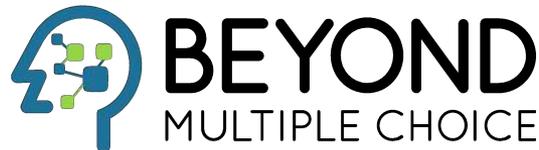# What do your students think? Automated analysis of student writing in STEM

Juli Uhl, Megan Shiroda, Jenifer Saldanha, Kevin Haudek

Automated Analysis of Constructed Response (AACR) Research Group

CREATE for STEM Institute, Michigan State University

Today's Presenters
Automated Analysis of Constructed Response (AACR) Research Group

Megan Shiroda
Postdoctoral Researcher
Microbiology

Juli Uhl
Postdoctoral Researcher
Genetics

Jenifer Saldanha
Assistant Professor
Biology

Kevin Haudek
Assistant Professor
Biochemistry

Acknowledgements

Jenifer Saldanha will present a poster later today (4:30 pm) on using the tool we discuss here in a classroom setting. Poster title: "Automated analyses of written responses reveal student thinking in STEM" Poster # P-14

Special thanks to Kamali Sripathi and Jennifer Kaplan who developed the predictive models used in today's demo

Polls:

Please answer in the chat…

(Open "Chat" on the bottom)
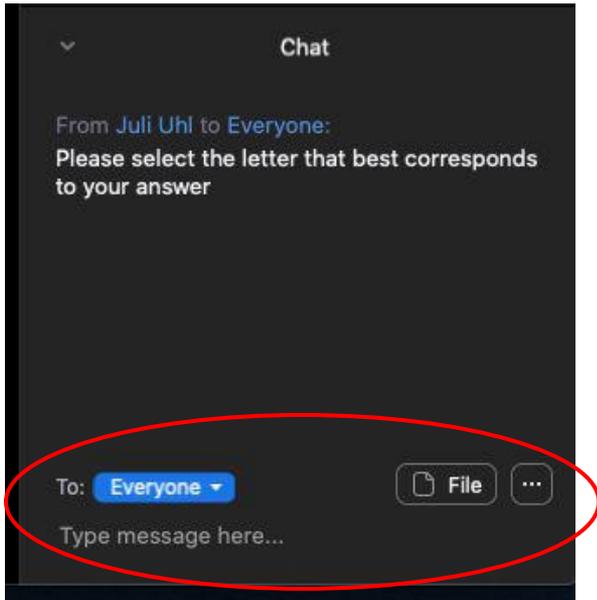
Or raise your hand to speak! (Open "Participants" on the bottom, click "Raise Hand")
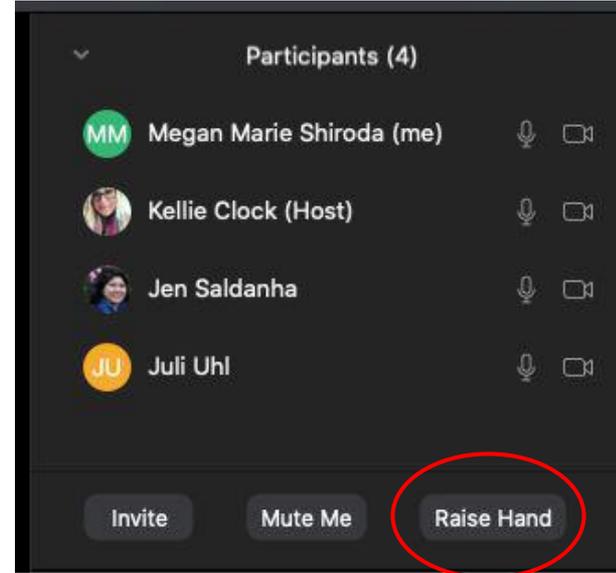
Poll: What is your role in education?

A. Administrator
B. Instructor or Educator
C. Educational Staff
D. Researcher
E. Graduate Student
F. Postdoctoral Research Associate
G. Other, I will type it in the chat

Poll: What is your disciplinary expertise or teaching focus?

A. Math
B. Statistics
C. Biological Sciences
D. Physiology
E. Chemistry
F. Physics
G. Other, I will type it in the chat

Poll: What do you hope to learn about today?

