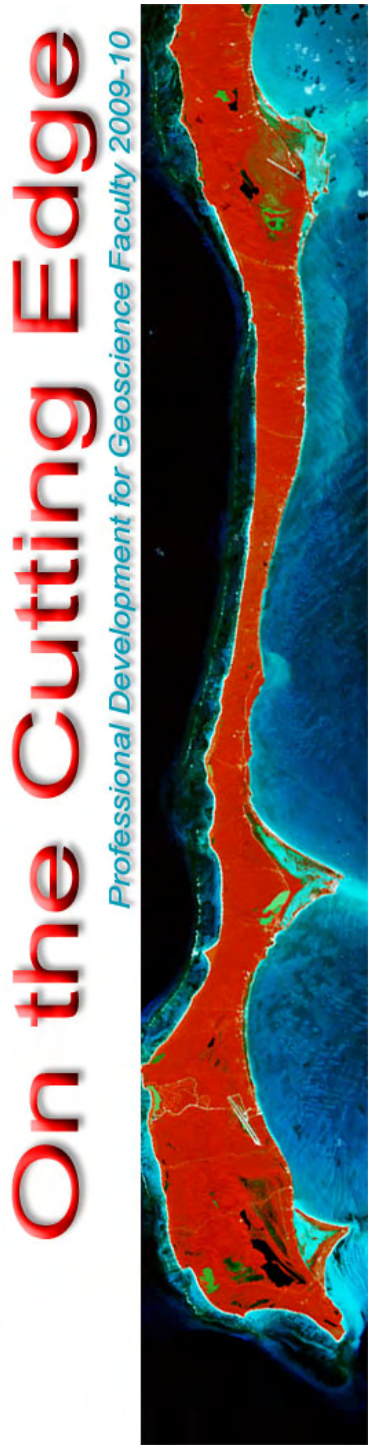
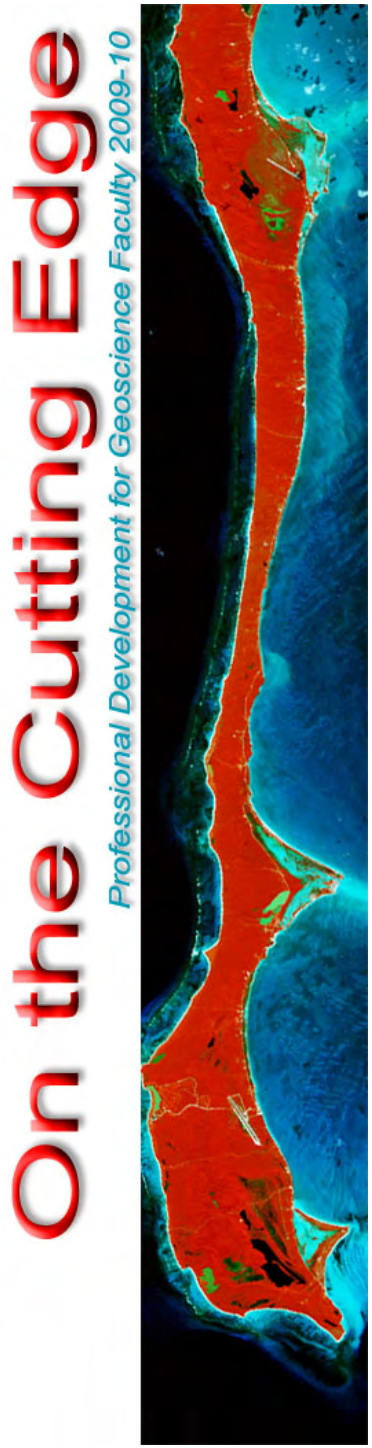


Teaching Metacognition: A Summary of Successful Strategies from the 2008 *On the Cutting Edge* Workshop

Carol Ormand, SERC, Carleton College
Cathryn Manduca, SERC, Carleton College
Jenefer Husman, Arizona State University
Katrien Kraft, Mesa Community College
David Mogk, Montana State University
Karl Wirth, Macalester College



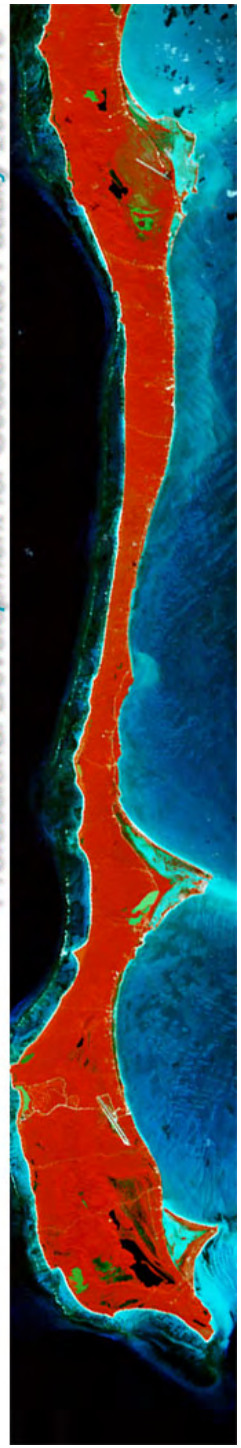
2008 *On the Cutting Edge* Workshop:

The Role of Metacognition in Teaching Geoscience

- 42 geoscientists, cognitive scientists, & educators
- 2.5 days of presentations, discussions, & working groups
- Website: http://serc.carleton.edu/25697

On the Cutting Edge

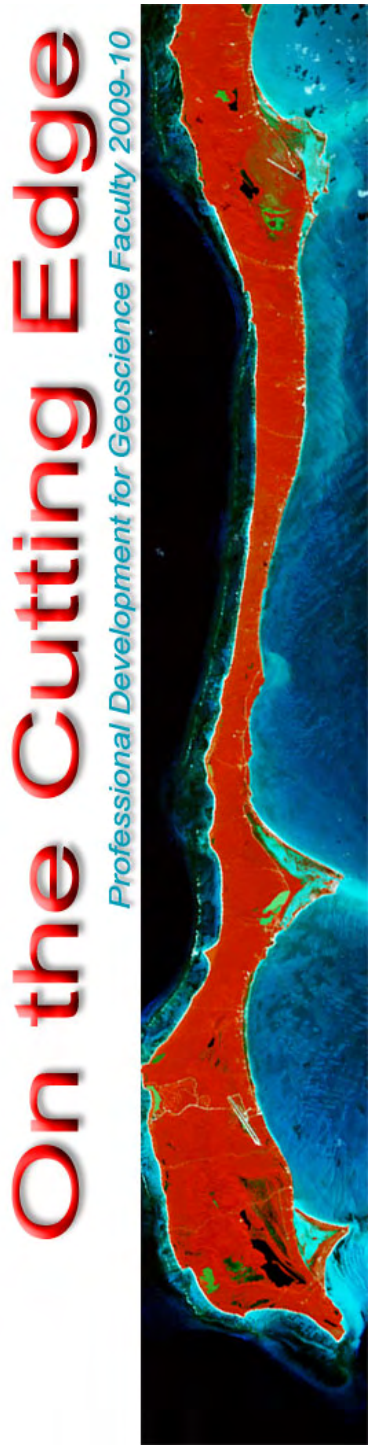
Professional Development for Geoscience Faculty 2009-10



2008 *On the Cutting Edge* Workshop:

The Role of Metacognition in Teaching Geoscience

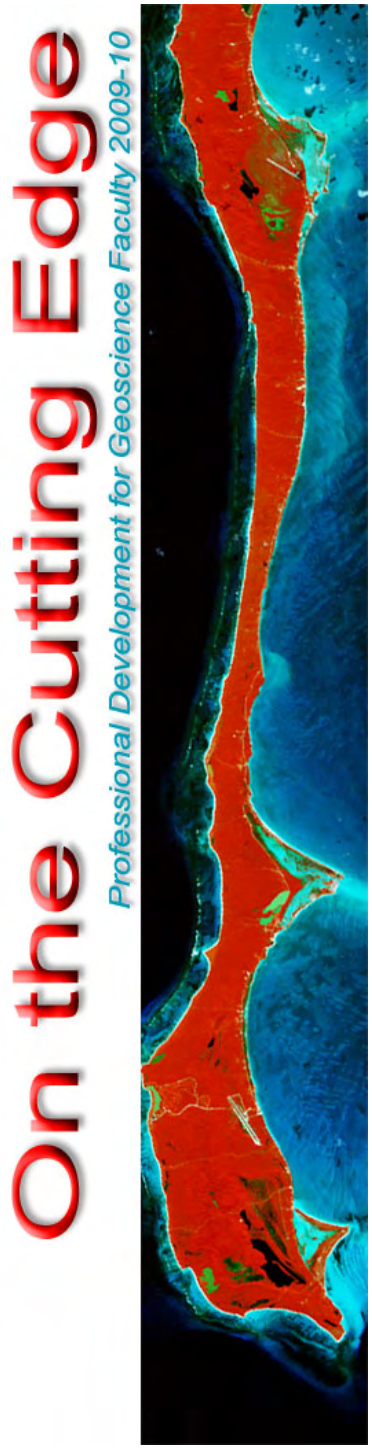
- **Goals:**
  - To understand the role of metacognition in geoscience teaching and learning
  - To consider ways to address metacognition in teaching



