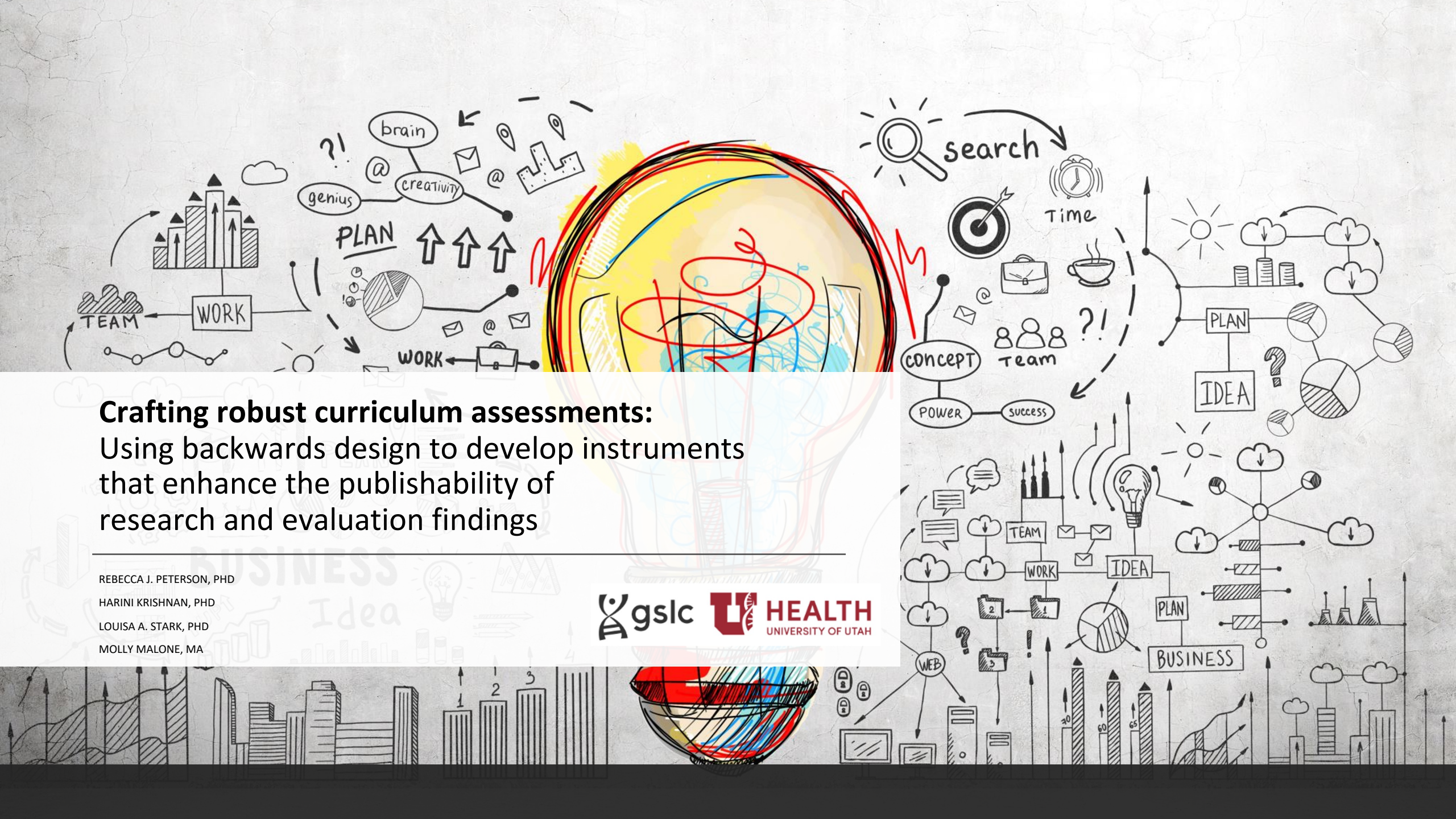

Crafting robust curriculum assessments:

Using backwards design to develop instruments that enhance the publishability of research and evaluation findings

