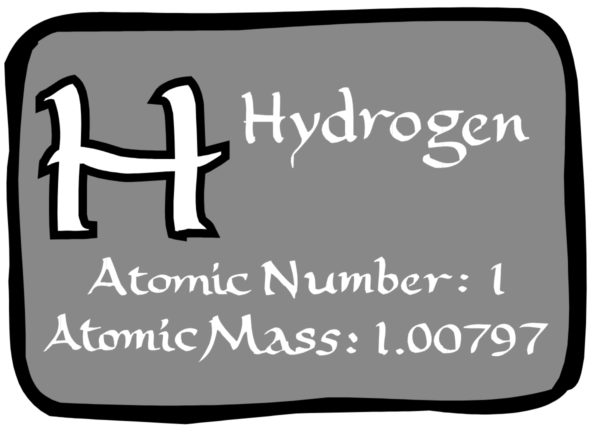


- Question: What happens when the magical fish is put in your hand?

Can you make water stay in a bottle?

How many breaths does it take to blow up a balloon?





Discussion

Discuss with your partner what you learned from the activities we did. Do you think the "activities" were effective?

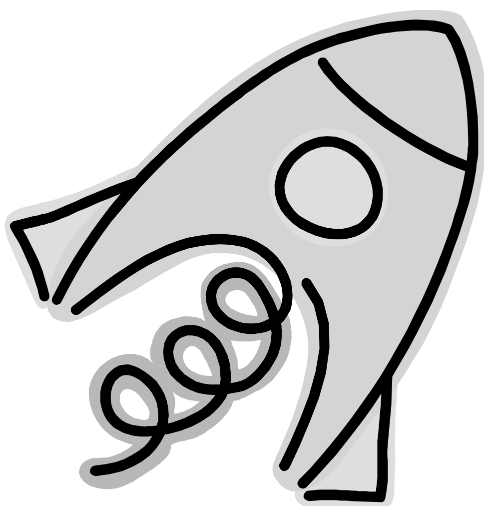
- "Learning should be driven by student efforts to answer essential questions and problems posed through unit activities and assessments. . . .This overall approach to learning activities moves students out of passive roles into active learning roles more supportive of learning for students with disabilities, because learning is hands-on and meaningful" (Childre, Sands, & Pope, 2009, p. 10).

How Children Learn Science

- Children come to the classroom with preconceptions about how the world works.
  - May learn for test-but revert back to old ideas

Adapted from National Research Council. (2005) How students learn: Science in the classroom. National Academy Press: Washington D.C.

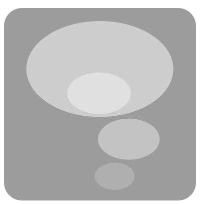
How Children Learn Science



- To develop competence:
  - Deep understanding of factual knowledge
  - Create connections between facts/ideas to concepts
  - Organize knowledge to retrieve it/apply it

Adapted from National Research Council. (2005) How students learn: Science in the classroom. National Academy Press: Washington D.C.

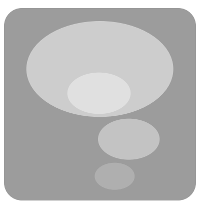
#1: Prior Knowledge and Experiences



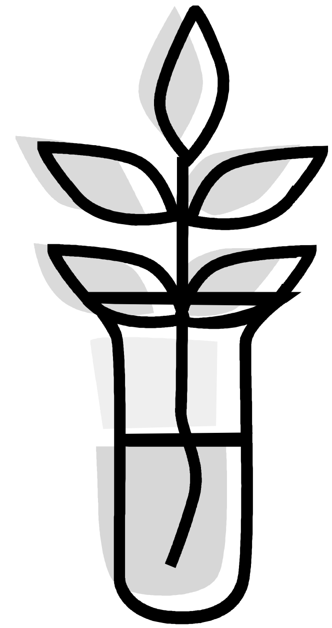
- New understandings are constructed on a foundation of existing understandings and experience

Adapted from National Research Council. (2005) How students learn: Science in the classroom. National Academy Press: Washington D.C.