2008 *On the Cutting Edge* Workshop:

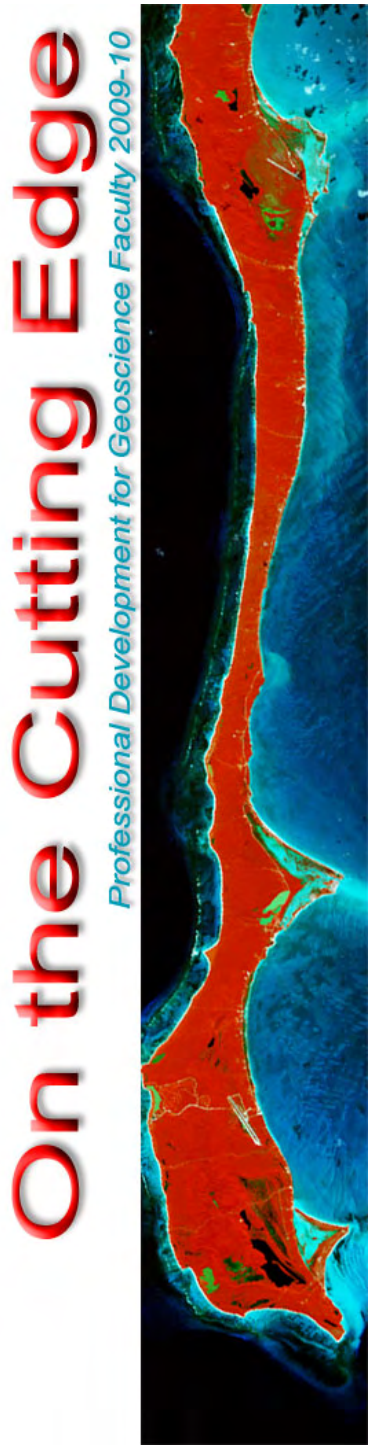
The Role of Metacognition in Teaching Geoscience

- Goals:
  - To collect examples of activities and assessments with metacognitive components
  - To build a network of leaders from geoscience education and cognitive science exploring the role of metacognition in teaching and learning



What We Learned About Metacognition

- High-performing students engage in metacognitive behavior
- Self-regulating behaviors can be taught and learned (without consuming a lot of class time)
  - Monitoring, assessing, and adjusting learning strategies
- Affective component
  - Managing attitudes and motivations toward learning



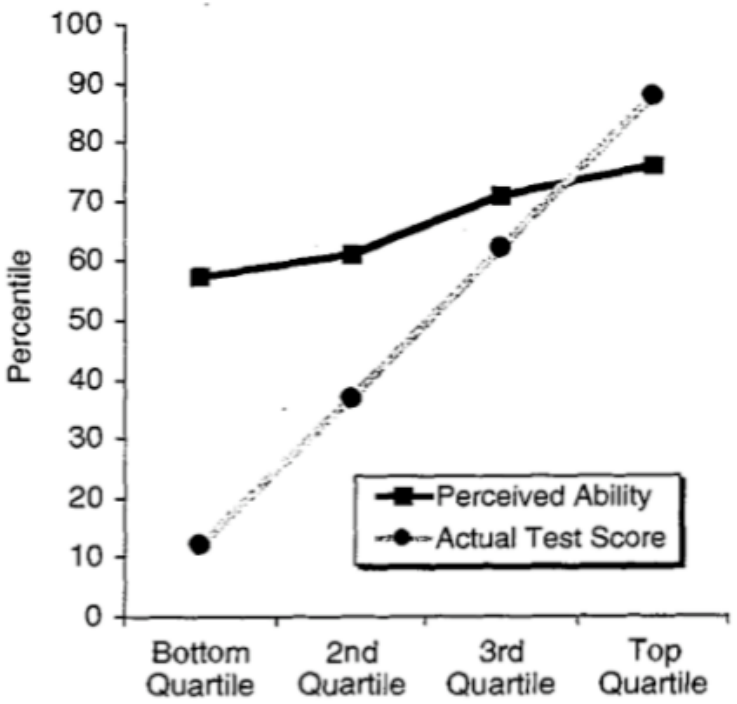
What We Learned About Teaching Metacognition

- Teach students that the ability to learn is not a fixed quantity
- Teach students how to set goals and plan to meet them
- Give students opportunities to practice self-monitoring and adapting

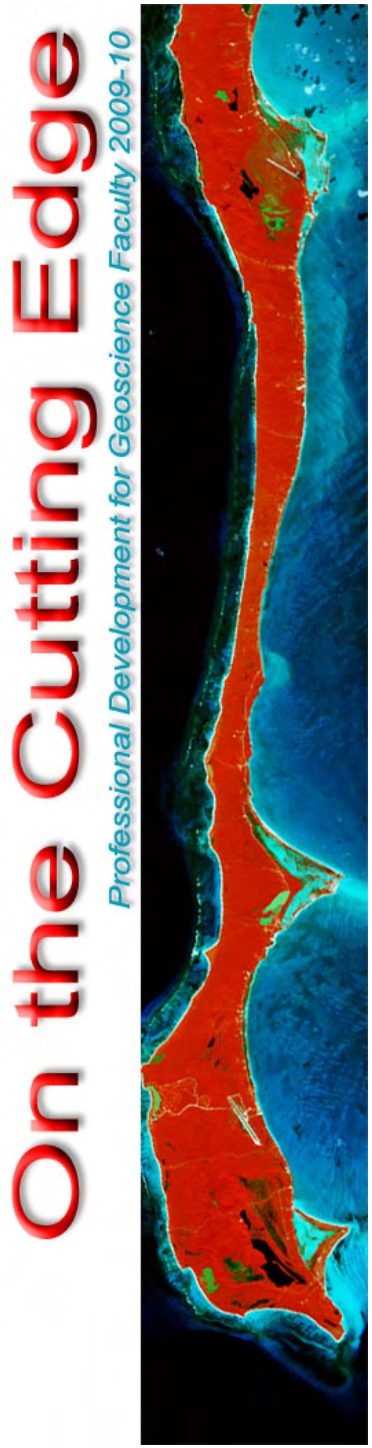
On the Cutting Edge
Professional Development for Geoscience Faculty 2009-10

What We Learned About Teaching Metacognition

- Accurate self-monitoring is particularly difficult; students need practice and immediate feedback

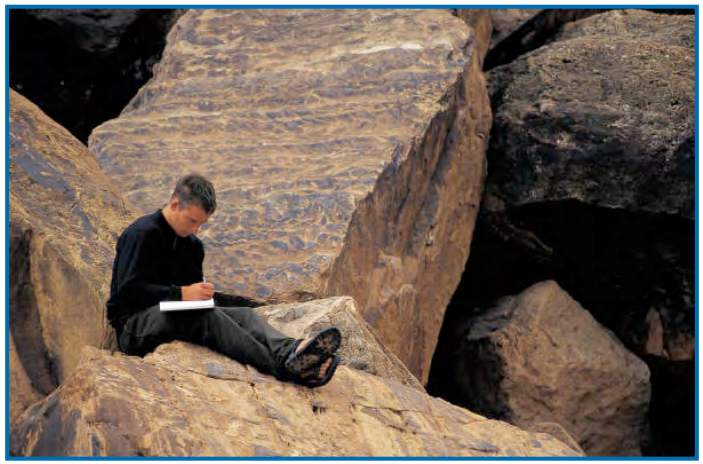


(Kruger and Dunning, 1999)



Supporting Self-Regulated Learning

- Goal-setting
  - Include rubrics with assignments
- Strategic outcome planning
  - Ask students what they want to "get" from an assignment, a unit, the course (knowledge, skill set, grade, ??)



