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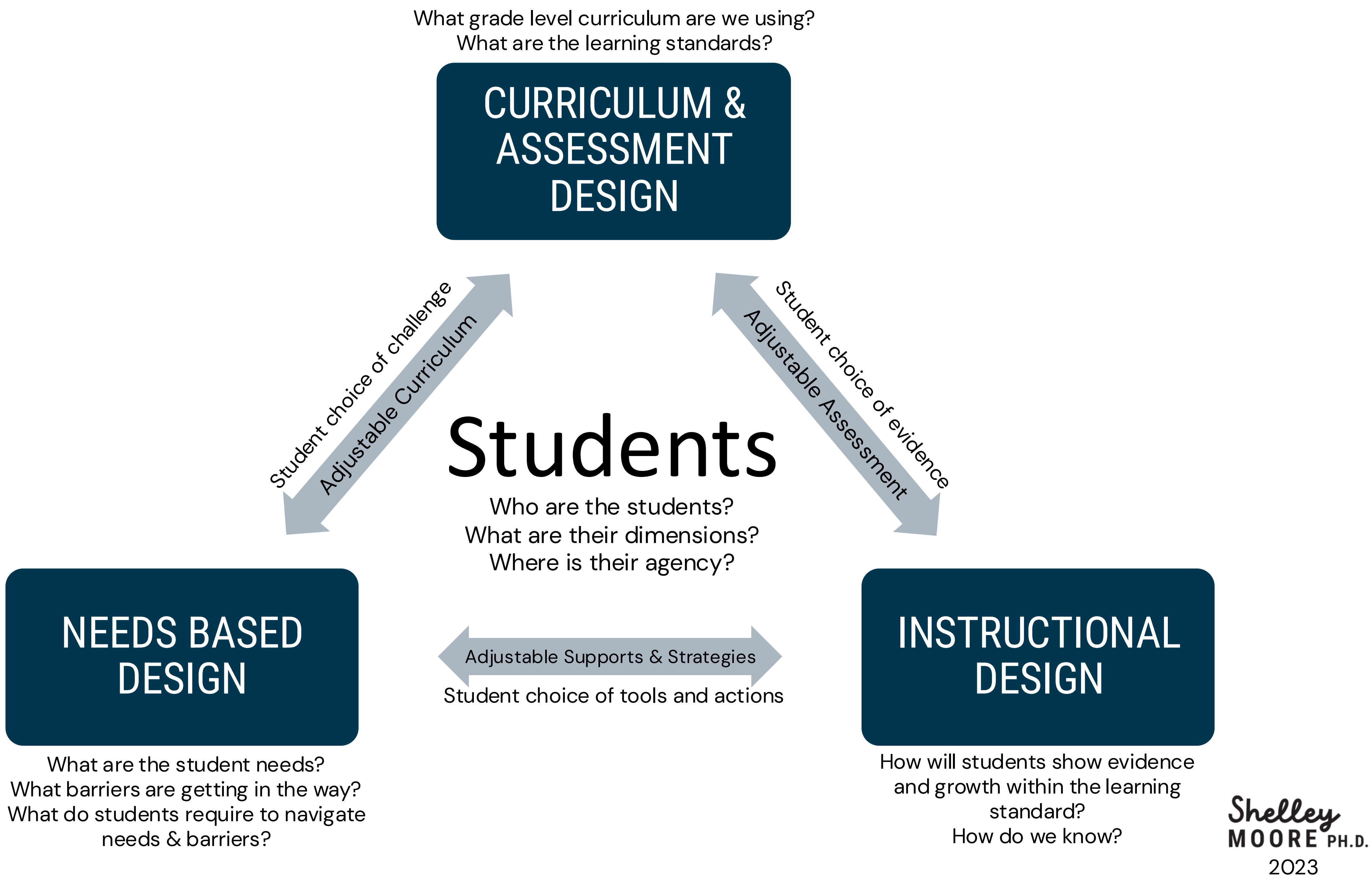
Dr. Shelley Moore

What is one useful idea so far today?

When the conditions are right, everyone can be successful

Shelley MOORE PH.D.
2023


What grade level curriculum are we using?
What are the learning standards?
CURRICULUM & ASSESSMENT DESIGN
Student choice of challenge
Adjustable Curriculum
Student choice of evidence
Adjustable Assessment
Students
Who are the students?
What are their dimensions?
Where is their agency?
NEEDS BASED DESIGN
Adjustable Supports & Strategies
Student choice of tools and actions
INSTRUCTIONAL DESIGN
What are the student needs?
What barriers are getting in the way?
What do students require to navigate needs & barriers?
How will students show evidence and growth within the learning standard?
How do we know?
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2023