#2: Big Ideas or Facts?

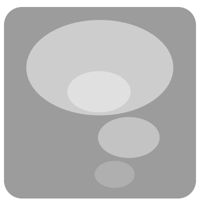


- Students need both!



Adapted from National Research Council. (2005) How students learn: Science in the classroom. National Academy Press: Washington D.C.

#3: Learning to Learn



- We need to help students to become *independent* thinkers and learners

Adapted from National Research Council. (2005) How students learn: Science in the classroom. National Academy Press: Washington D.C.

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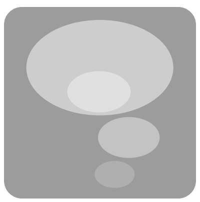

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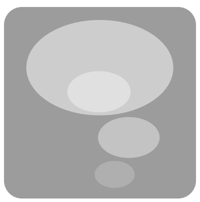
Gobstoppers

1) Turn to your shoulder partner.
What do you know about gobstoppers?

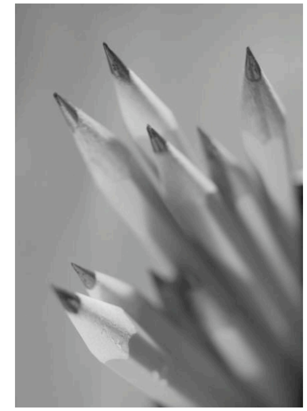
2) How could we make sure gobstoppers change colors?

Let's Write



- Connections:
  - It reminds me of ________________ because_____________________.

Let's Write



Cause and Effect

- When I ______________________, it _________________.

Curiosity and Questions:

- I am curious about __________________ or
- It surprised me that ________________ because ____________________.
- I wonder what would happen if ______________?

Question 1:

What does ________________________ do? How does it act?

Modified from Cothron, Giese, & Rezba, 2000, p. 28

Question 2:

What materials are readily available for conducting an experiment on__________________________?

Modified from Cothron, Giese, & Rezba, 2000, p. 28

Question 3:

How can we change the set of ________________
materials to affect what the gobstopper does?

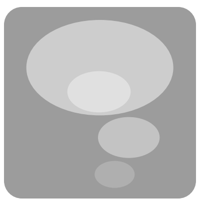
Modified from Cothron, Giese, & Rezba, 2000, p. 28

Question 4:

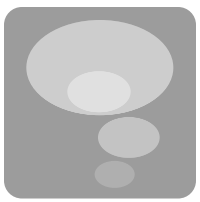
How can I measure or describe the *response* of ________________ to the change?

Modified from Cothron, Giese, & Rezba, 2000, p. 28

Directions



- Place a Gobstopper® in a container of water.
- **Observe:** Observe the Gobstopper® and water. Record what happens.



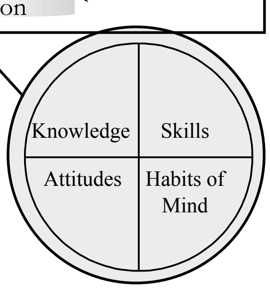
4 Question Strategy

- Tool to use to help students "think" through the design process to come up with a testable question
- Allows students to brainstorm additional ideas for experiments
- Can start anywhere in the process

Ascending Intellectual Demand: Experimentation

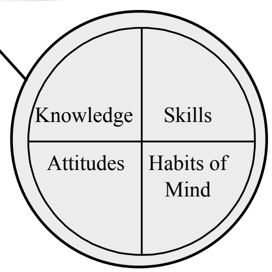
Novice

- Learner does not know how to pose a scientifically testable question
- Learner has trouble formulating and recognizing that a hypothesis reflects a cause and effect relationship
- Learner sees a disproved hypothesis as a failure
- Learner inadvertently includes and fails to manage multiple variables
- Learner does not know how to collect or analyze data
- Learner does not see the value in creating repeated trials
- Learner does not know what tools to use to collect evidence
- Learner does not know the difference between opinion and evidence
- Learner does not know how to plan for the collection of evidence
- Learner has trouble formulating and communicating an explanation