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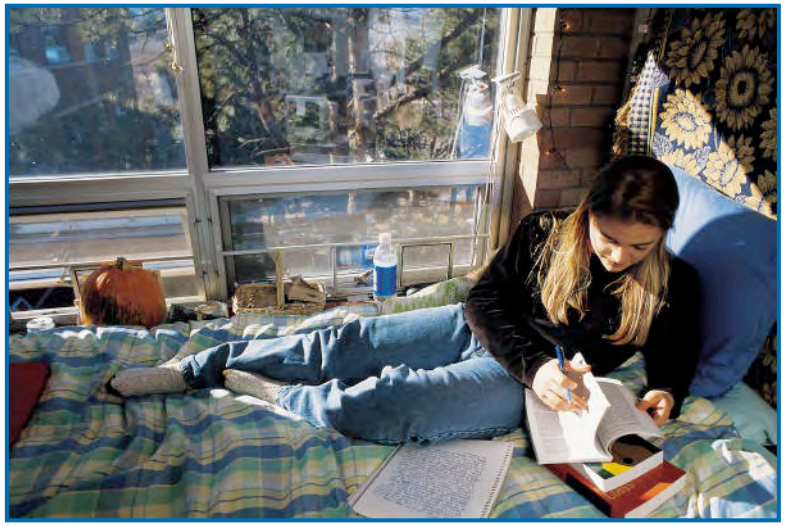
Supporting Self-Regulated Learning

- Strategy implementation and monitoring:
  - Have students consult rubric mid-assignment
  - Have students report how and where they study



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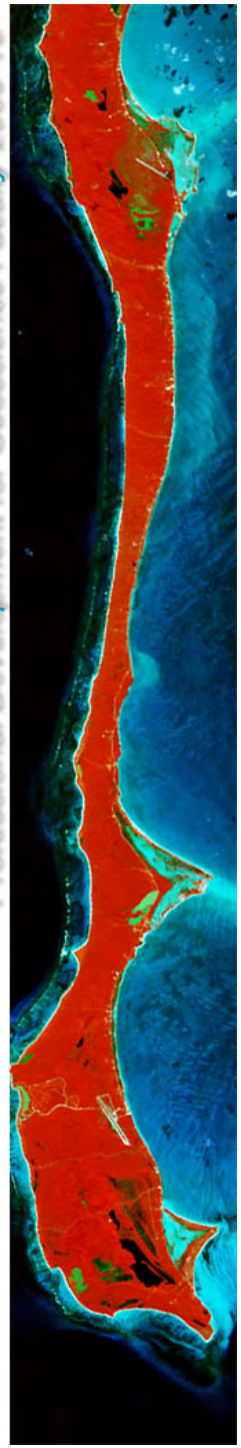
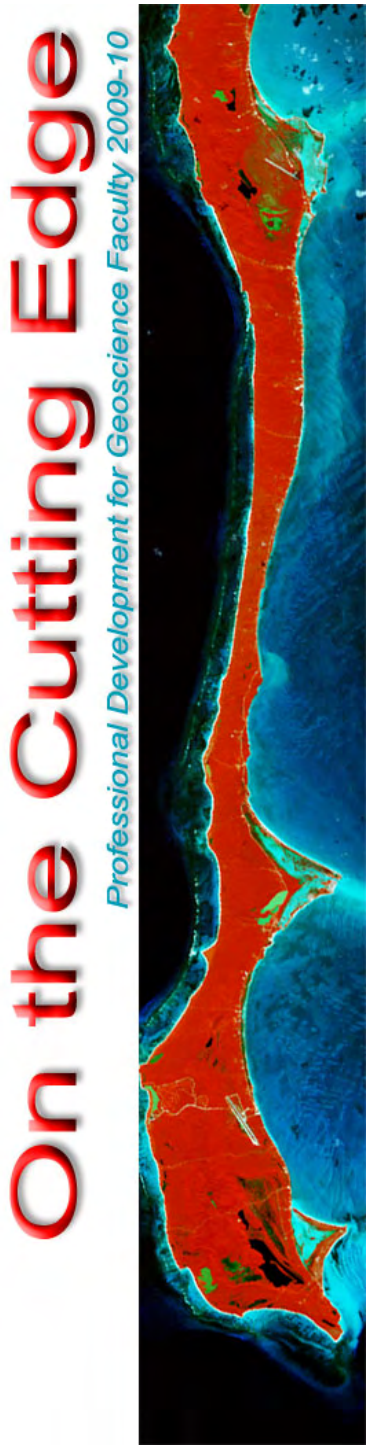


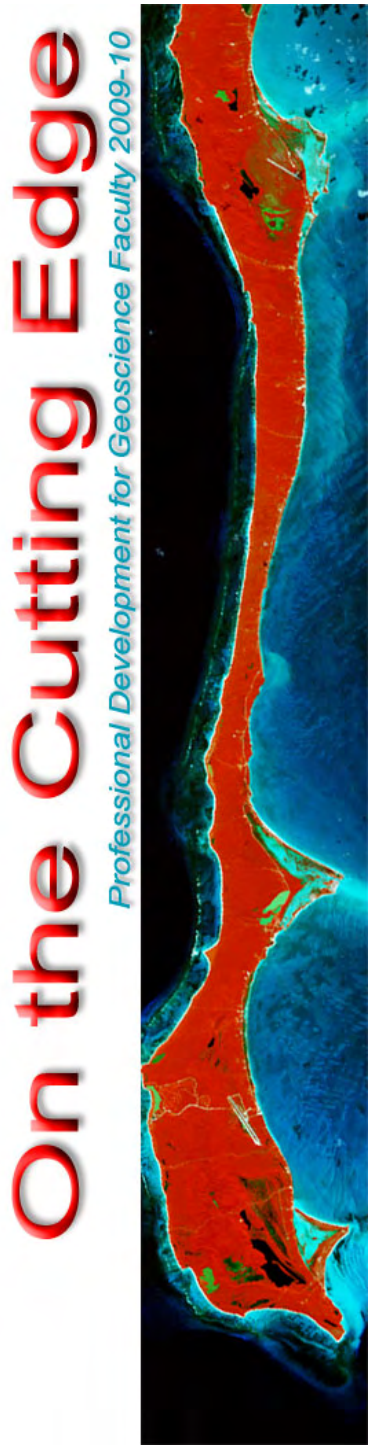
Supporting Self-Regulated Learning

- Self-evaluation and monitoring
  - Have students reflect on whether they "got" what they wanted. Was their learning strategy a good choice? Will they make any changes?



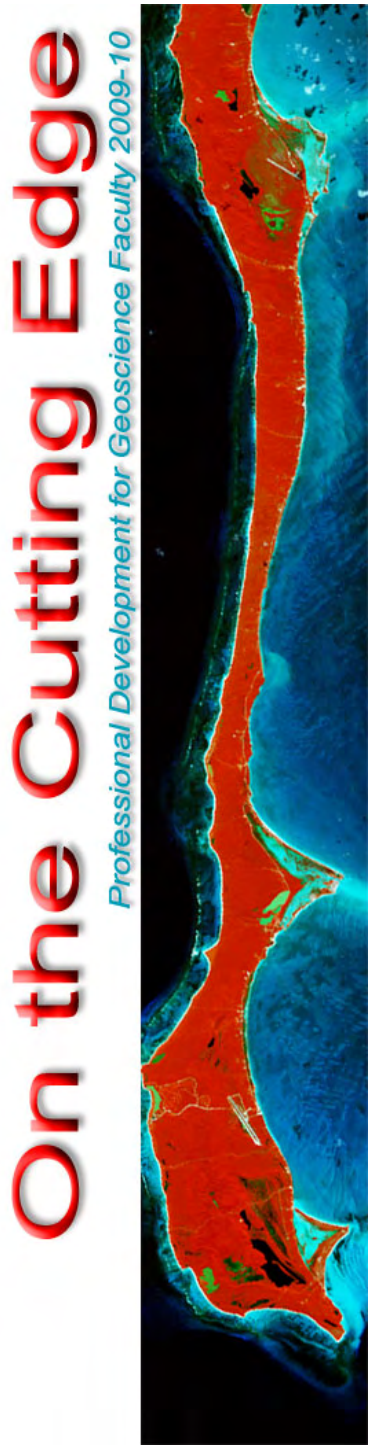
Successful Strategies

- Modeling or revealing expert thought processes, behaviors, procedures:
  - "Talk-alouds":
    - Talk aloud as you show students how you would solve a geoscience problem. Include examples of the kinds of questions you would ask yourself if you were encountering this problem for the first time.
    - Ask students to talk explicitly about their thought processes as they work on a similar problem (in small groups).



