ASSESSMENTS:
MEASURING PROGRESS AND PROMOTING METACOGNITION

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cCWCS Active Learning in Organic Chemistry

Atlanta, Georgia

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HOW CONFIDENT ARE YOU IN YOUR ABILITY TO IDENTIFY THE US CURRENCY THAT EQUALS ONE CENT, A PENNY?

Identify the correct penny. – 15 seconds

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HOW MANY PENNIES SHOW ABRAHAM LINCOLN FACING IN THE WRONG DIRECTION?

Study the pennies for 30 seconds

HOW MANY OF THE PENNIES SHOWED "LIBERTY" TO THE LEFT OF THE ABRAHAM LINCOLN BUST?

Where you successful?

What did you do to be successful?

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Overview

- Introduction
  - *Characterizing Content Mastery*
  - *Metacognition*
- Pre and Post Assessments Basics
- Implementation Strategies and Examples
- Dissemination and Feedback

Demographics – Organic Chemistry Course

- A historically Black College
- Competitive liberal arts college
- All female
- Approximately 2,100 students from 41 states and 15 foreign countries.
- 25 – 30 students on average
- Primarily chemistry/biochemistry majors, approximately 15% non-majors
- **No assigned textbook**
- **Interactive engagement – flipped**

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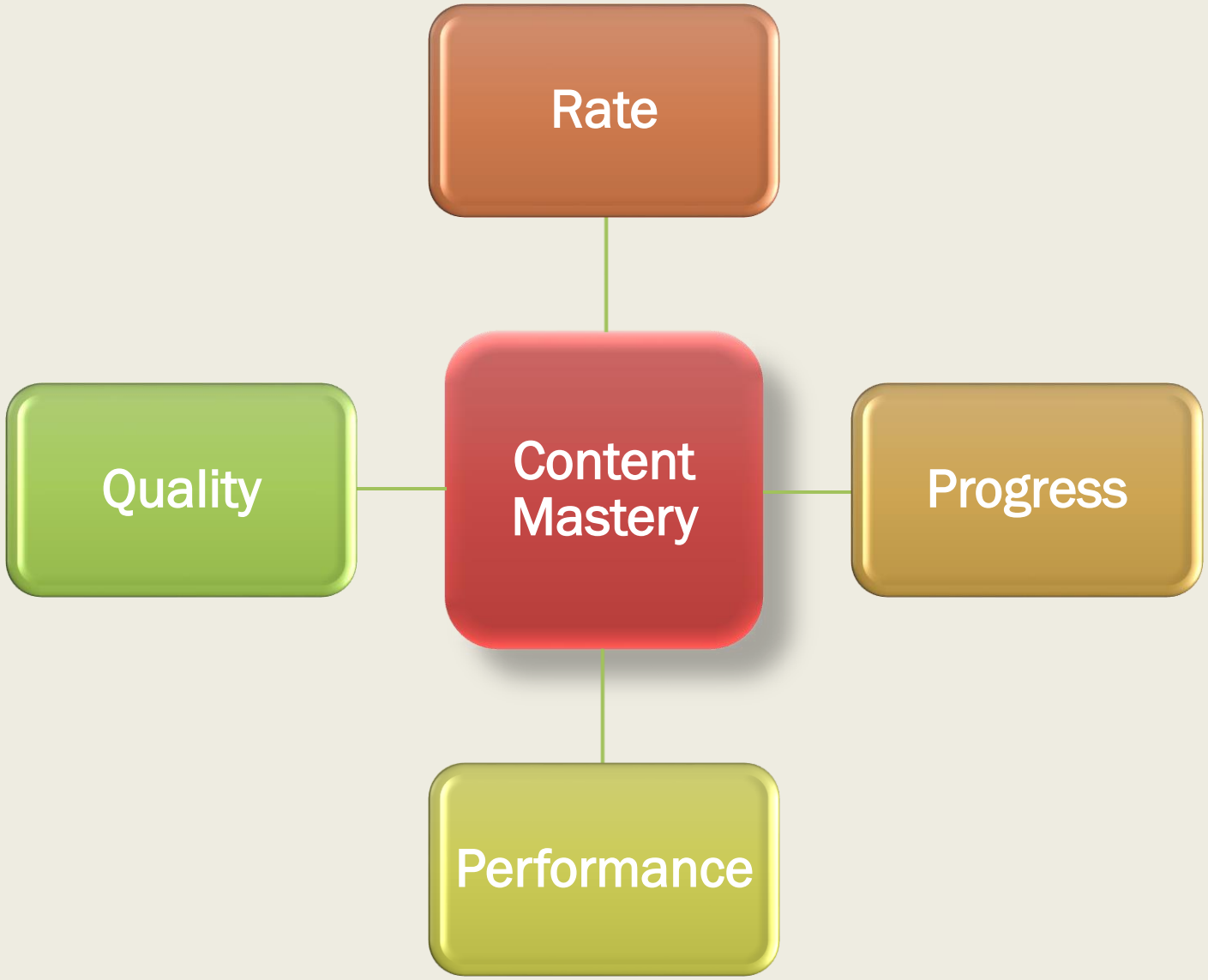
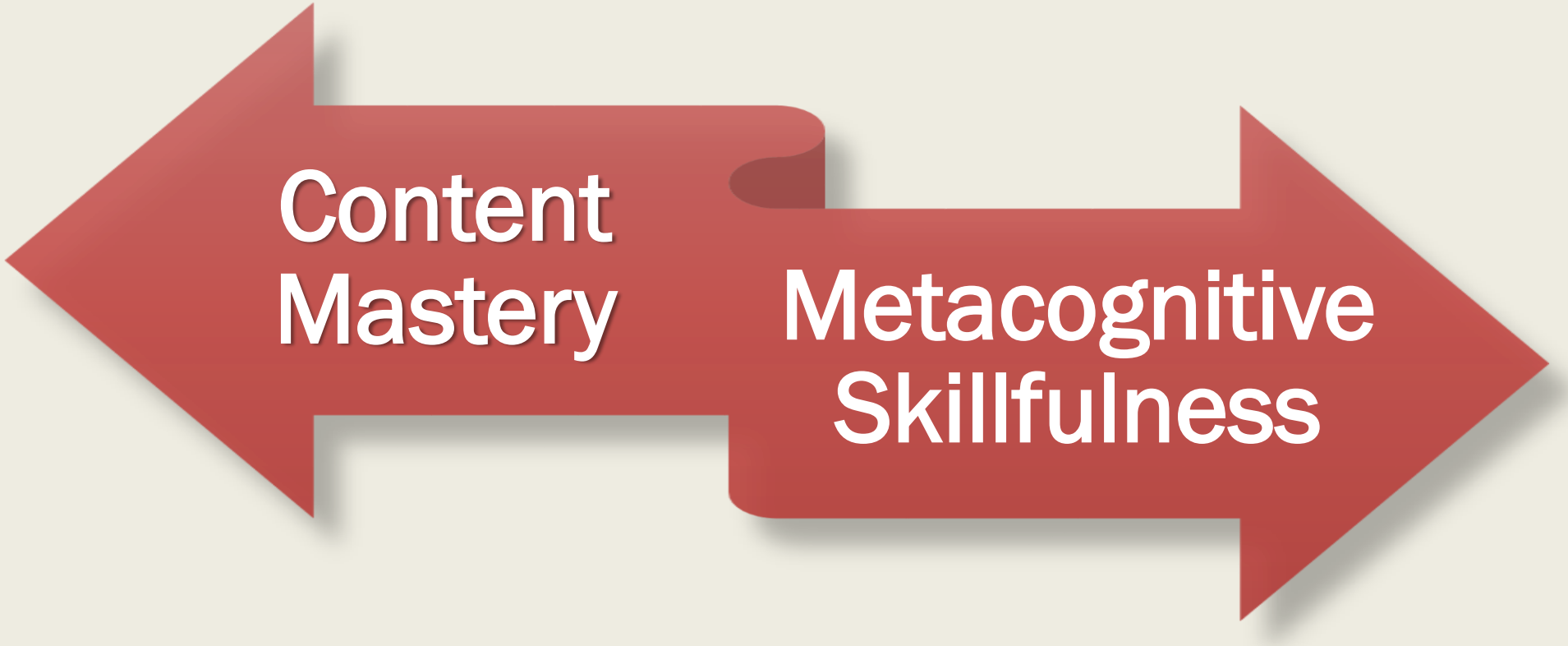
OVERVIEW

Characterizing Content Mastery



Pre and Post Assessments



1. Cooper, M. M.; Sandi-Urena, S. *J Chem Educ* **2009**, *86*, 240.
2. Mathabathe, K. C.; Potgieter, M. *Chem Educ Resand Pract* **2014**, *15*, 94-104.
3. Potgieter, M.; Ackermann, M.; Fletcher, L. *Chem Educ Resand Pract* **2010**, *11*, 17-24.