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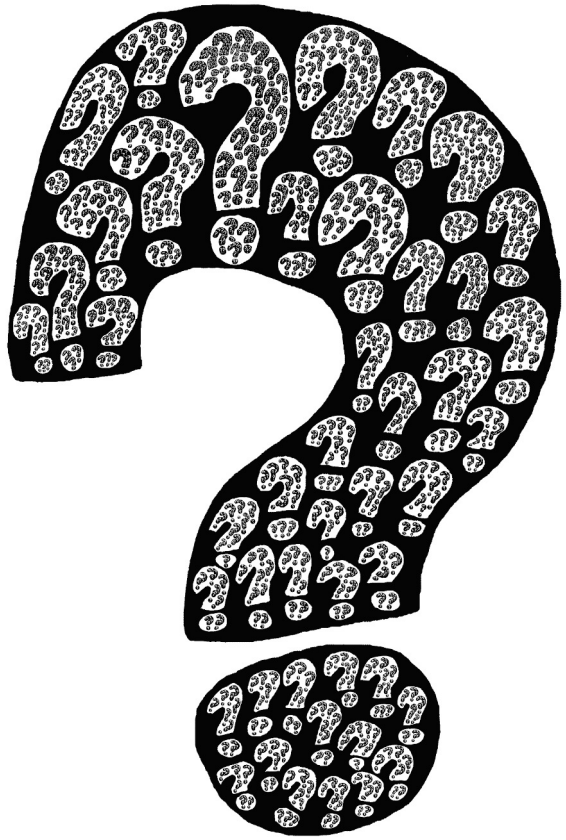
Participant Packet

https://tinyurl.com/SciEd24-Assess

Workshop Objectives

Apply	Apply backwards design to develop aligned assessments
Practice	Practice writing assessment items tied to learning objectives & Depth of Knowledge (DOK) levels
Discuss	Discuss strategies for establishing validity arguments



What do you see as the sequence of development between assessment and curricular materials?

Problem: Curriculum & Assessment Misalignment

Curriculum tends to get developed independently from assessment

Solution: Collaborative Backwards Design

- Alignment of expectations
- Measurable learning outcomes
- Scope of materials design

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What is Backwards Design?

- There is no such thing as a “valid test,” only valid uses of test data
- Validity refers to uses of test data, not the test itself
- Results obtained from a test are useful for a specific purpose (validated)

(American Educational Research Association et al., 2014)

Applying Backwards Design: Bioengineering

Design with validation in mind

DEFINE MEASURABLE OUTCOMES

DETERMINE EVIDENCE NEEDED

PLAN LEARNING EXPERIENCES

Applying Backwards Design: Bioengineering

DEFINE MEASURABLE OUTCOMES

Teachers identified big ideas:

- Neurons interact in body systems to send, receive and interpret signals.
- The structure of a nerve cell determines its function.
- The nervous system responds to stimuli in the environment through motor and sensory neurons.

Curriculum Writers Created a Learning Objective:

Students will describe how the nervous system responds to stimuli in the environment through motor and sensory neurons.

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Think About It: Writing Assessment Questions

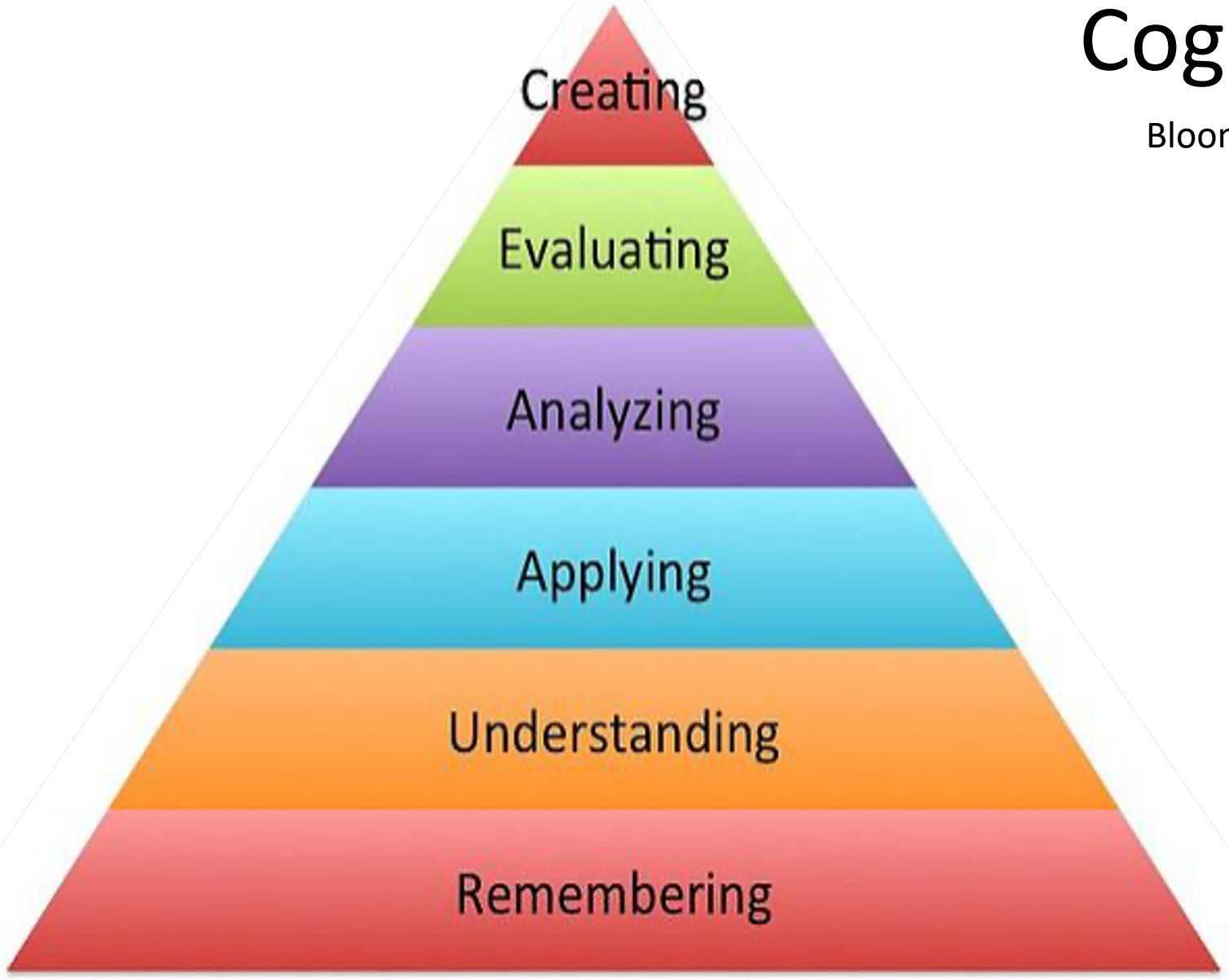
Students will describe how the nervous system responds to stimuli in the environment through motor and sensory neurons.