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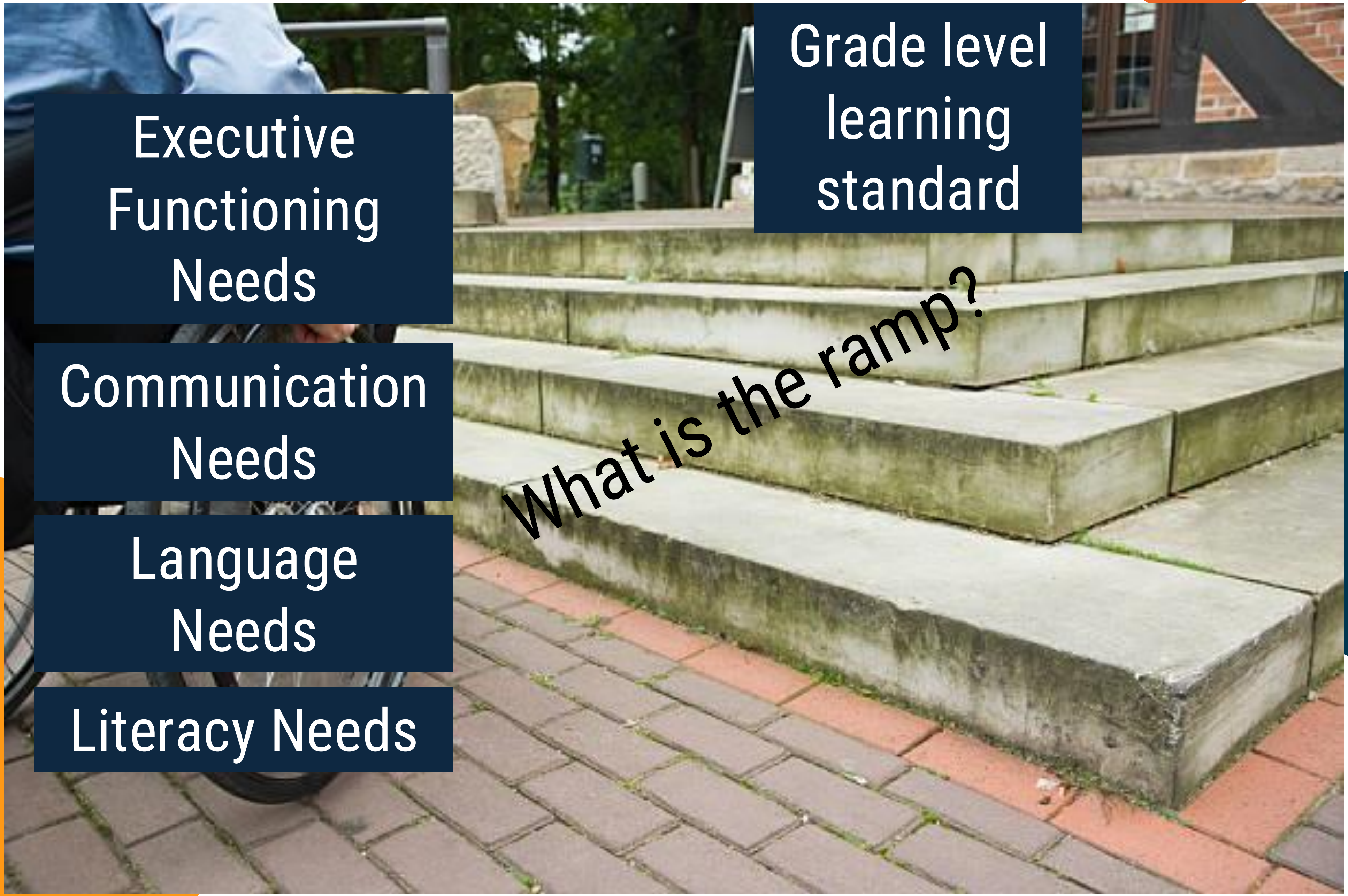
2023



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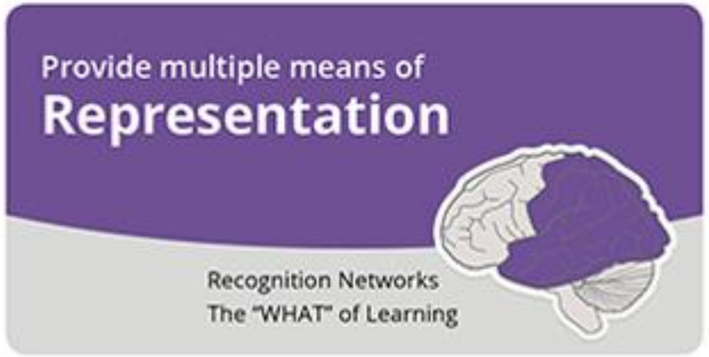
Accessing Grade Level Learning Standards

All students need to be engaged



All students need to understand

All students need to show learning

What universal supports & strategies can be taught to reduce barriers for everyone?

	Design Multiple Means of **Engagement**	Design Multiple Means of **Representation**	Design Multiple Means of **Action & Expression**
Access	Design Options for **Welcoming Interests & Identities** (7) • Optimize choice and autonomy (7.1) • Optimize relevance, value, and authenticity (7.2) • Nurture joy and play (7.3) • Address biases, threats, and distractions (7.4)	Design Options for **Perception** (1) • Support opportunities to customize the display of information (1.1) • Support multiple ways to perceive information (1.2) • Represent a diversity of perspectives and identities in authentic ways (1.3)	Design Options for **Interaction** (4) • Vary and honor the methods for response, navigation, and movement (4.1) • Optimize access to accessible materials and assistive and accessible technologies and tools (4.2)
Support	Design Options for **Sustaining Effort & Persistence** (8) • Clarify the meaning and purpose of goals (8.1) • Optimize challenge and support (8.2) • Foster collaboration, interdependence, and collective learning (8.3) • Foster belonging and community (8.4) • Offer action-oriented feedback (8.5)	Design Options for **Language & Symbols** (2) • Clarify vocabulary, symbols, and language structures (2.1) • Support decoding of text, mathematical notation, and symbols (2.2) • Cultivate understanding and respect across languages and dialects (2.3) • Address biases in the use of language and symbols (2.4) • Illustrate through multiple media (2.5)	Design Options for **Expression & Communication** (5) • Use multiple media for communication (5.1) • Use multiple tools for construction, composition, and creativity (5.2) • Build fluencies with graduated support for practice and performance (5.3) • Address biases related to modes of expression and communication (5.4)
Executive Function	Design Options for **Emotional Capacity** (9) • Recognize expectations, beliefs, and motivations (9.1) • Develop awareness of self and others (9.2) • Promote individual and collective reflection (9.3) • Cultivate empathy and restorative practices (9.4)	Design Options for **Building Knowledge** (3) • Connect prior knowledge to new learning (3.1) • Highlight and explore patterns, critical features, big ideas, and relationships (3.2) • Cultivate multiple ways of knowing and making meaning (3.3) • Maximize transfer and generalization (3.4)	Design Options for **Strategy Development** (6) • Set meaningful goals (6.1) • Anticipate and plan for challenges (6.2) • Organize information and resources (6.3) • Enhance capacity for monitoring progress (6.4) • Challenge exclusionary practices (6.5)

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High Impact UDL Strategies

- Benefits all students
- Reducing many barriers at the same time
- Meets multiple needs at the same time
- Small adjustments that make big differences to student learning
- <u>Does not</u> compromise evaluation

What are you already doing?