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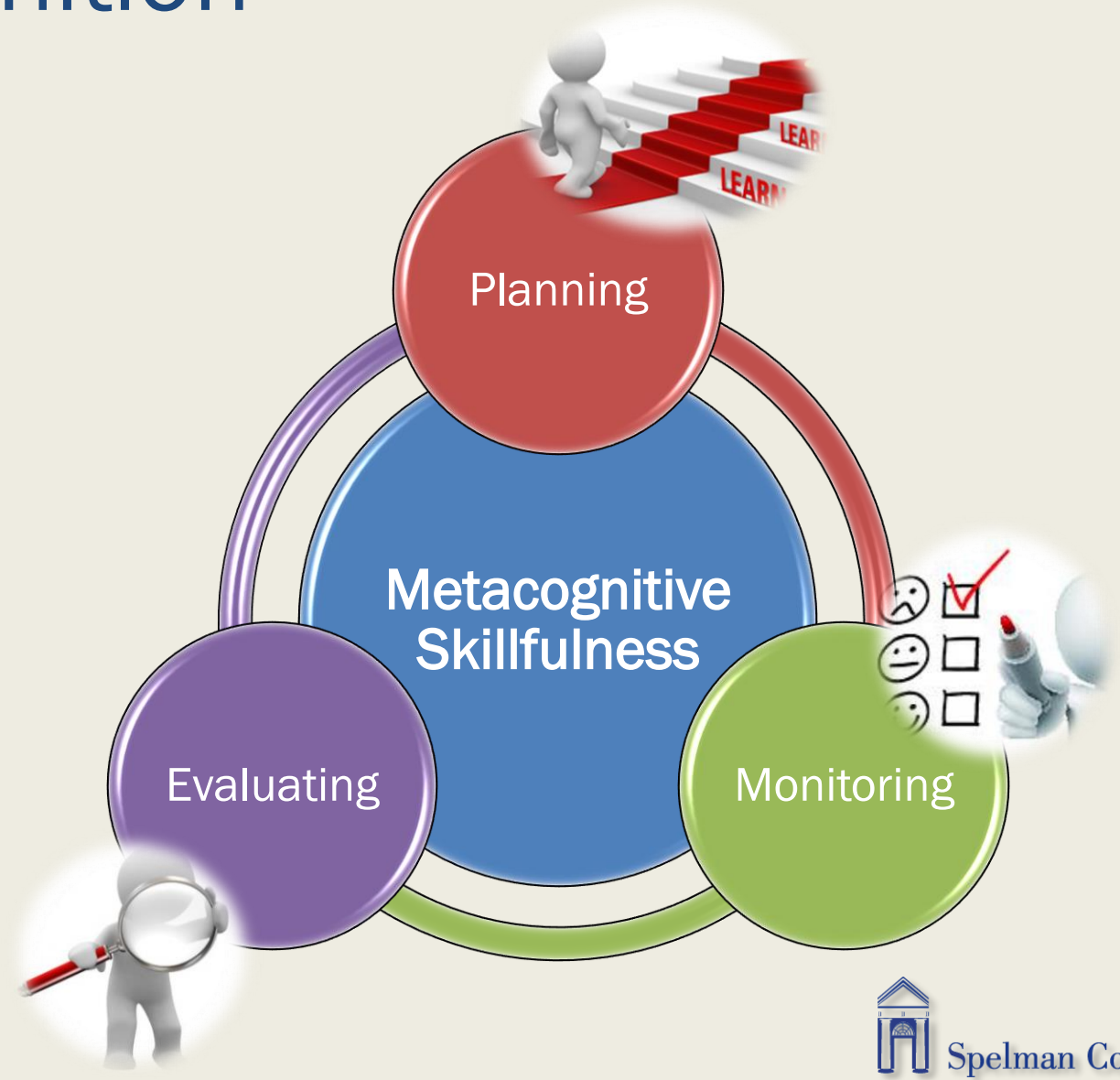
Stages of Metacognition

- Accurately assess your knowledge and modify strategies to obtain knowledge
  - *Awareness*
  - *Skillfulness (or Monitoring)*
  - *Experience*



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1

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How do we get students to reflect on their process?