What questions would you write?

Clear picture of what you're measuring?

Cognitive Complexity

Bloom's Taxonomy (Anderson et al., 2001)



Depth of Knowledge

- Level 1: Recall and Reproduction
- Level 2: Basic skills and concepts
- Level 3: Strategic thinking and reasoning
- Level 4: Extended thinking

(Webb & Christopherson, 2019)

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Using DOK to focus our work

The Source Document
https://tinyurl.com/Webb-DOK

Our “cheat sheet”
https://tinyurl.com/SciEd24-DOK

Starting the discussions

Collaborative Backward Design

What are our Intended Learning Outcomes? (ILOs)

https://tinyurl.com/SciEd24-ILO

DEFINE MEASURABLE OUTCOMES

DETERMINE EVIDENCE NEEDED

Students will describe how the nervous system responds to stimuli in the environment through motor and sensory neurons.

LO 1.1 (DOK 1): Students will identify the three distinct parts of a neuron and name the function of each part.

LO 1.2 (DOK 1): Students will describe the role each part of a neuron plays in receiving and responding to stimuli from the environment.

Example Bioengineering Learning Objective

Original: Describes neural response to stimuli

Refined: Specifies neuron parts, functions, DOK level

Collaborative Assessment Design

After LOs are established with specified DOK levels

The Assessment Planner

1. **Write** 2 to 3 times the number of items
    a. Different difficulty levels for DOK specified

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Activity: Create Assessment Items

Topic: Engineering For Health - Genetic Technology Investigations

- Write 2 items for each of the objectives in the Participant Packet
  - (divide up 2 people per intended learning outcome)

- https://tinyurl.com/SciEd24-Assess

Collaborative Assessment Design

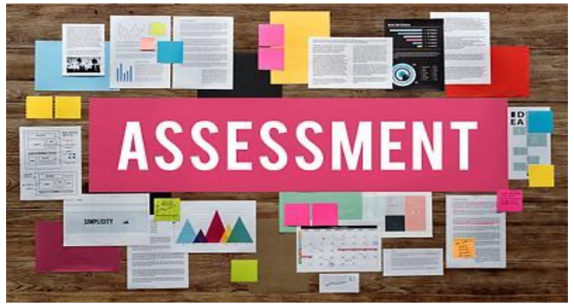
After LOs are established with specified DOK levels

Activity: Alignment Check

Topic: Engineering For Health - Genetic Technology Investigations

1. Review the assessment items you wrote for each of the objectives in the packet
2. Check DOK alignment with your group

- https://www.webbalign.org/dok-definitions-for-science



Collaborative Assessment Design

After LOs are established with specified DOK levels

The Assessment Planner

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Cognitive Labs

Protocol
Data Collection

The approach

- Scripted
  - Introduction
  - Modeling by interviewer and practice
  - Read questions
- Open-ended probing questions
  - Focused on understanding approaches to thinking
- Emphasis on thought process, not correct answers
- Record transcripts
- Track data

+

Tools of the Trade

Cognitive Lab Interview Protocol

Genetic Science Learning Center

Rebecca J. Peterson, PhD
November, 2023

Thank you for facilitating the cognitive labs for the Genetic Science Learning Center. The following information describes the cognitive interview procedure.