What is one more thing you could try?

High Impact UDL Strategies in Curricular Design

Design Multiple Means of Engagement

Access

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Welcoming Interests & Identities (7)

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- Optimize relevance, value, and authenticity (7.2)
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Support

Design Options for
Sustaining Effort & Persistence (8)

- Clarify the meaning and purpose of goals (8.1)
- Optimize challenge and support (8.2)
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Executive Function

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Design Multiple Means of Representation

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Design Options for
Perception (1)

- Support opportunities to customize the display of information (1.1)
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Executive Function

Design Options for
Building Knowledge (3)

- Connect prior knowledge to new learning (3.1)
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- Maximize transfer and generalization (3.4)

Design Multiple Means of Action & Expression

Access

Design Options for
Interaction (4)

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How I came to understand BACKWARDS DESIGN

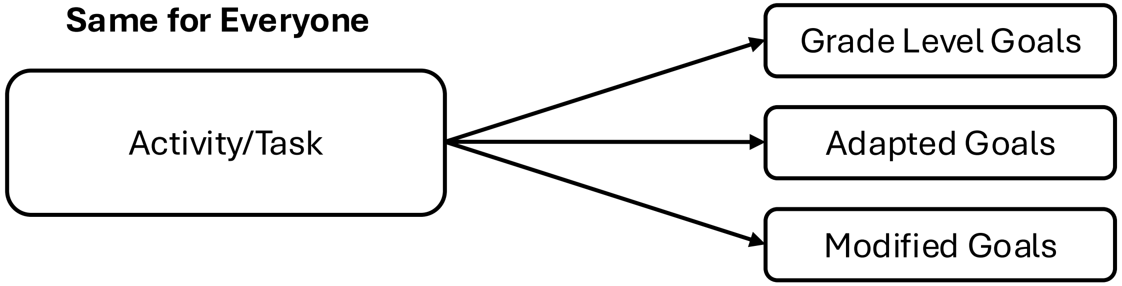
Design with the End in Mind!

Forward Design

Standardized

Differentiated

Same for Everyone

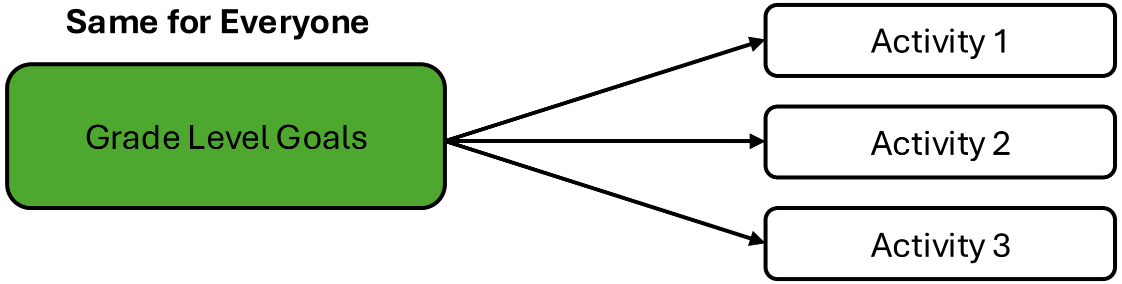


Compromises the integrity of evaluation

Backward Design

Differentiated

Same for Everyone



Does not compromise the integrity evaluation

McTigue, 2010

Standards Based

High Impact UDL Strategies

8.1: Clarify the Meaning and Purpose of Goals

- What grade level learning standards and sub-standards are we intentionally targeting, teaching and assessing the unit??
- There are different kinds of goals in Backwards Design
  - Competencies
  - Understandings
  - Knowledge
  - Skills

Grade: 5	Subject Area: Science
Learning Standard: 5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen	
Learning Goals	**Curricular Language** **What do Students need to Know and Do?**
Science and Engineering Practices (skills)	**Developing and Using Models** building and revising simple models and using models to represent events and design solutions. Use models to describe phenomena.
Disciplinary Core Ideas (knowledge)	**PS1.A: Structure and Properties of Matter** Matter of any type can be subdivided into particles that are too small to see matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations including the inflation and shape of a balloon and the effects of air on larger particles or objects.
Crosscutting Concepts (understanding)	**Scale, Proportion, and Quantity** Natural objects exist from the very small to the immensely large.

High Impact UDL Strategies in Curricular Design

Design Multiple Means of Engagement

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High Impact UDL Strategies

7.2: Optimizing relevance, value & authenticity

8.1: Clarify the Meaning and Purpose of Goals

8.3: Foster collaboration and community

3.2: Highlight patterns, critical features, big ideas and relationships

2.1: clarify vocabulary, symbols, and language structures

- Developing guiding questions that anchor learning in an authentic and relevant problem, collective context and/or a community-based idea that they can learn about together over time
- Giving students an opportunity to understand and/or translate the learning standards
- Identity and teach the vocabulary you want students to know and use

Grade: 5	Subject Area: Science	Strand/Topic: Structure and Properties of Matter
Learning Standard: 5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen		**Unit Guiding Question(s):** How do we know that something exiits if we cannot see it?
Content Vocabulary: model, matter, particles, idea, bulk matter		**Skills Vocabulary: create, build, change, solve a problem, observe**