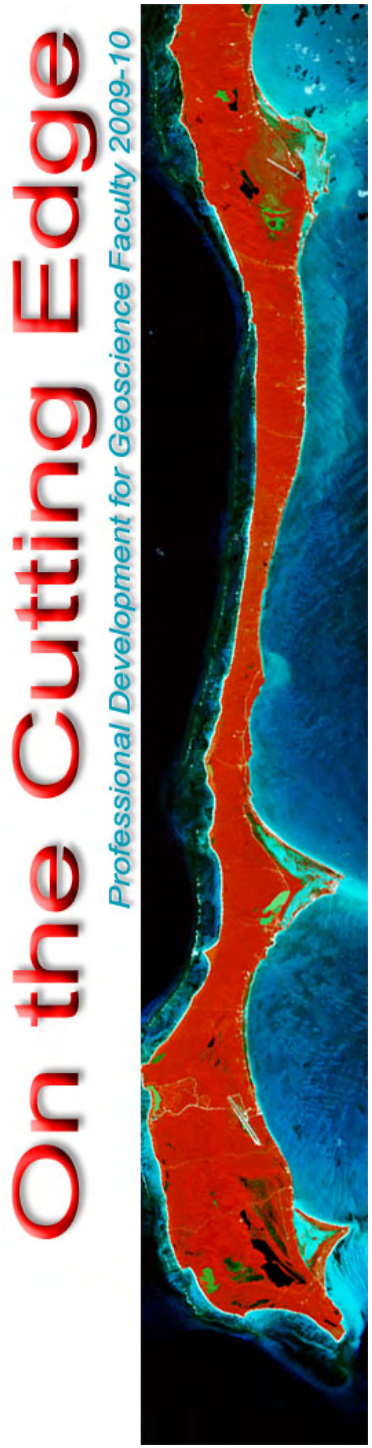
Successful Strategies

- Modeling or revealing expert thought processes, behaviors, procedures:
  - Guided Discovery Problems
  - Provide questions to guide reading of primary literature
  - Provide questions to guide evaluation of information sources
  - Teach concept mapping and other organizational strategies
  - Logic trees



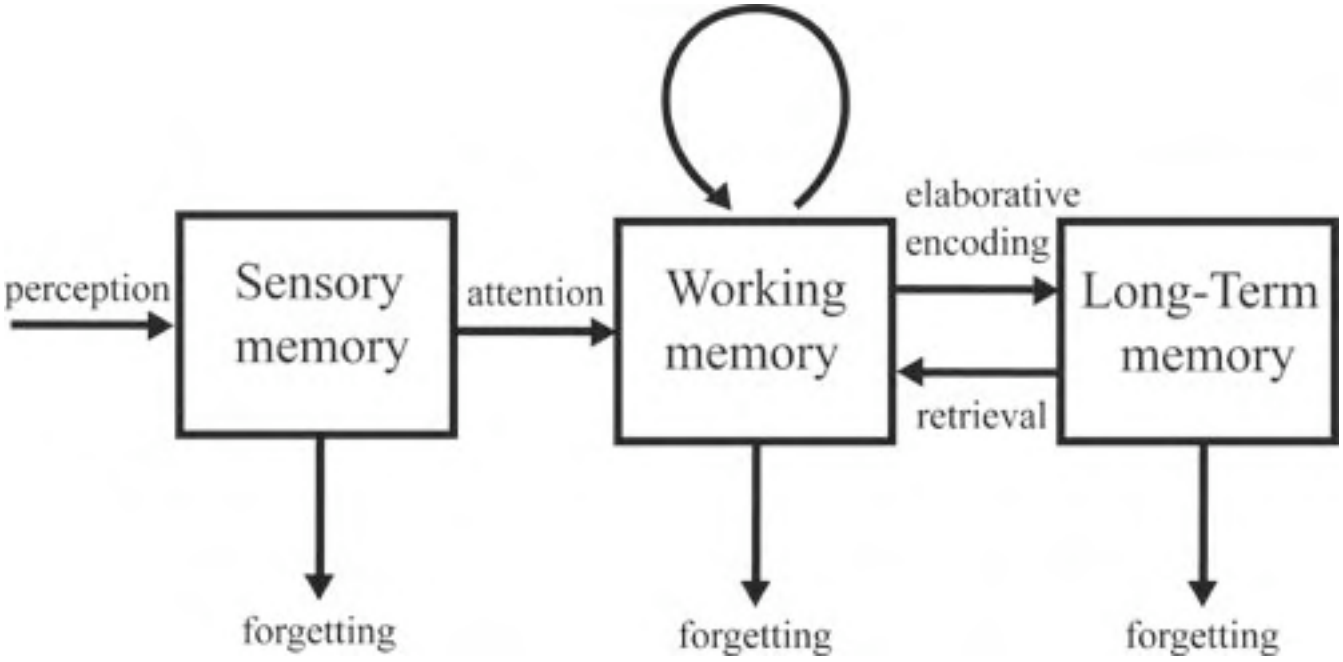
Successful Strategies

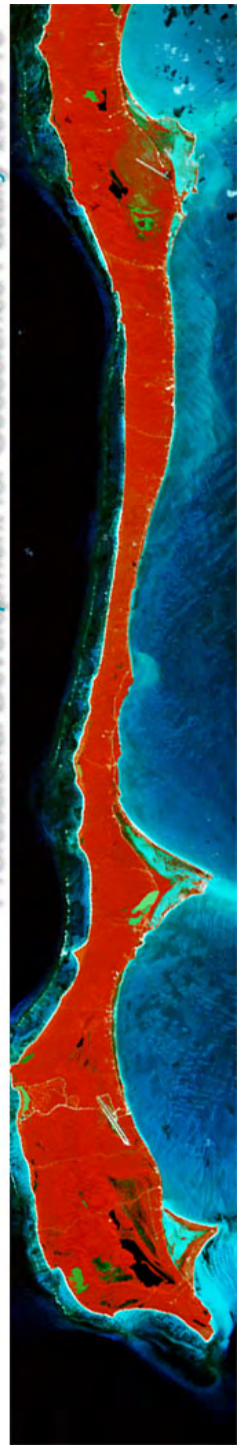
- Building in time for reflection
  - What am I doing? How is it working for me? What might I do differently?
  - Providing timely feedback to student reflections



Successful Strategies

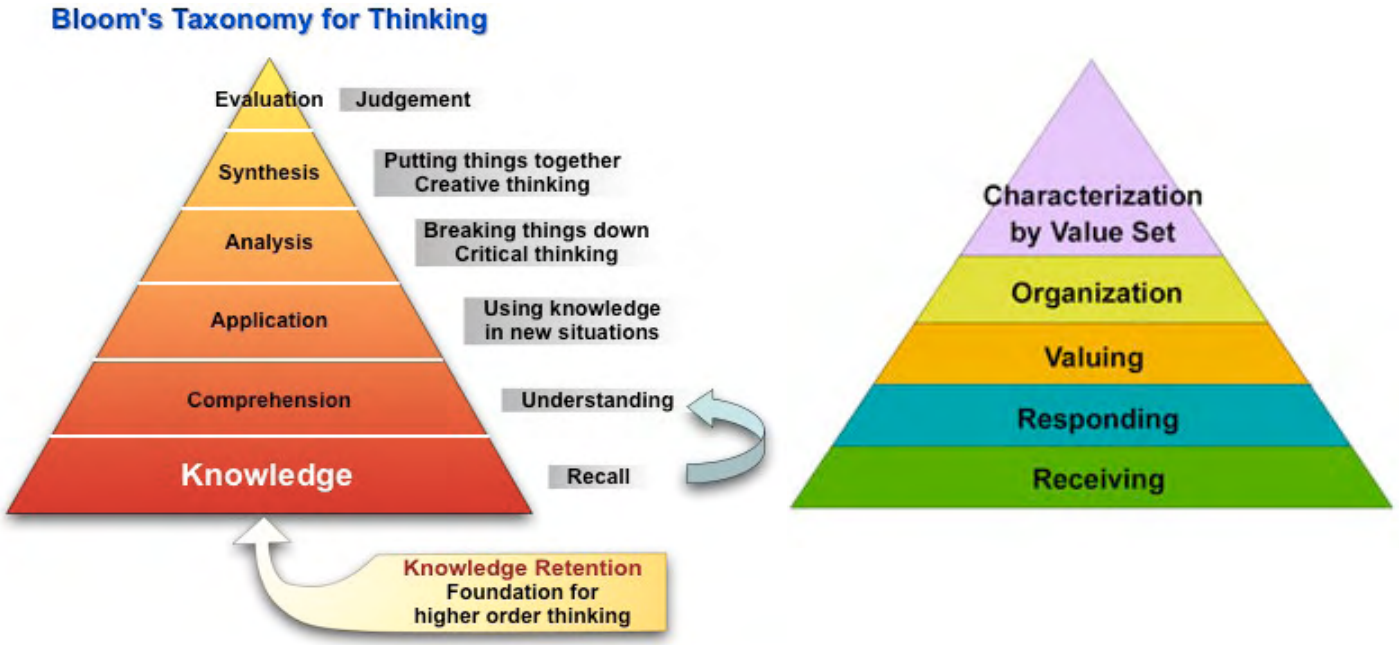
- Teaching students about the learning process