A. Constructed response
B. Formative assessment
C. Automated online assessment tool
D. Student thinking in STEM
E. Addressing student misconceptions
F. Methods to improve student learning
G. Other, I will type in the chat

Objectives of the AACR Project

- Evaluate students' understanding of scientific concepts and/or ability to engage in scientific processes

- Generate automated scoring models for short, student text responses

- Examine student thinking

- Provide formative feedback to instructors

- Support instructional interventions

We develop large-scale formative assessments for:

- A variety of disciplines
    - Biochemistry
    - Biology
    - Chemistry
    - Physiology
    - Statistics

- A variety of constructs
    - conceptual understanding
    - mechanistic reasoning
    - principled reasoning
    - scientific argumentation

Think about these questions for ~1 minute. Then post a response in the chat

- Which tool(s) do you use for formative assessment?

- How do these tools help you understand student thinking?

Common formative assessments:

Multiple-choice:
- correct response by guessing
- test taking strategies

Constructed-response:
- More complete picture of student thinking
- Combination of scientific and non-scientific ideas

Assessing constructed responses is time consuming!

Assessing a Big Idea in Biology: Tracing Matter and Energy Across Scales (AAAS, 2011)

A scientific explanation of where mass goes during weight loss includes the idea that <u>carbon dioxide and water</u> are eliminated from our bodies
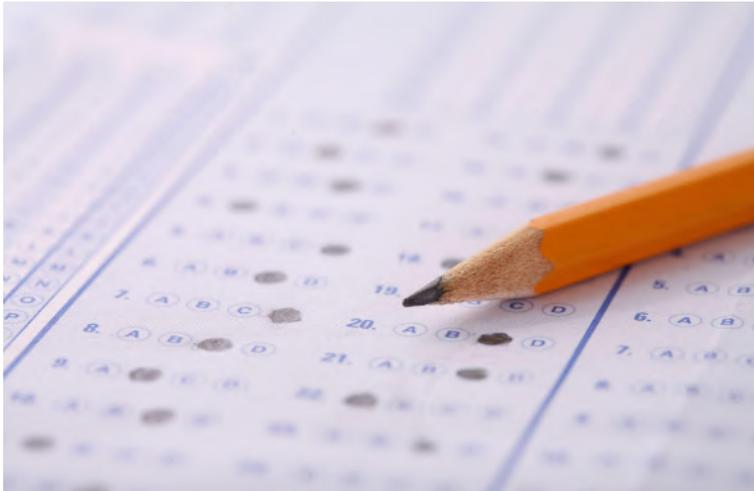
In a study of 800+ students from 19 institutions: 81% of students selected a multiple-choice option that captures the scientific idea above

In a constructed-response explanation, these students used an average of 2.1 ideas

59% of students who selected the correct multiple-choice option included at least one non-scientific idea in their constructed responses!
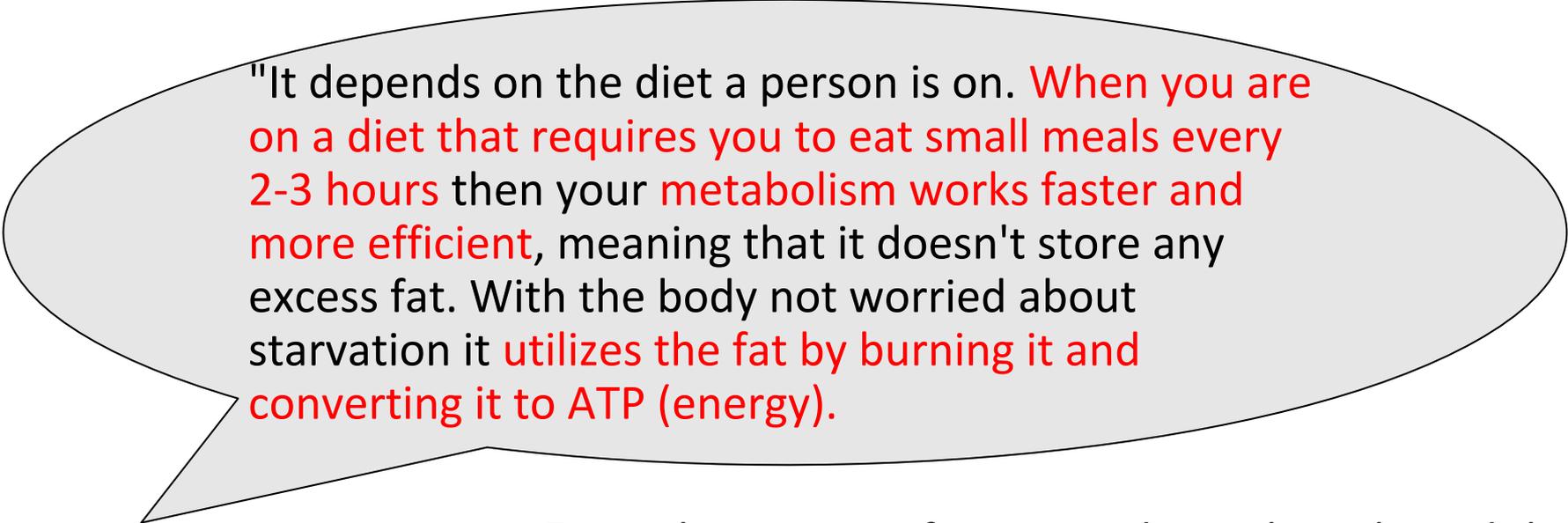
"It depends on the diet a person is on. When you are on a diet that requires you to eat small meals every 2-3 hours then your metabolism works faster and more efficient, meaning that it doesn't store any excess fat. With the body not worried about starvation it utilizes the fat by burning it and converting it to ATP (energy).