PRE AND POST ASSESSMENTS BASICS

Why I Use Pre and Post Assessments

- To determine current knowledge
- To determine gains in knowledge
- To encourage critical analysis of learning strategies
- To improve course engagement
- To measure the value/quality of an activity

To improve learning outcomes

Quick Start Guide to Pre and Post Assessments

1. Keep it short (beginning and end of semester assessments can be longer)
2. Keep the questions simple
3. Pre and post assessment can be the same or different
4. Develop strategies to communicate outcomes to students
5. Identify what will be measured content mastery, metacognition, or both
    a) *Content mastery – specific and connected*
    b) *Metacognition – broad and consistent*

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IMPLEMENTATION AND EXAMPLES

Example 1: Knowledge and Metacognition

- Objective 1: Students will be able to draw, explain, interpret…
- Objective 2: Students will improve in their ability to…
- Objective 3: Students will demonstrate metacognitive skillfulness..
- Objective 4: Students will demonstrate improved confidence in their knowledge of/ability to…

- Administered before and after a topic

Example 1: Knowledge and Metacognition

1. On a scale of 1 – 5, indicate your level of confidence with each item below. Circle a number below each concept.

   a. drawing structures in expanded formula.

   Not at all confident 1 2 3 4 5 **Extremely Confident**

   b. drawing structures in condensed formula.

   Not at all confident 1 2 3 4 5 **Extremely Confident**

   c. converting expanded formula to condensed formula.

   Not at all confident 1 2 3 4 5 **Extremely Confident**

   d. converting condensed formula to expanded formula.

   Not at all confident 1 2 3 4 5 **Extremely Confident**

2. Draw the expanded formula for propanol – $CH_3CH_2CH_2OH$.

Example 2: Knowledge and Metacognition

- Objective 1: Students will demonstrate improved ability to…
- Objective 2: Students will demonstrate metacognitive skillfulness..
- Objective 3: Students will demonstrate improved confidence in their knowledge of/ability to…

- Administered before and after class

- Pre- prompts
  - *What questions do you currently have about today's topic?*
  - *What do you know about today's topic?*
- Post-prompts
  - *What questions do you currently have about today's topic?*
  - *What did you learn today?*

Example 2: Knowledge and Metacognition

Discussion 36w

Also, I am having trouble with chem drill 21 3.b. I think I did the newman projection and wedge correctly but I am having trouble naming it. It is kind of difficult to figure out the parent name because of this ethyl group being attached to a long chain.

Discussion & Questions Nov 10, 2014

For topic 7, free radical polymerization, how do you predict the major products when the initiator used is Cl2. I know that the order of reactivity when the initiator is bromine is tertiary>secondary>primary.

Discussion & Questions Oct 30, 2014

If the most basic molecule is the better nucleophile, and the least basic molecule is the better leaving group, why is I- the best nucleophile and the best leaving group of all the halogens? Or am I getting something mixed up?

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Example 3: Knowledge and Metacognition

- Objective 1: Students will demonstrate improved ability to…
- Objective 2: Students will demonstrate metacognitive skillfulness..
- Objective 3: Students will demonstrate improved confidence in their knowledge of/ability to…

- Administered before and after a topic

- Pre- and Post combined prompts
  - *What concepts did you learn in the previous topic?*
  - *How are these concepts relevant/connected to the next topic?*

Example 3: Knowledge and Metacognition

What is the relationship between Lewis Acids and Bases and Topic 8, Nuclephilic Substitution?

In nucleophilic substitution, the Lewis base is the nucleophile. The Lewis base is electron rich in nucleophilic substitution and usually has a negative charge. The Lewis acid is the electrophile in nucleophilic substitution that is bonded to the leaving group. The Lewis base is electron deficient and usually has a positive charge.