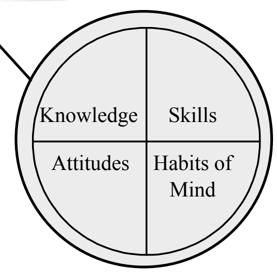
Apprentice

- Learner uses existing scientific questions for research and experimentation
- Learner develops hypothesis that are cause and effect statements
- Learner manipulates one variable within an experiment with ease.
- Learner understands, identifies, and analyzes the relationship among the independent and dependent variables, constants, and controls
- Learner understands that repeated trials increases accuracy
- Learner uses pre-made charts to collect data; can do a general analysis of data
- Learner understands what constitutes evidence and can identify the appropriate tool to extend and enhance collection
- Learner does not always verify the accuracy of evidence
- Learner formulates explanation from observational evidence



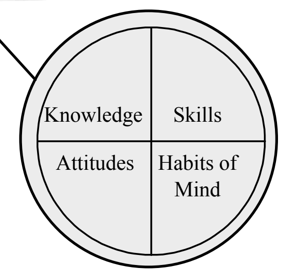
Practitioner

- Learner poses new scientific questions
- Learner develop hypothesis statements that reflect relationships and specifically articulate what is believed might occur
- Learner effectively manipulates multiple variables within an experiment
- Learner plans for and observes a wide range of factors (variables, constants, controls) and discerns patters
- Learner is able to create and design simple data tables
- Learner is able to formulate explanation from observational and other relevant sources



Expert

- Learner poses original scientific questions that test the limits of existing body of knowledge
- Learner develops hypothesis statements with ease
- Learner selects appropriate tools with ease and fluidity
- Learner designs specific data collecting
- Learner analyzes evidence and independently examines other resources in order to form the link to explanations
- Learner forms reasonable and logical argument to communicate explanations



Hedrick & Flannagan, 2006

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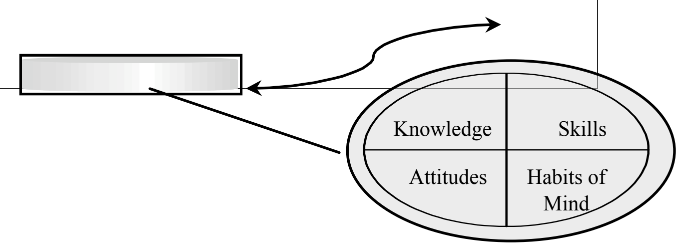

"The rung of a ladder was never meant to rest upon, but only to hold a man's foot long enough to enable him to put the other somewhat higher."

~Thomas Henry Huxley

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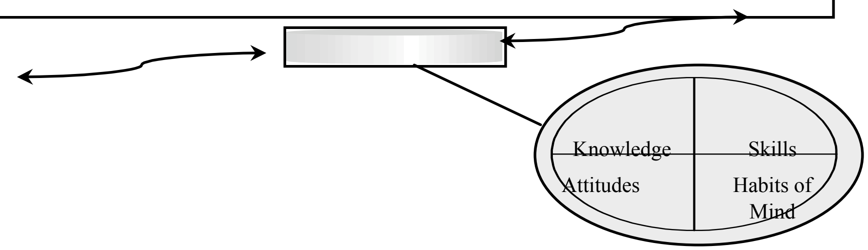

Hedrick & Flannagan 2006

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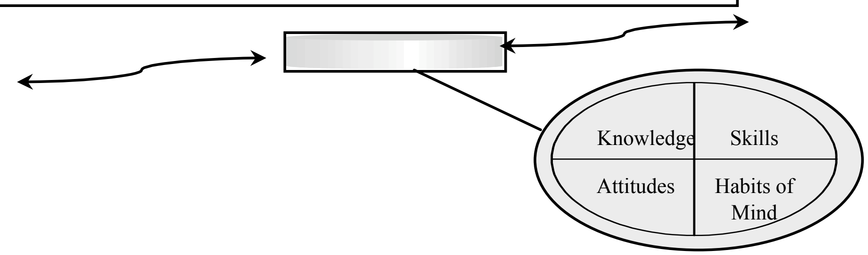