Learning Goals	Curricular Language What do Students need to Know and Do?	Student Friendly Language
Science and Engineering Practices (skills)	**Developing and Using Models** building and revising simple models and using models to represent events and design solutions. Use models to describe phenomena.	• I can create and improve a model • I can use a model to show an idea • I can use a model to solve a problem
Disciplinary Core Ideas (knowledge)	**PS1.A: Structure and Properties of Matter** Matter of any type can be subdivided into particles that are too small to see matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations including the inflation and shape of a balloon and the effects of air on larger particles or objects.	• I know that matter can be broken apart into tiny particles that are too small to see • I know that even if tiny particles are too small for my eyes to see, there are other ways to observe them • I know that a model is a way to observe tiny particles too small to see • I know some examples of models that can help me observe tiny particles that are too small to see
Crosscutting Concepts (understanding)	**Scale, Proportion, and Quantity** Natural objects exist from the very small to the immensely large.	• I understand that there are things that are very tiny and very large

High Impact UDL Strategies in Curricular Design

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High Impact UDL Strategies

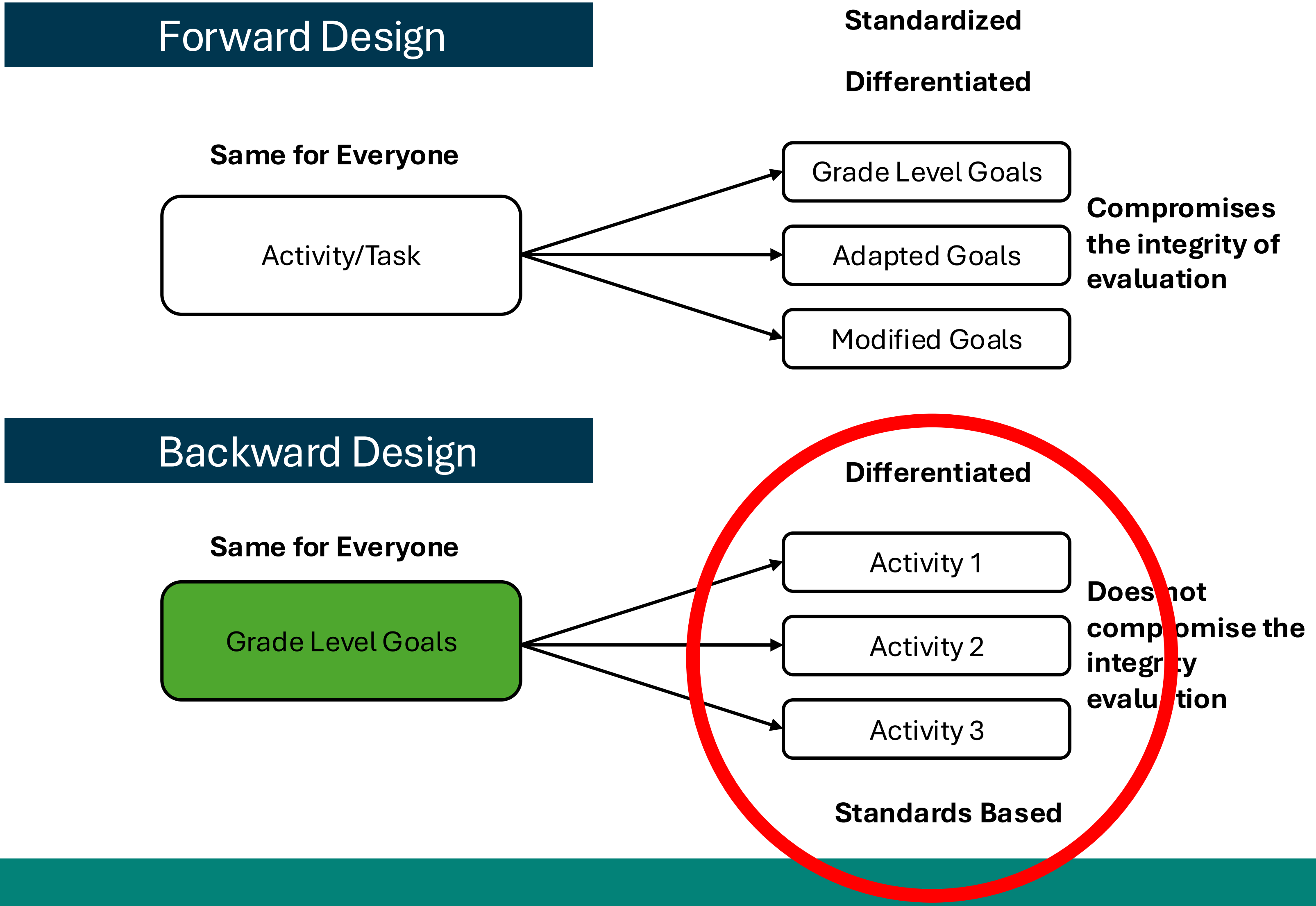
4.1: Vary & honour the methods for response, navigation, and movement