Example response from a student who selected the correct multiple choice option, non-scientific ideas in red text

Developing the Constructed Response Classifier (CRC) Tool
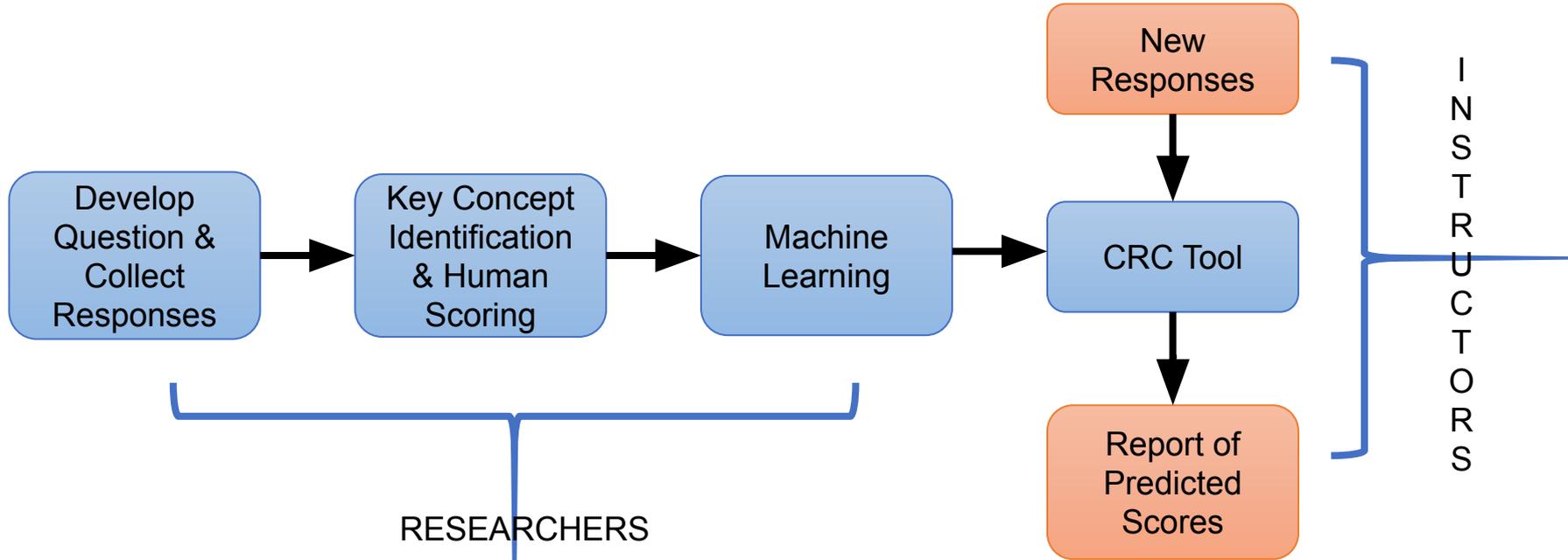
Things to discuss in small groups

1. How does the information in the report compare to information from other tools with which you are familiar?

2. Does the web diagram inform your interpretation of student thinking? If so, how?

3. How might this type of report facilitate course structures to allow responsive teaching?

4. In what ways could you incorporate the information from this report into your course and/or curriculum?

5. Is there anything else you would like to see in the reports?

What is one thing your small group focused on, or found most engaging during your discussion?

Examples of how the CRC tool has been used:

- **Implementation in a biology classroom: Jenifer Saldanha's poster presentation at 4:30, "Automated analyses of written responses reveal student thinking in STEM" (Poster Number: P-14)**
- Development of a new learning activity (Pelletreau et al., 2016)
- Assessing curricular implementation across institutions (Noyes et al., 2020)
- Tracking effectiveness of interactive tutorial (Uhl et al., under review)

BEYOND
MULTIPLE CHOICE

For more information visit
beyondmultiplechoice.org

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