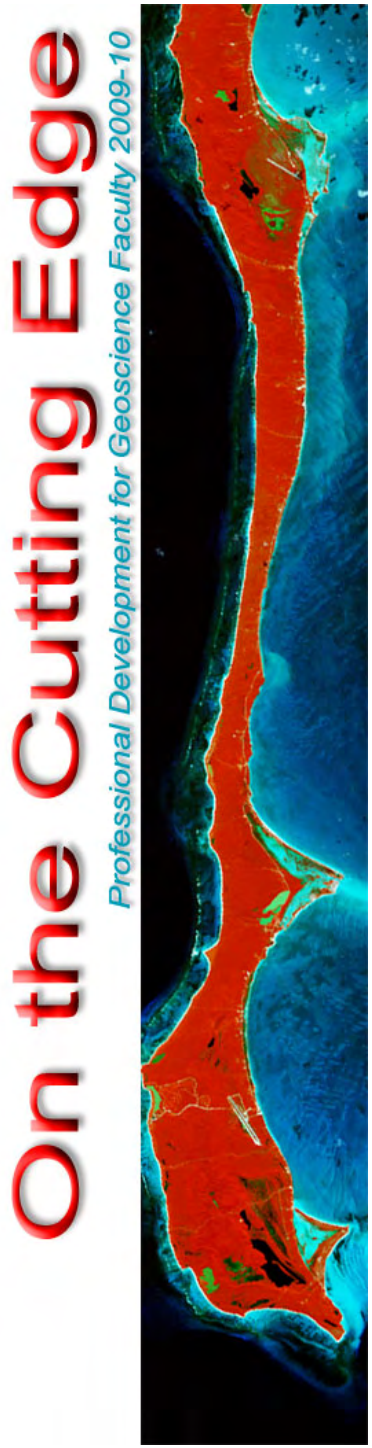




Successful Strategies

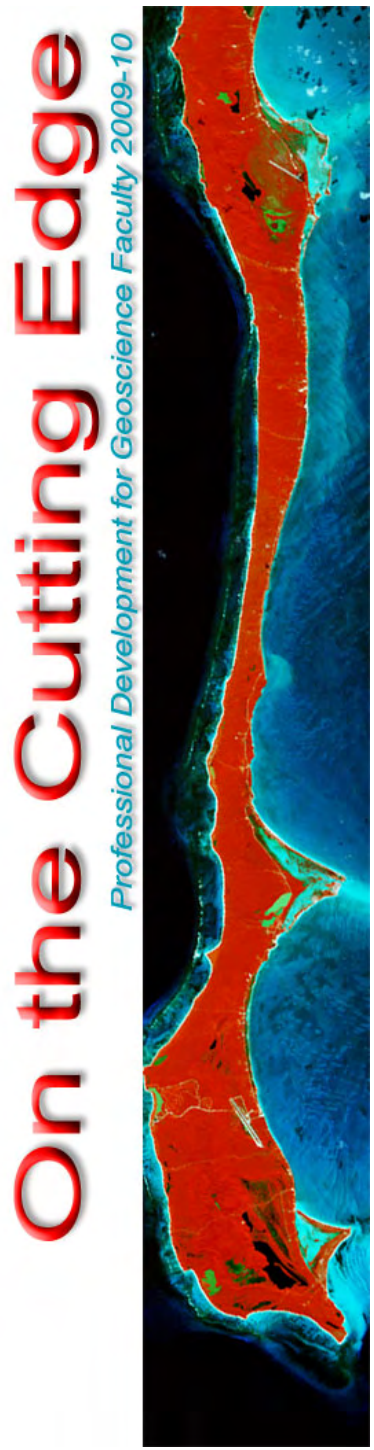
- Introduce students to Bloom's Taxonomy for the cognitive domain and/or affective domain





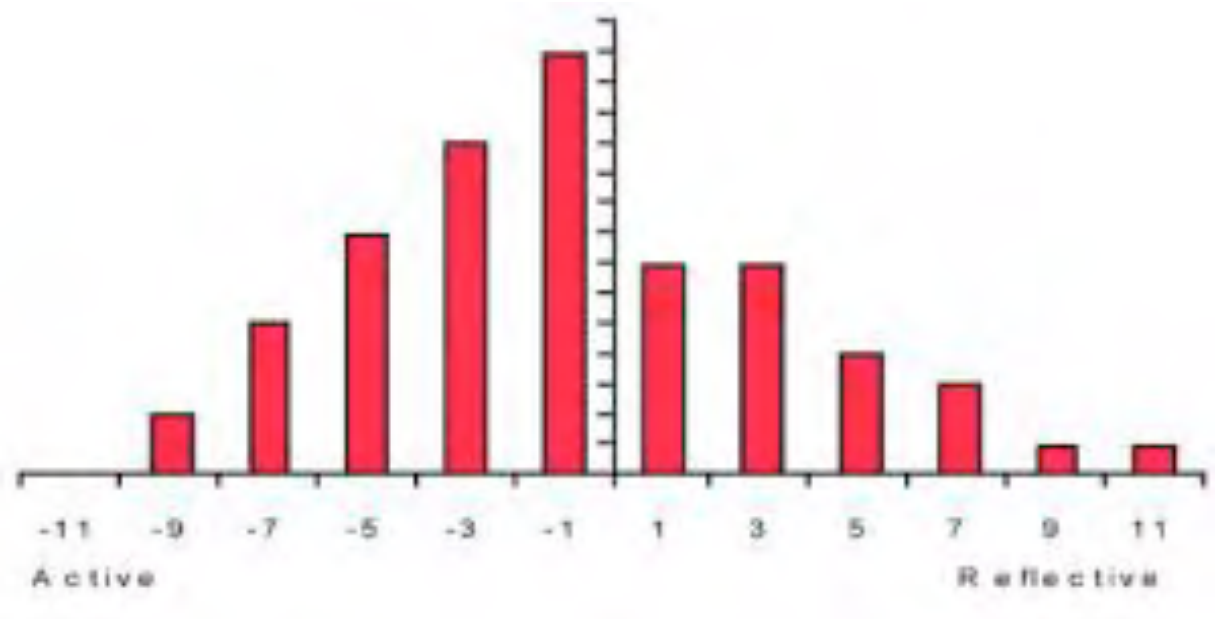
Teaching Activities with a Metacognitive Component

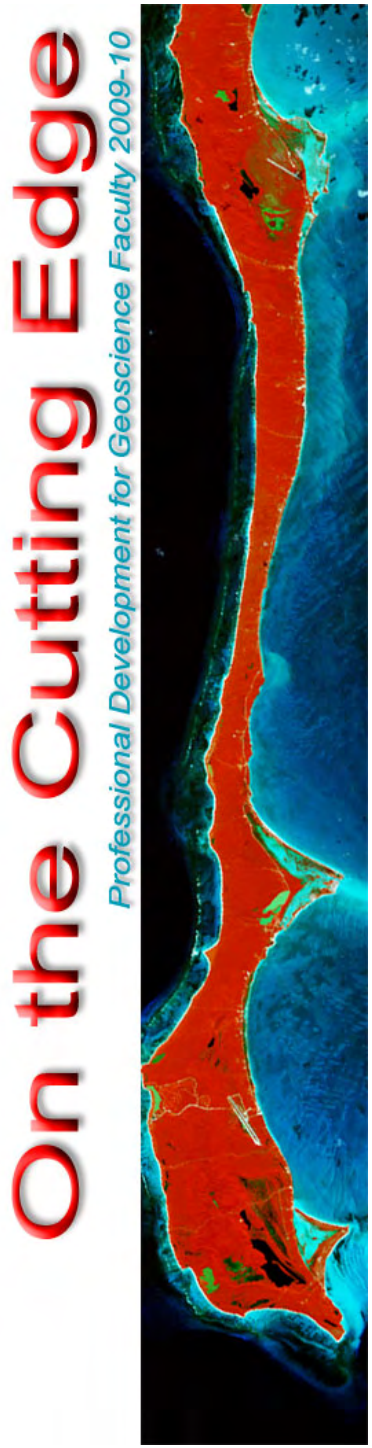
- Refer to Bloom's Taxonomy for the cognitive domain and/or affective domain
  - Point out to students what level of thought you are asking from them (in your course, on specific assignments)
  - When students ask high-level questions in class, ask the class to categorize the question by taxonomic level before answering the question