Hedrick & Flannagan 2006

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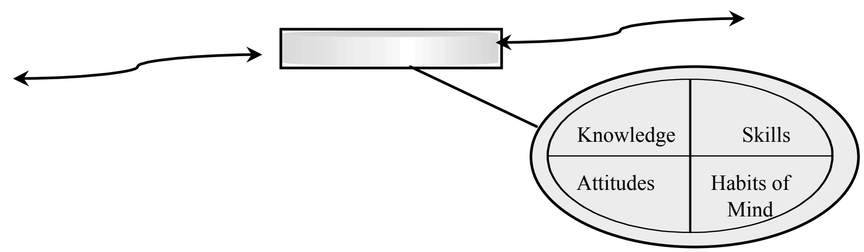
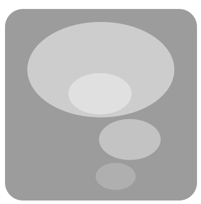
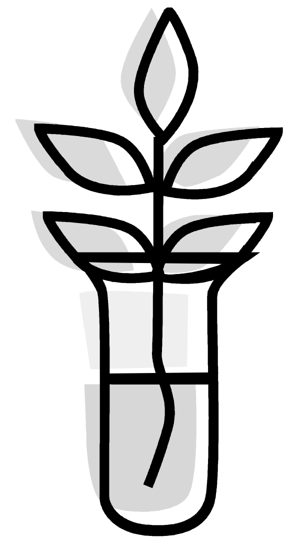


Hedrick & Flannagan 2006

#2: Big Ideas or Facts

- Students need both!





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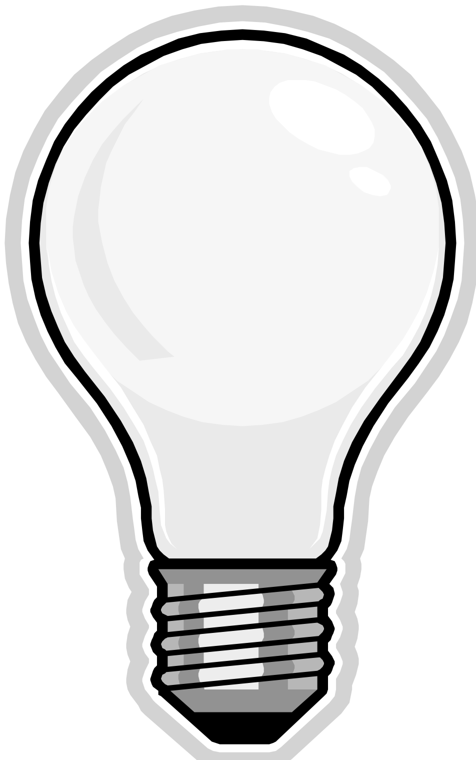


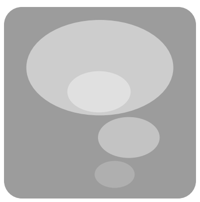
Big Idea:

Scientists use their senses to explore, use words to describe what they find, and record their words in their notebook

Focus Question

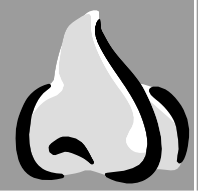
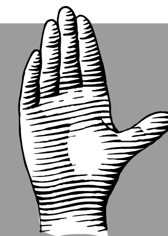
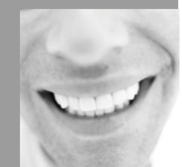
- What are these crystals we have in our cups?

Words to Describe



- Using your eyes, what words can we use to describe our crystals?
- Using your ears, do you hear anything?
- Use your nose, do the crystals smell?
- Use your hand, what words can we use to describe how the crystals feel?

Make Observations:

See 	Hear 	Smell 	Feel 	Taste 
What size is it? What shape is it?	Do you hear a sound?	Does it smell/ odor?	Does it feel soft/hard? Does it feel light or heavy?	X

Differentiation

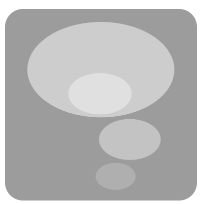
- How could you modify the “Senses” graphic organizer for different learners?