The nucleophile is a Lewis base (it donates its electrons) and the electrophile is a Lewis acid (it receives electrons)

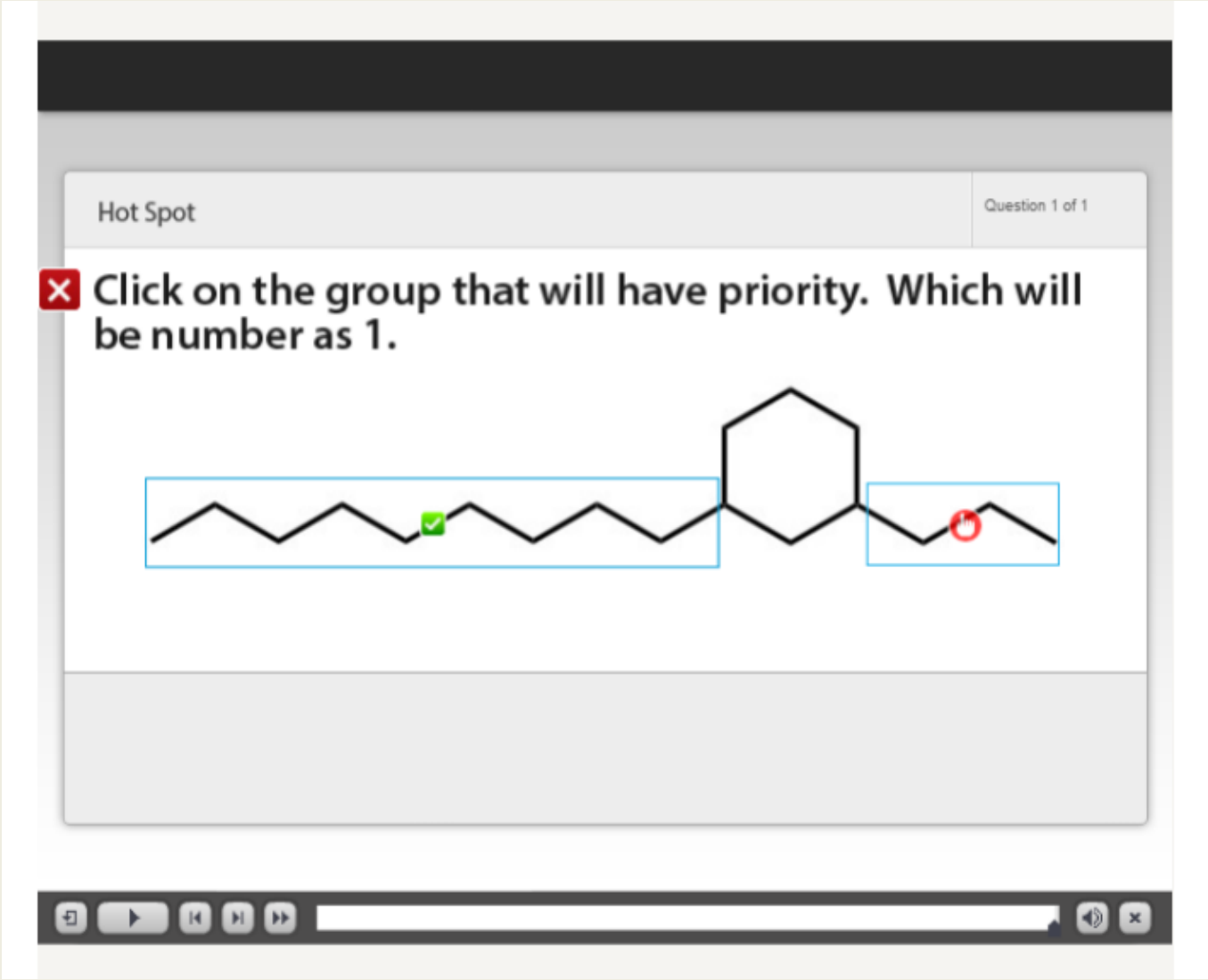
Example 4: Knowledge and Metacognition

- Objective 1: Students will demonstrate improved ability to…
- Objective 2: Students will demonstrate metacognitive skillfulness..
- Objective 3: Students will demonstrate improved confidence in their knowledge of/ability to…

- Administered before and after an online activity

- Pre/Post-questions
  - *What questions do you have about the topic?*
  - *Multiple choice*
  - *Short answer*
  - *Sorting*
  - *Ranking*
  - *Hot spots*