Teaching Activities with a Metacognitive Component

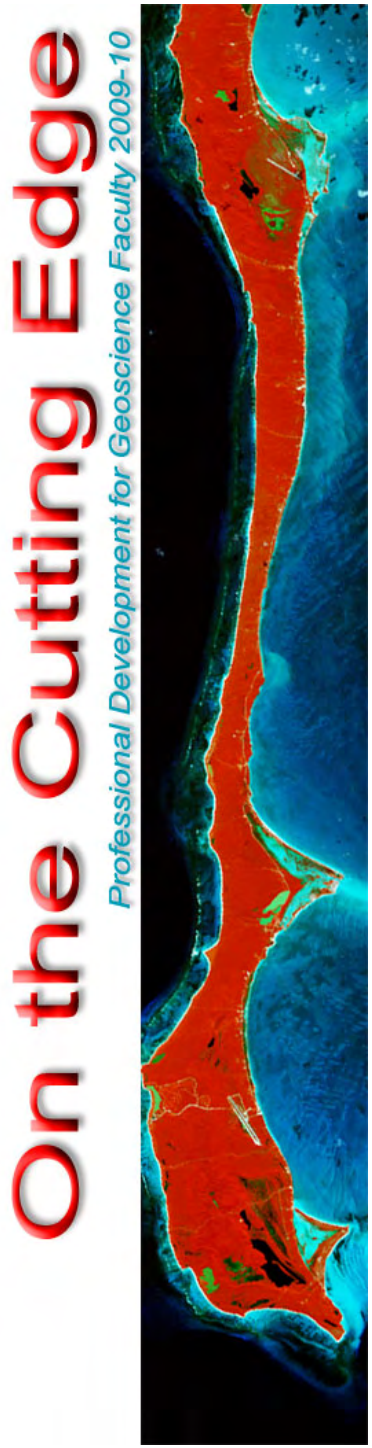
- Explicitly address learning styles and learning strategies in class





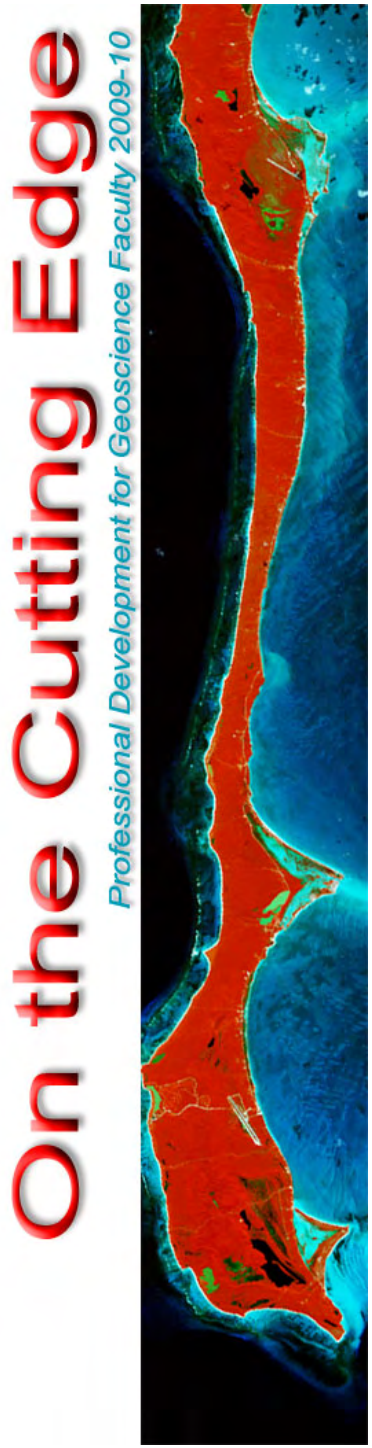
Teaching Activities with a Metacognitive Component

- Explicitly address learning styles and learning strategies in class
  - Have students take a learning styles assessment
  - Have students read about how to use their preferred learning style and to strengthen their other modes of learning



Teaching Activities with a Metacognitive Component

- Use technology to "capture" students' thinking in real time (and to provide immediate feedback)
  - "Clickers" (Personal Response Systems)
  - LectureTools: "clickers" plus: students can pose questions semi-anonymously, take electronic notes on instructor's slides, and record their perception of their comprehension
  - Just-in-Time Teaching questions can include metacognitive component

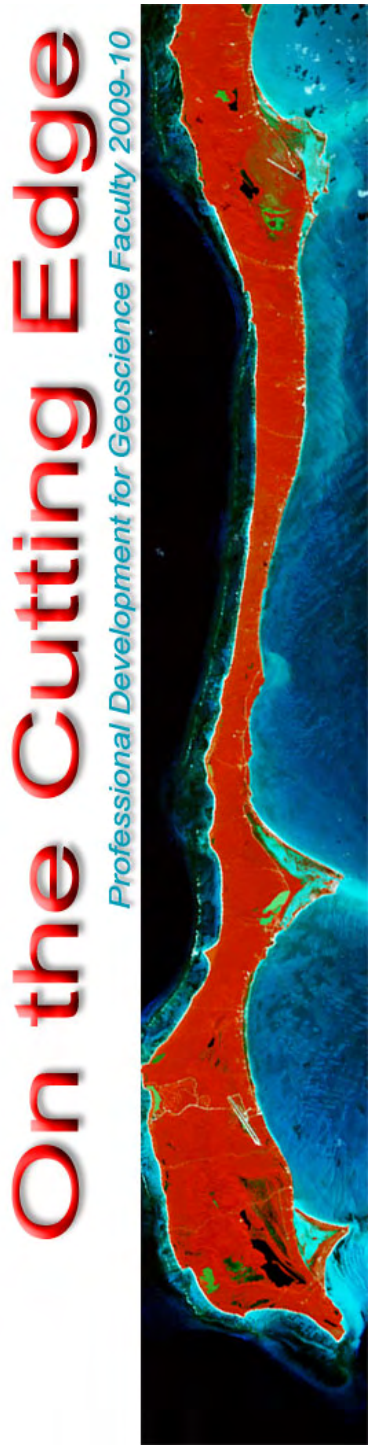


Teaching Activities with a Metacognitive Component

- Wrappers
  - Lecture wrapper: tell students you will ask them at the end of the lecture to write down the key points, and have them do so. Collect their answers, and then tell them what your key points were.
  - Exam wrapper: when you return an exam, ask students to reflect on the effectiveness of their study strategies and plan how they will study for the next exam. Return their plans a week before the next exam.

Teaching Activities with a Metacognitive Component

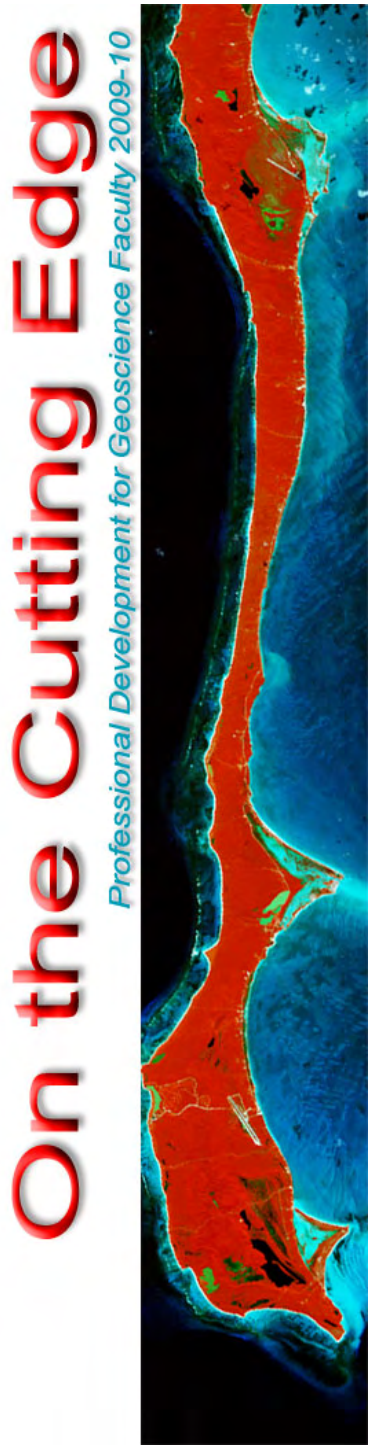
- **Wrappers**
  - Activity wrapper: before students begin a learning activity (e.g., lab exercise, homework assignment) have them reflect on how well they can do the tasks they are about to practice. Ask the same thing after the activity.