5.2: Use multiple tools for construction, composition and creativity

5.3: Build fluencies with graduated support for practice and performance

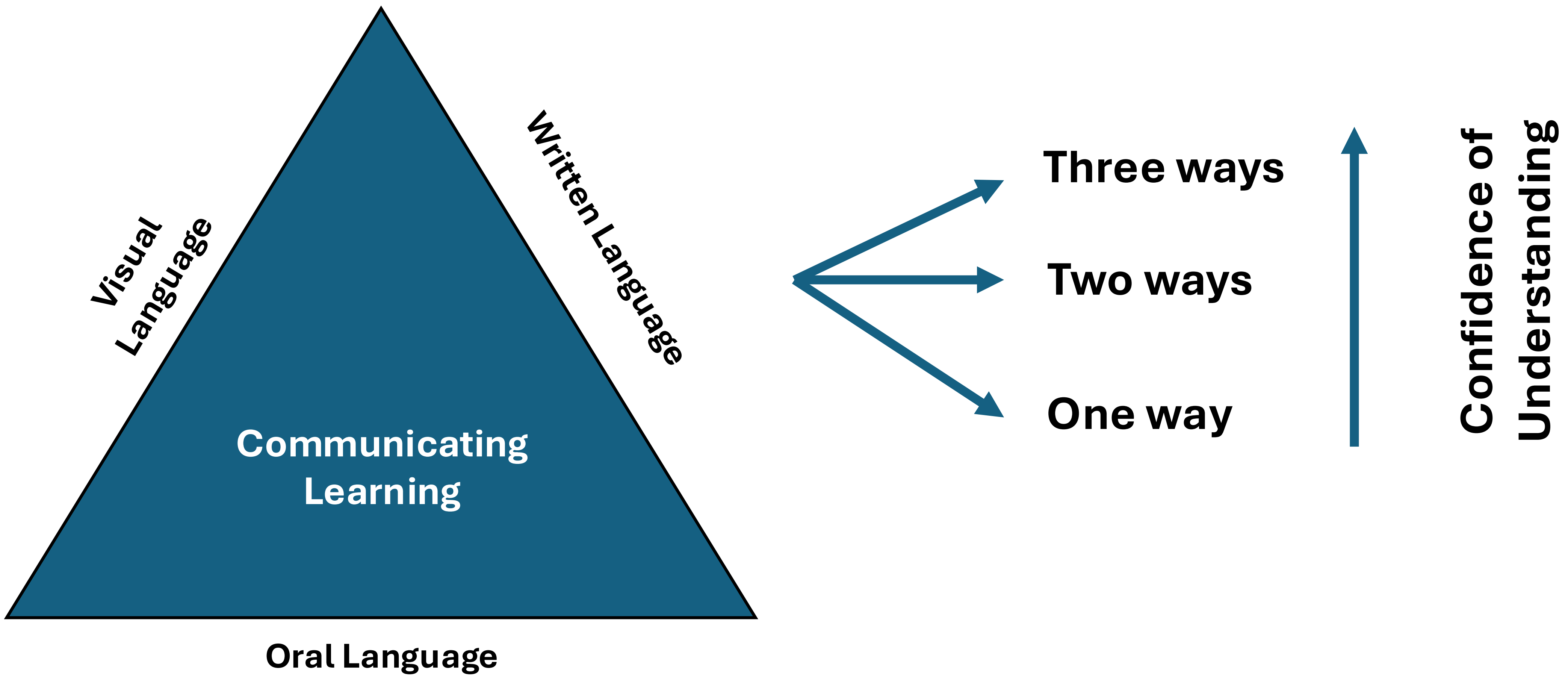
- **Designing lessons that create opportunities for teaching all students how to show their learning in many ways**
- **Students must show their learning in all ways, but use strongest evidence to evaluate learning standards**
- **Collecting multiple pieces of similar evidence over time to build fluency**

Design with the End in Mind!

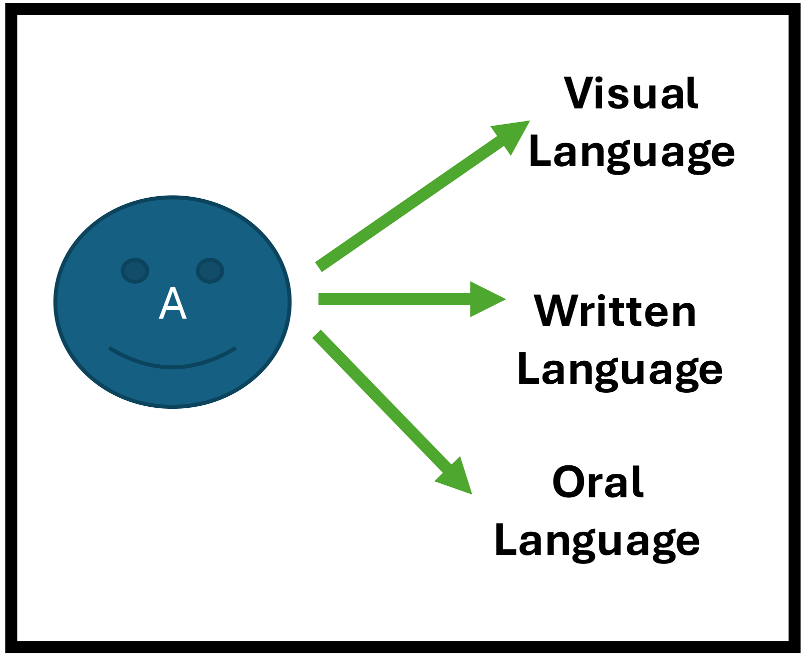


McTigue, 2010

How do student show what they know?



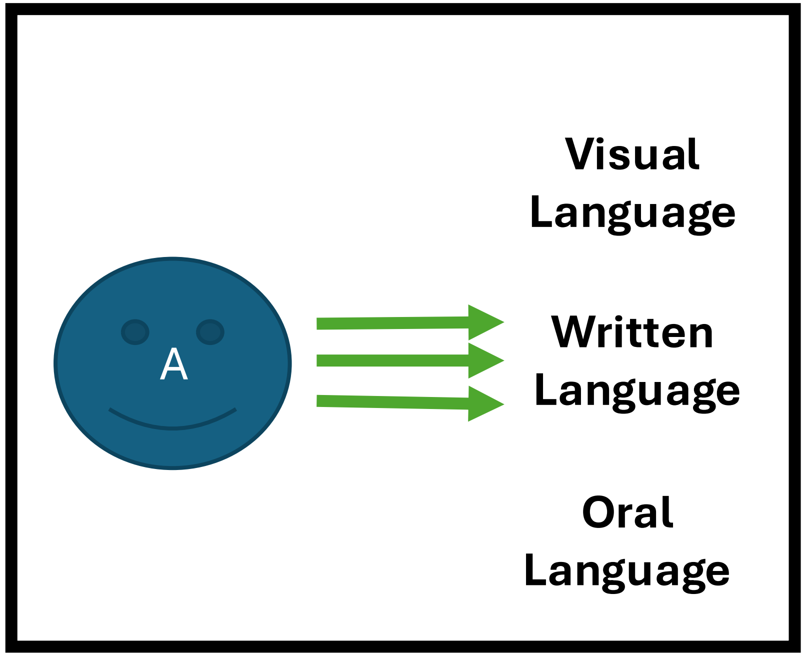
All Languages (in literacy) are Treated Equal!