Example 4: Knowledge and Metacognition



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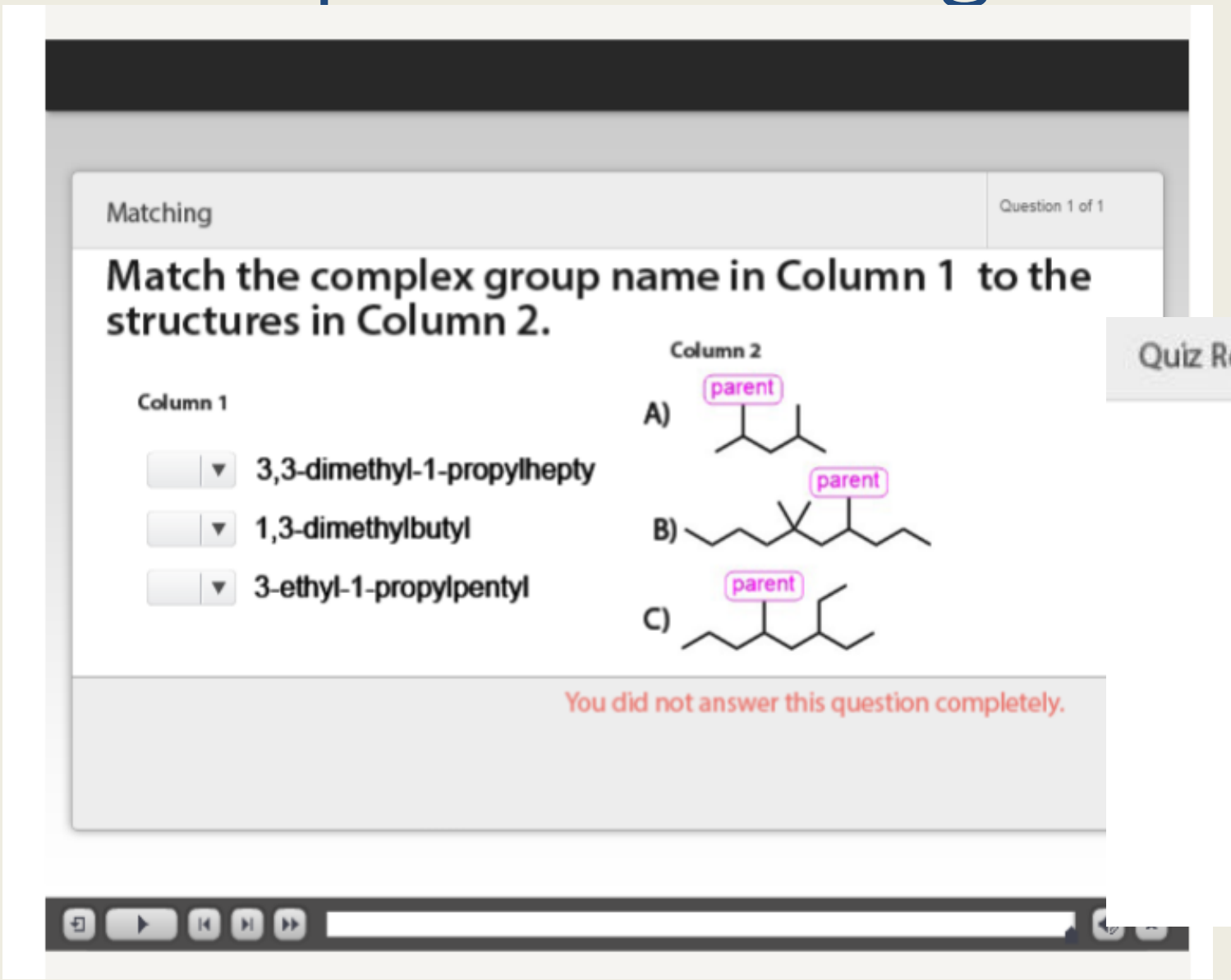
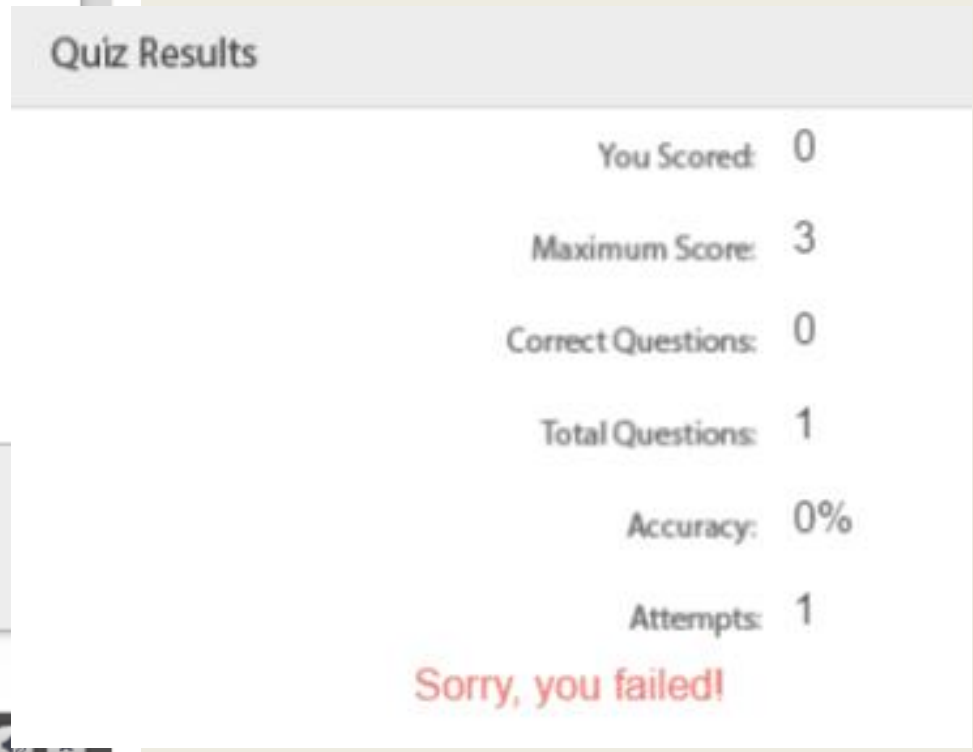
Example 4: Knowledge and Metacognition