Assessing Students' Metacognition

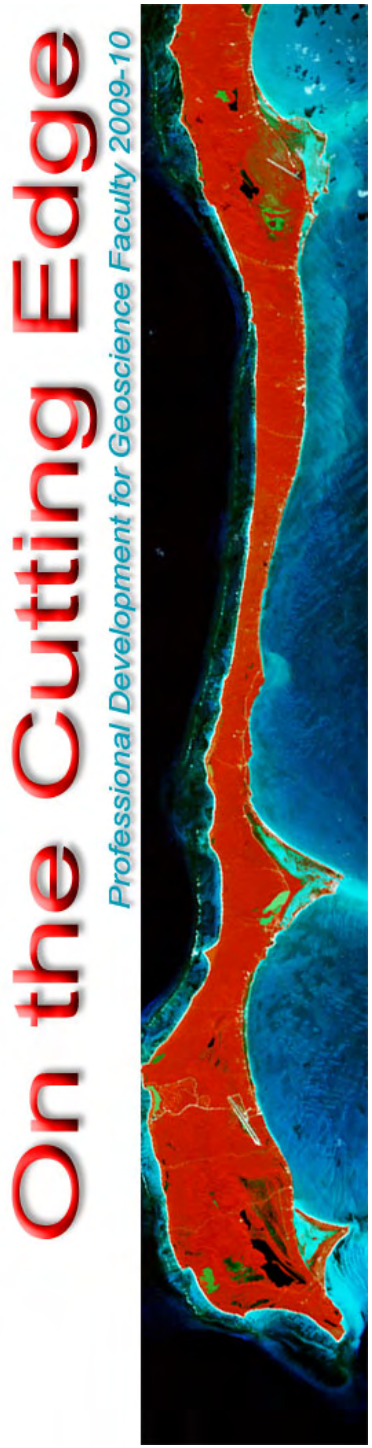
- Assess the process of solving a problem, not just the product
- Listen to talk-alouds

"Maybe [doing] chemistry or something other than geology, I think it's more… it takes more time to, to gather all the information together, is probably what I'm saying. Like in chemistry you have to go through the process of … well, no, because chemistry, prediction, hypothesis; but I think [~5 seconds of silence] think that… hm, maybe it does go about the same…. I just think, I think it does go about the same way, I just think that chemistry or something else will take a little bit long... Well no, ***that doesn't make any sense***, because everything is going to take time."



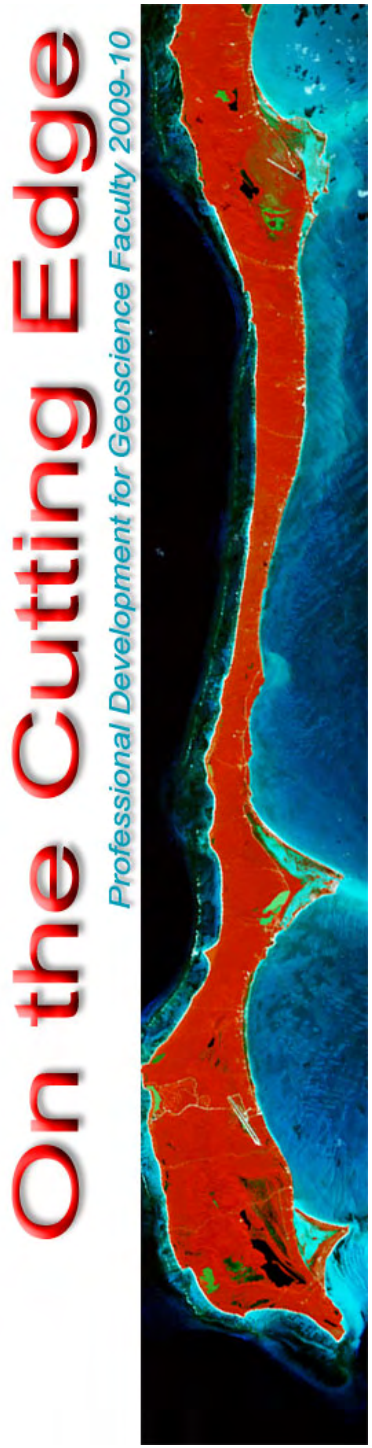
Assessing Students' Metacognition

- Students' self-reports, in response to surveys or interviews or in learning journals
  - What have they learned about their learning?
  - Have they changed their learning strategies over the course of the term? Why? How?
  - Have they made changes to their learning strategies for other courses? How so?



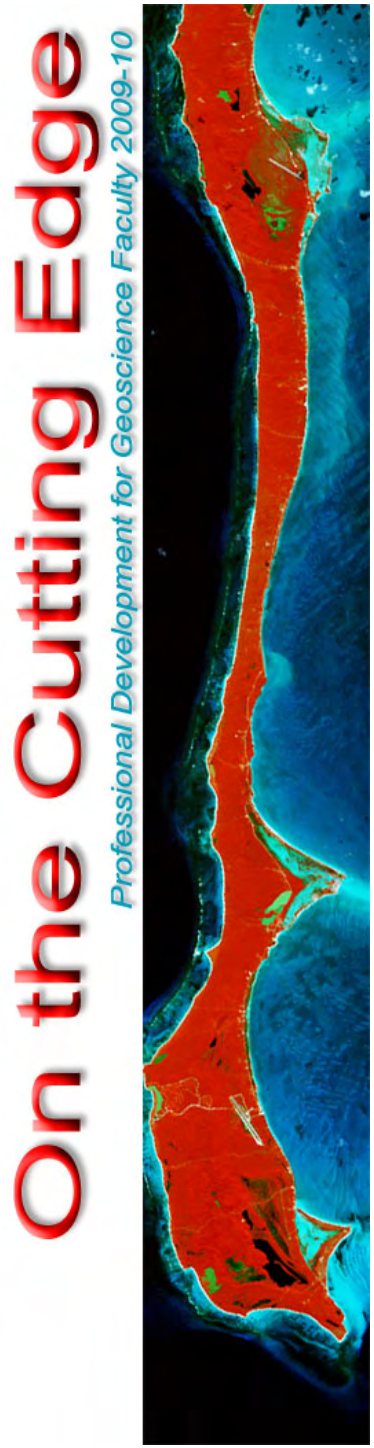
Benefits of Teaching Metacognition

- Student learning increases
- Students take ownership of, and responsibility for, their learning
- Students focus on the process of learning more than on grades
- Well-aligned with teaching critical thinking skills