The MORE WAYS students can demonstrate learning, the more confident we are of meeting a goal

Instead of

The NUMBER OF TIMES, a student can show their learning in one way, the more confident we are of meeting a goal



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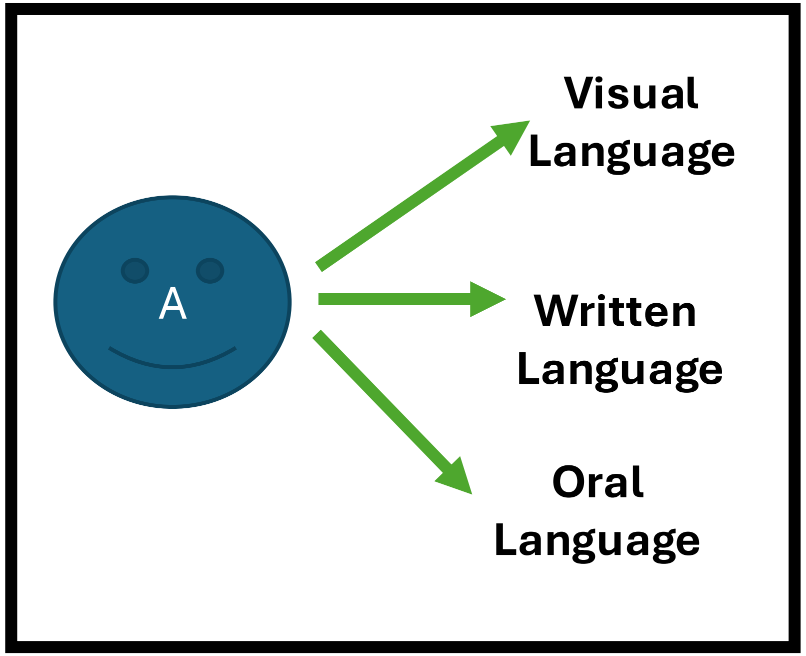

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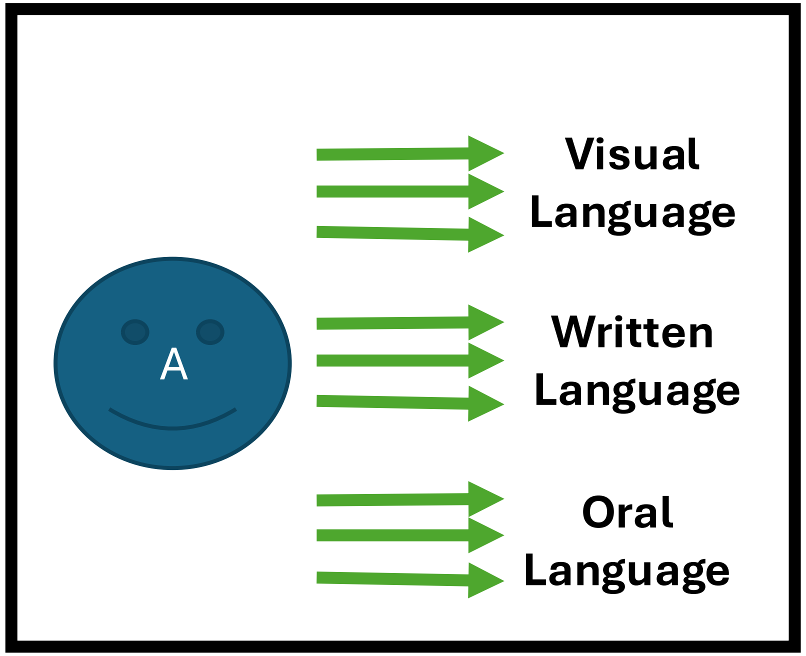
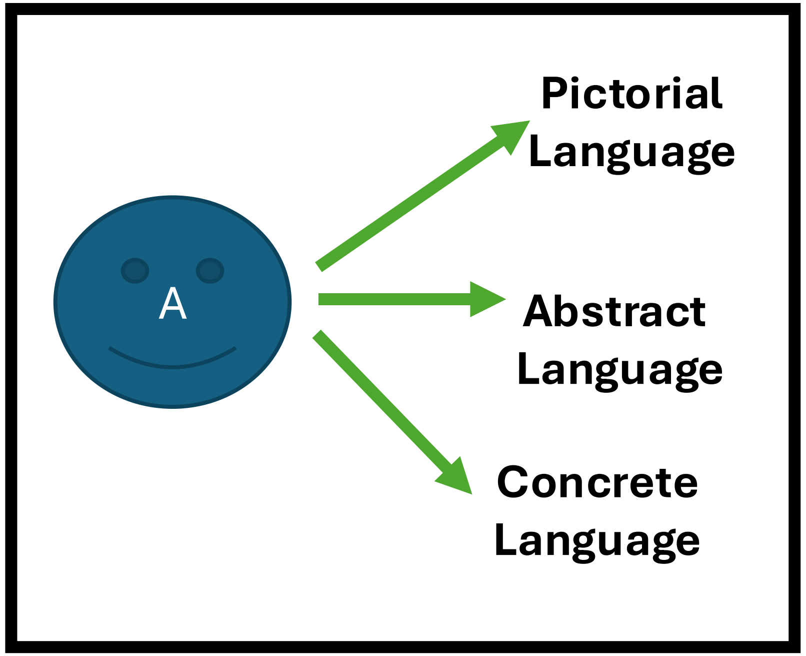


All Languages (in numeracy) are Treated Equal!