- The protocol is divided into three main sections: pre-interview tasks, interview protocol, and post-interview tasks.
- It is important that you follow the protocol as written.
  - Where there are scripted instructions or prompts, please read them verbatim.
- If you have any questions about any portion of the protocol, please don't hesitate to reach out.

Pre-Interview Tasks

1. Review the protocol to make sure that you understand the procedures.
2. Familiarize yourself with:
   - The interview script (see below)
   - The assessments (Cog Lab Form A and Cog Lab Form B)

rview Protocol Script

cized text should be read aloud to students. Non-italicized text provides directions for the ver and is not part of the script.*

n

nts! My name is [interviewer name] and I'll be leading our interview today. First, I'd like to ith your teacher that we have received student assent forms and parent consent forms for each of acher name], can you confirm we have permission to proceed?

k you. Now, when I call your assigned number, please say "here" so I know who is who for our w today.

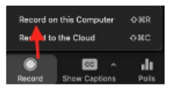
nes during our interview today to keep your

g our interview today, I will ask you to share n my screen.

g invitation. You will be made host of the
   - The Zoom meeting will be scheduled to start 10 minutes before the arrival of any meeting participants.
2. Open the Qualtrics assessment link for the test form you are using for the interview.
   - Day 1 interviews will use Cog Lab Form A, and Day 2 interviews will use Cog Lab Form B.
3. Make sure you can share the screen that has the Qualtrics assessment displayed.
4. Be prepared to start recording the audio of the meeting to your local computer once the teacher and students have joined.
   - No video recording is permitted.
   - The host may have their video on so that participants can see the host and the host's shared screen, but the host will not be able to see participants.
   - The meeting settings will be set to prevent participants from turning video on.
   - Participants will be automatically muted upon entering the meeting.

Starting The Meeting

1. At the time the meeting is scheduled to begin, verify with the teacher or other school personnel that the students are present with them and that they are ready to begin.
2. Tell the teacher to assign one student to be student 1, one to be student 2, and the remaining student to be student 3 and remind them not to share their names.
3. Notify participants that you will be audio recording this interview and begin the recording by clicking on the record button on the Zoom meeting controls and selecting "Record on this computer."
4. Verify that the recording has started before beginning the interview.



	A	B	C	D
	Student Number	**Student ID (assigned by teacher for the study)**		
	1			
	2			
	3			
		DOK 1 **ex. classify, associate, describe, follow steps, identify, list, match, name, order, recall, recognize, sort, state, etc.**	**DOK 2** **ex. apply, compare/contrast, connect, describe unfamiliar ideas or constructs, develop models, explain familiar ideas, infer, interpret, oganize, predict, summarize, draw conclusions**	**DOK 3** **ex. analyze, critique, design solutions, develop hypotheses, evaluate against criteria, construct explanations, identify patterns, interpret data in context, investigate, justify, make decisions, reason, relate, synthesize, draw conclusions based on evidence, apply knowledge in new or unfamiliar situations**
	Question 1			
	Question 2			
	Question 3			
	Question 4			
	Question 5			
	Question 6			

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Statistical Analyses

- Descriptive Statistics
- Item Difficulty
- Discrimination
- Reliability
- Dimensionality
- Differential Item Functioning (DIF)
- Guessing Parameters (IRT)

Establishing Validity Arguments

Collect evidence: assessment use for intended purpose (American Educational Research Association et al., 2014)

Key Points: *Standards for Educational and Psychological Testing*

1. Define and Align Content

- Clearly outline the knowledge, skills, and abilities the curriculum aims to teach.
- Ensure test items match the curriculum's learning objectives.
- Provide reasons for how test items align with these objectives.

2. Ensure Accurate Reflection of Learning

- Gather evidence that test scores show what students have learned.

3. Minimize Unfair Influences

- Make sure test results reflect students' mastery of the curriculum, not external factors.

4. Analyze Test Structure

- Assess item difficulty, discrimination, reliability, and overall coherence.

5. Validate for All Student Groups

- Ensure test fairness and relevance for all student subgroups.
- Look into differential item functioning and potential biases in test content or administration.

(American Educational Research Association et al., 2014)

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Key Takeaways

- Start assessment design early
- Use DOK for shared expectations
- Collaboration is key
- Validation is evidence-based

Selected Articles
https://tinyurl.com/SciEd24-CBWD

Questions?

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