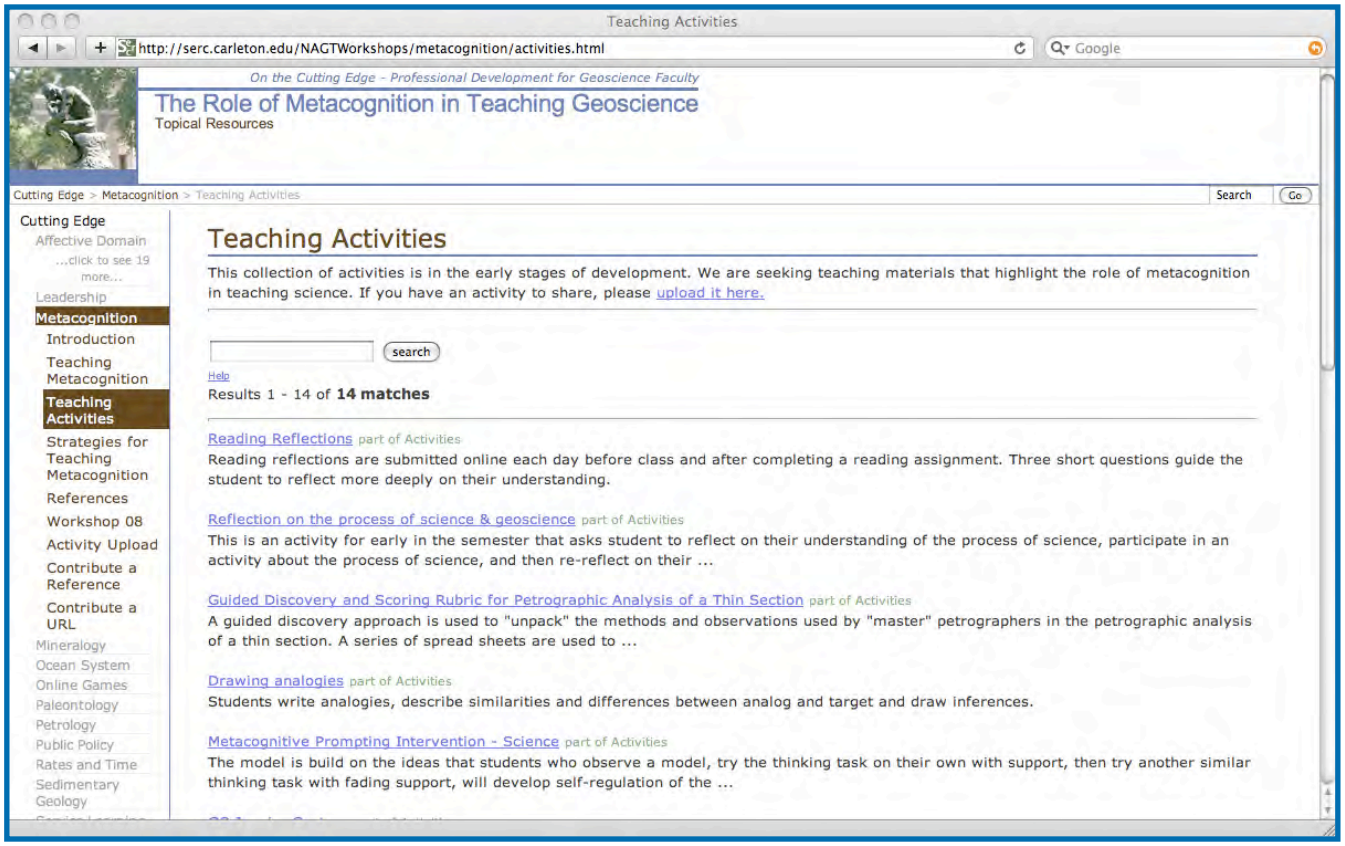
Recommendations from Workshop Participants

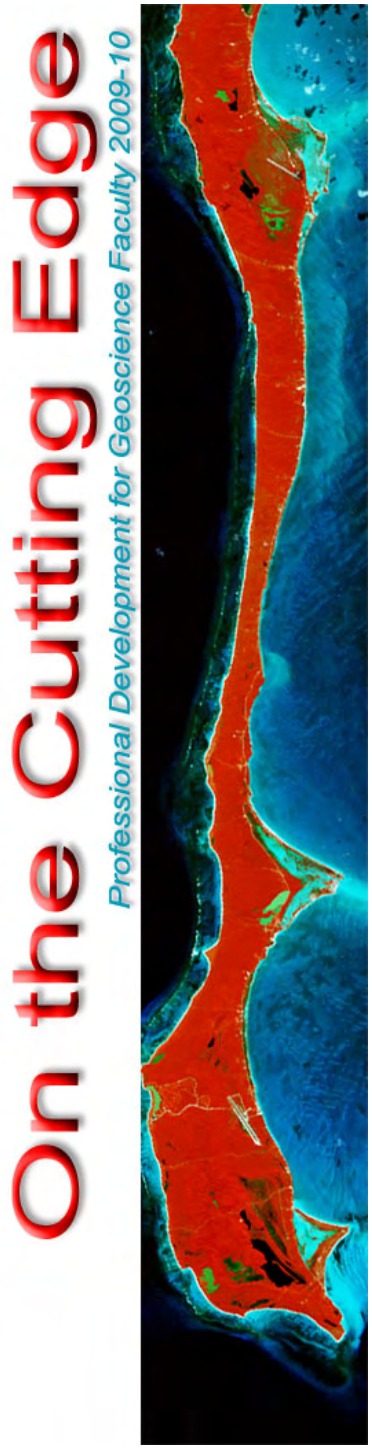
- Start small (evolution, not revolution)
  - Changes in teaching need not be wholesale; what one new thing can we (you) implement?
- Consider metacognition in course design/revision
- Seek allies among your colleagues



Recommendations from Workshop Participants

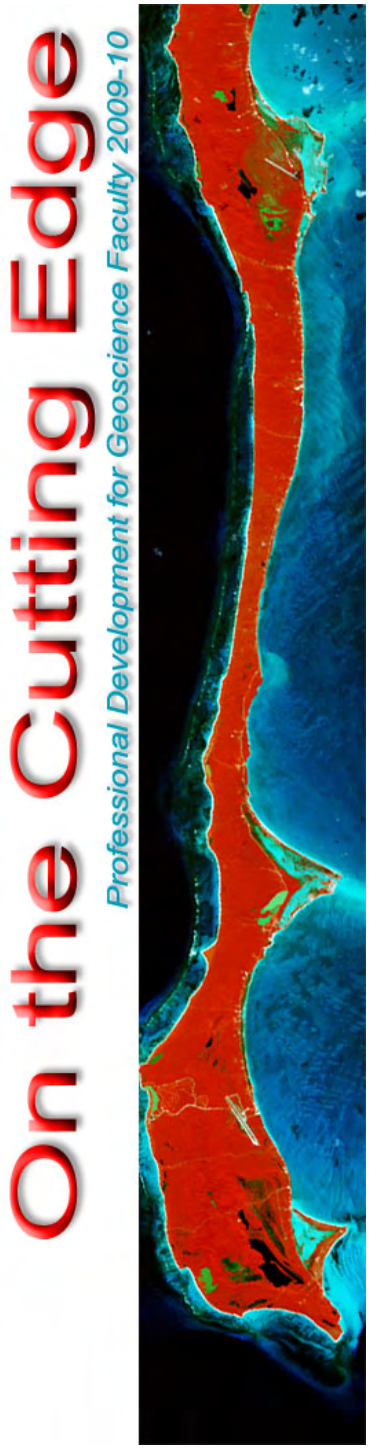
- If it works, please share it!
  - http://serc.carleton.edu/28030





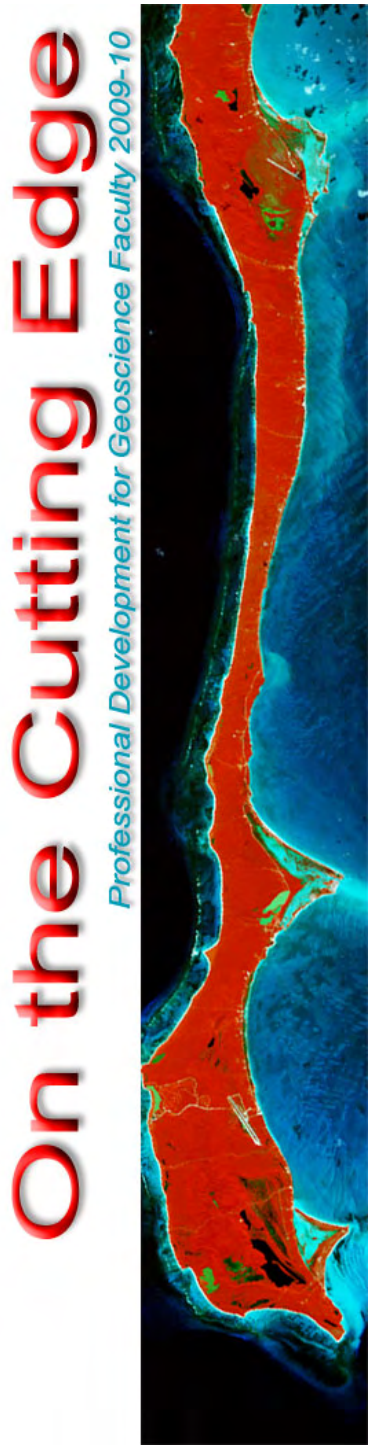
Future Work

- Assessing metacognition
- Using metacognition to frame the teaching of difficult key concepts/ skills in geoscience
  - Spatial thinking
  - Deep time
  - Learning in the field
  - Analyzing incomplete, ambiguous data
  - The process of science



On Our Website

- http://serc.carleton.edu/NAGTWorkshops/metacognition/index.html
  - Overview, teaching activities, references
- http://serc.carleton.edu/NAGTWorkshops/metacognition/workshop08/index.html
  - Program (including all presentations), posters, essays, tactics and recommendations



Thanks to

- NSF, funding *On the Cutting Edge*
- Workshop conveners, leaders, and participants