Connections

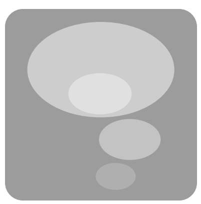
It reminds me of ________________

because________________________.

What are you curious about?



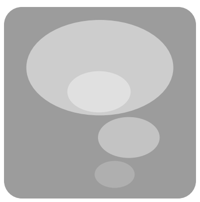
What happens when we put these crystals in water?



- What steps could we take to find out?

- Think-Pair-Share

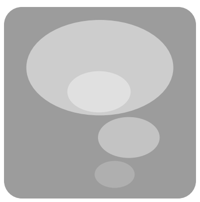
What did you find out?



- *Before* we put the crystal in water

- *After* we put the crystal in water

Change



- Does change always happen slow or fast?
- What could we change about our materials that might affect how fast or slow the crystal changes?

Ideas

Crystal	Water

What could we observe?

Did changing the temperature make a difference on how fast the crystals changed?

THE BOX & T-CHART

Similarities

Hot Water	Cold Water

Differences

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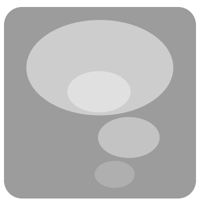
COMPARE AND CONTRAST
Writing Frame



Start with how things are the same or similar.	The _____ and the ______ are the same because they both ___________.
Add more details as needed.	In addition, they both _________________.
Explain how they are different. You can compare the same property or characteristic in the same sentence. Use "and", "but", or "whereas" to set up the contrast.	They are different because the ______, but the ______ does not.
Add more detail as needed.	Also, the ________, whereas the _________________does not.

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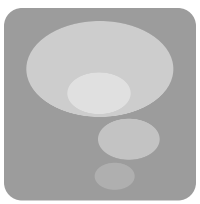
#3: Learning to Learn



- We need to help students to become independent thinkers and learners

Adapted from National Research Council. (2005) How students learn: Science in the classroom. National Academy Press: Washington D.C.

If yeast is added to the peroxide mixture, then…

It Says	I Say	And so

Does the data support or not support what we predicted?

Moving from Dependence to Independence through Support

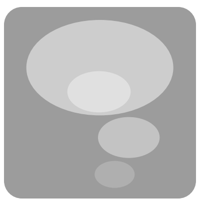
I Do	**I Do**	**You Do**	**You Do**
You Watch	**You Help**	**I Help**	**I Watch**
Modeled	**Interactive**	**Guided**	**Independent**
Shared			



Autonomy

Flannagan, 2006

Challenge



- Develops a child's sense of **self-efficacy** (Bandura, 1997)
- **Motivation** is promoted through challenge-learners must have useful feedback
- Setting children up to **succeed** (Greenspan, 1997)
- **Zone of proximal development** (Vygotsky, e.g.,1962, 1978)

Hedrick & Flannagan, 2006

The Keys to Success

- High quality curriculum
- Differentiated instruction
- Meaningful (to the learner) experiences
- Ongoing assessment and adjustment
- Ongoing opportunities to expand understanding and skills (Ascending Levels of Intellectual Demand, The Parallel Curriculum Model, 2002, 2005)

Hedrick & Flannagan, 2006

Ascending Intellectual Demand

(From The Parallel Curriculum Model by Tomlinson, et al., 2002)

"The escalating match between the learner and the curriculum" (p. 13)

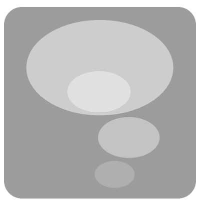
Returning to *Backward Design*....