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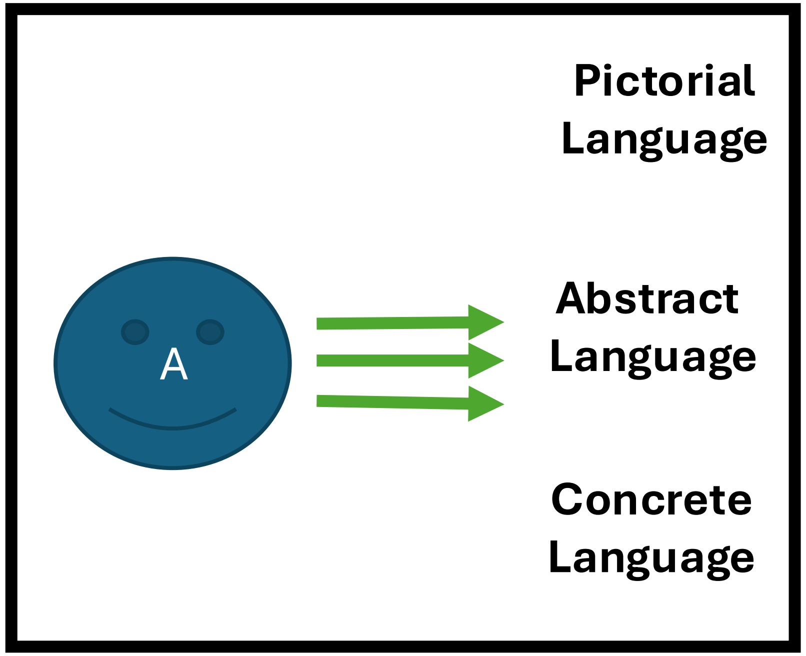

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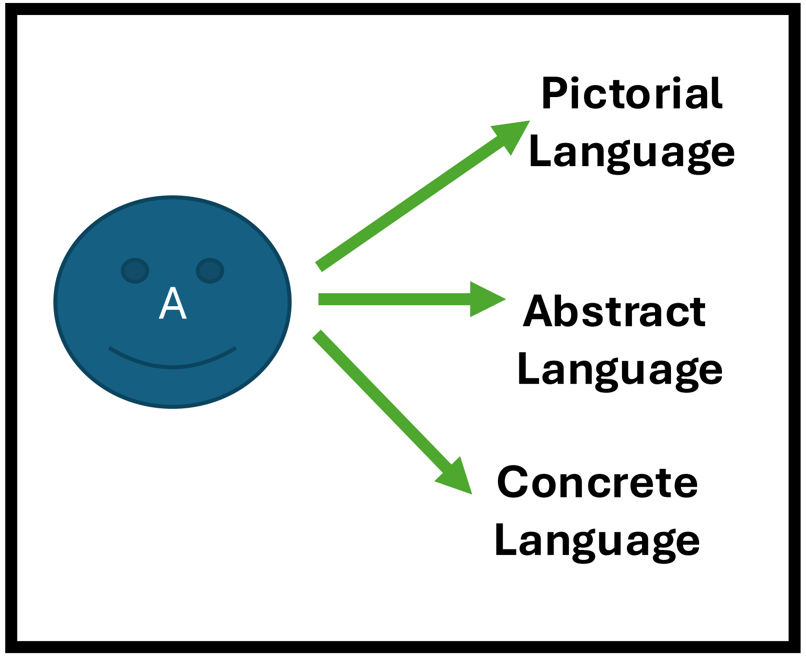

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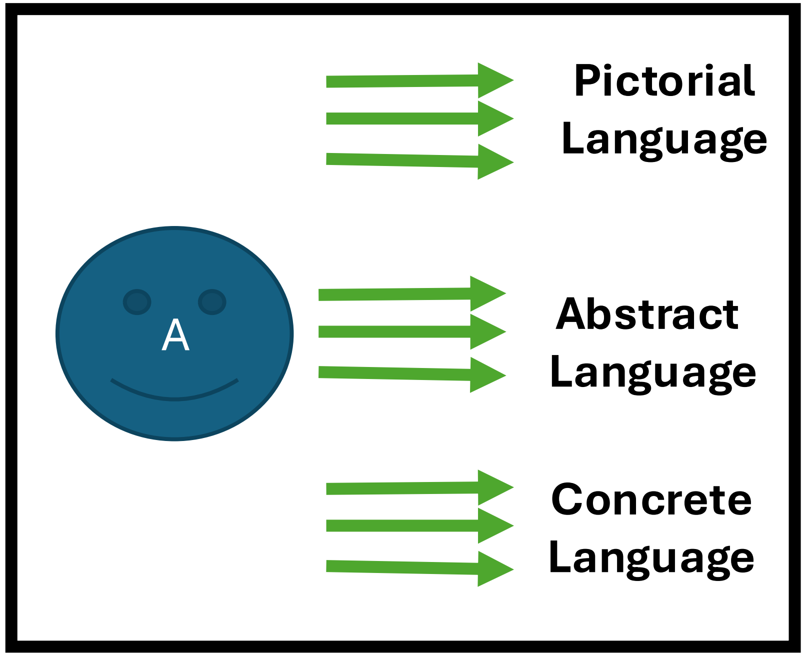


Learning Standards/ Outcomes	Assessment Tasks to Capture Learning	Differentiation of Evidence			
		Written	Oral	Kinesthetic	Visual

Lesson in instructional resource

MATERIALS

Student

- 1 Science notebook*
- 1 Student Investigation Sheet 2A: *What Are the States of Matter?*
- 1 Pair of safety goggles*

Team of four students

- 1 Clear plastic container with lid, 24-oz
- 20 Marbles

Teacher

- 1 Student Investigation Sheet 2A: *What Are the States of Matter?* (Teacher's Version)
- 1 Balloon
- 1 Glass beaker (100 mL) filled with ice
- 1 Glass beaker (100 mL) filled two-thirds with water
- 3 Clear containers of different shapes, filled with equal volumes of water*
- 3 Clear plastic containers with lids, 24 oz
- 3 Colors of food coloring*
- 1 Graduated cylinder, 1,000 mL
- 1 Hot plate*
- 1 Modeling-clay lump (shape and size to resemble the small, rigid, solid object below)
- 1 Oven mitt*
- 1 Pair of safety goggles*
- 1 Resealable plastic bag, 1 gal*
- 1 Small, rigid, solid object* (e.g., a plastic toy car)
- 1 Thermometer
- Chart paper or whiteboard*
- Marbles
- Markers*

*These materials are needed but not supplied.