Example 5: Metacognition

- Objective 1: Students will demonstrate metacognitive skillfulness..
- Objective 2: Students will demonstrate improved confidence in their knowledge of/ability to…

- Administered before and after a exam

Example 5a: Metacognition (before exam)

What grade do you expect to earn on Exam 3?

0 10 20 30 40 50 60 70 80 90 100

Slide the bar to indicate your expected average

How confident do you feel about the information to be covered on Exam 3.

Why did you indicate that level of confidence?

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Example 5a: Metacognition (after exam)

Perceived Knowledge

Indicate your level of agreement with each statement.

After completing the exam, I am confident in my knowledge of the concepts covered on Exam 3. *

	1	2	3	4	5	6	7	8	9	10	
Disagree	○	○	○	○	○	○	○	○	○	○	Agree

The grade I earned on the exam (or will earn on the exam) reflects my knowledge of the information? *

	1	2	3	4	5	6	7	8	9	10	
Disagree	○	○	○	○	○	○	○	○	○	○	Agree

Example 5c: Metacognition (after exam)

- What strategies did you use to learn the information?
- What did your professor do to assist you learn the information?
- What will you do differently to prepare for the next exam?

DISSEMINATION AND FEEDBACK

Feedback

- Improvements in performance and confidence
- Accuracy of grade predictions
- Correct answers are given for assessments associated with online activities, but not in-class pre/post assessments

- **Encourage reflection and aid metacognitive development**

Tools used in Class for Dissemination

- **Scantron**
  - *Students receive a copy of both the next day*
- **Poll Everywhere** (https://www.polleverywhere.com/)
  - *Immediate composite feedback*
- **Socrative** (https://www.socrative.com/)
  - *Feedback is automated through the system*
- **Google Forms** (https://www.google.com/forms/about/;
  - *set as quiz under setting and select time to release responses*

Tools used Online for Dissemination

- Google Community* (https://plus.google.com/communities)
  - *Students provide feedback on questions and concerns posted by their peers*
  - *I moderate the feedback*
- Google Forms or Qualtrics (https://www.qualtrics.com/)
- TechSmith Relay
- Captivate

Muddiest Points

What remaining questions do you have about promoting metacognition?

Thank You

Contact Info

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References

- https://canvas.instructure.com/courses/773049/pages/stangor-8-dot-2-how-we-remember-cues-to-improving-memory
- McGuire, Saundra Y. Stylus Publishing, LLC, 2015.
- Cook, Elzbieta; Kennedy, Eugene and McGuire, Saundra Y. . *Journal of Chemical Education* 90.8 (2013): 961-967.
- Weimer, Maryellen. John Wiley & Sons, 2002.

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