- 1) Identify learners
- 2) Identify curricular priorities
- 3) Design assessment framework
- 4) Create learning activities
  - a) Design and sequence learning activities
  - b) Check for integration of accommodations

b) Check for integration of accommodations

- Supporting students with LD
  - Text/content enhancements
  - Summarization strategies
  - Peer tutoring and cooperative learning groups
  - Self-regulation/self-questioning
  - Inquiry based learning

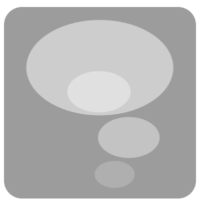
Inquiry based learning



- Student centered
- “hands on”
- An emphasis on concrete, meaningful experiences
- Emphasis on depth rather than rote memorization
- Higher order questioning and coached elaborations

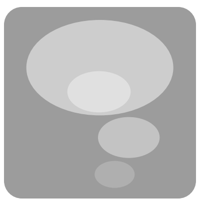
(see Scruggs, Mastropieri, & Okolo, 2008)

Scaffolds in Science



- Place words in a pocket chart-easier to pull words out of pocket chart and use them
- Have words at a center in pocket chart and allow students to sort them into groups

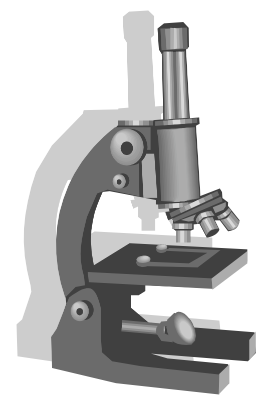
Science Word Walls



- “When terms come first, students just tend to memorize so much technical jargon that it sloughs off in a short while” (Donovan and Brandford, 2005, p. 512

Use Icons

- Add icons or simple diagrams to help students remember word meanings



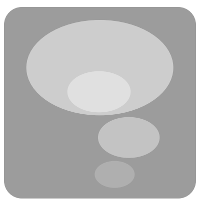
Microscope

- “Many students with high-incidence disabilities will perform similarly to normally achieving students on a constructivist science task, even though they are far behind in reading and math achievement”

(Mastropieri et al., 2001, p. 131)

However, inquiry based learning must be highly structured!

(Mastropieri et al, 2008).



- This reinforces the importance of *Backward Design*
- Teachers must plan intentionally

Effective Inclusive Science Learning

(see Scruggs & Mastropieri, 1994)

- 1) An open, accepting classroom environment
- 2) Administrative support for inclusion
- 3) General effective teaching skills on the part of the general education teacher
- 4) Special education support, in the form of consultation or direct assistance
- 5) Peer mediation, in the form of classroom assistance or cooperative learning
- 6) Appropriate curriculum (supporting a hands-on approach to science learning)
- 7) Teaching skills specific to particular disability or need areas

Reinforcing skills across the curriculum: Reading Standards (4th Grade, VA)

The student will read and demonstrate comprehension of *nonfiction*.

- Use text organizers, such as type, headings, and graphics, to predict and categorize information.
- Formulate questions that might be answered in the selection.
- Explain the author's purpose.
- Make simple inferences, using information from texts.
- Draw conclusions, using information from texts.
- Summarize content of selection, identifying important ideas and providing details for each important idea.
- Describe relationship between content and previously learned concepts or skills.
- Distinguish between cause and effect and between fact and opinion.
- Identify new information gained from reading.

Reinforcing science *concepts* and *knowledge* in Language Arts

- Writing
  - Expository essays based on science experiments
  - “Science-fiction” stories: “Inside the . . .”
- Reading
  - Non-fiction comprehension strategies
  - Guided reading groups: use non-fiction texts covering science content
  - Magic School Bus books
  - Reference skills (dictionary, thesaurus, glossary, index)

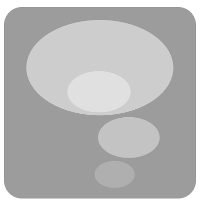
Reinforcing science *skills* in math

- Charting and Graphing
  - Bar graphs
  - Pictographs
  - Histograms
  - Frequency charts
- Interpreting graphs (i.e., force & motion)
- Weight and Measurement

General skills

- Observation
- Teamwork
- Following multi-step directions
- Scientific method for problem solving
- Developing graphic organizers, mnemonics, visual-spatial displays
- Summarization strategies

Questions?



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