1. Distribute a copy of Student Investigation Sheet 2A: *What Are the States of Matter?* to each student. As a brief review, instruct students to complete the first two rows of the chart individually. Ask students to share their responses.

2. Conduct Demonstration #1 where all students can observe. During the demonstration, allow students to ask questions to refine their understanding of these three states of matter.

a. Solids: Display the toy car and the lump of modeling clay. Squeeze the lump of modeling clay to change its shape. Ask:

- What did you observe when I squeezed each solid object? *(The clay changed shape, but the car did not.)*
- Did the masses of these solid objects change? Did the volumes change? *(No, the mass and volume did not change. If students do not recognize this, you may wish to form the clay back into a ball, and measure the mass and volume of both the clay and the car in front of the class. Squeeze the clay again and remeasure to demonstrate there is no change in mass or volume.)*
- Recall from the previous lesson that all matter is made of tiny building blocks called particles. If the volume or mass did not change, do you think the number of particles making up each object changed when the objects were squeezed? Explain your answer. *(No, because adding or removing particles would cause the object's volume or mass to change.)*

b. Liquids: Display the three containers of colored water you prepared, and ask students to observe the volume of liquid in each container. Pour the water from the containers of different shapes into three identical clear plastic containers to demonstrate that the quantities of liquid have equal volume. Pour the water back into the original containers to demonstrate that the volume stays the same but the liquid takes the shape of the container. Ask:

- What did you notice about the volume of each liquid? *(Students should notice that it looked like the volumes of the three liquids were different because the water levels were unequal, but when the liquids were poured into identical containers, it was obvious that they all had the same volume.)*
- What can you conclude about the volume of a liquid and the shape of its container? *(A liquid takes the shape of its container, but its volume does not change when the size of the container is changed.)*

c. Gases: Gently squeeze the balloon to demonstrate that the gas inside changes shape with the balloon. Do the same with the bag of air, and then open the seal to demonstrate that the air leaves the bag and disperses into the room. Ask:

- What did you notice when I squeezed the balloon and the bag of air? *(The gas seemed to move around inside both the balloon and the bag.)*
- How did the bag of air change when I opened it? Predict what happened to the gas inside. *(Students should predict that because the bag seemed to deflate when it was opened, the air left the bag.)*

3. Write the following statements on the board in a single column:

- A material that has definite shape and volume.
- A material that has definite volume but takes the shape of its container.
- A material that has no definite shape or volume and can expand freely to fill a container of any size or shape.

In a second column, write "solid," "liquid," and "gas." As a class, match each state of matter to one of the descriptions you wrote on the board. Instruct students to copy the descriptions into the first row of Student Investigation Sheet 2A.

Teaching Tip

Students may struggle to understand that solids like modeling clay have a definite shape. Explain that the modeling clay is malleable, or can change its shape, but that the individual particles that make up the modeling clay do not change in shape.

4. Explain that the next demonstration will utilize the same type of matter, water, in three different states. Students will observe phase changes, or the changes from one state of matter to another. Provide a pair of safety goggles for each student. Once you and the students have the goggles on, display the beaker of ice cubes and the beaker of water. Pour a little water from the water beaker into the beaker of ice and insert the thermometer. Measure the temperature of the ice water and record it on the board.

Teaching Tip

Dispel misconceptions that a material's temperature is increased only by extremes such as boiling or cooking. Bringing a glass of ice to room temperature is also an example of heating the material.

5. Place the beaker on a hot plate and begin to heat the ice water. Record the temperature every minute until all the ice has melted and the water is at a full boil. As the beaker heats up, ask students to observe what is happening and share their observations with the class. Students should notice that as the hot plate raises the temperature, the ice melts into water. The liquid water begins to boil, and some of the water turns into water vapor.

Teaching Tip

Exercise caution when using the hot plate. Do not touch or allow students to touch the hot plate. Also use caution when handling the beaker. Use an oven mitt or allow the beaker to cool completely before handling.

6. Turn off the hot plate and provide time for students to discuss what they observed in their groups. After some time, facilitate a class discussion using the following questions:

- How did the water change during this demonstration? How many phase changes occurred? *(Students should be able to identify two state changes: Ice was heated until it became water. Water was boiled until it become water vapor.)*
- What pattern do you notice with these phase changes? *(Both of the phase changes were the result of adding heat.)*
- How can you make ice? *(Freeze water.)*

Lesson in instructional resource

Teaching Tip

Make sure students understand that heat energy was added to cause the phase changes they observed. Explain that when water is frozen, heat energy is removed from the system.

7. Discuss melting point, freezing point, and boiling point. Write the following definitions on the board. Direct students to copy each into their science notebooks.

a. A material's freezing point is the temperature at which it changes from a liquid to a solid. For water, this is 0°C (32°F).

b. A material's melting point is the temperature at which it changes from a solid to a liquid. For water, this is 0°C (32°F).

c. A material's boiling point is the temperature at which it changes from a liquid to a gas. For water, this is 100°C (212°F).

Encourage students to provide examples of phenomena related to these terms, such as creating popsicles, melting ice cream, or steaming soup.

8. Ask students if they observed any particles during the demonstration. Make sure students understand that particles are too small to be seen with the eye and require a powerful microscope to view. Ask:

- Think about the ice, water, and vapor. Are these materials made of the same particles? *(Yes)*
- Do you think the number of particles changed as the water changed state? *(Answers will vary. Explain that the number of particles did not change.)*

9. Distribute 20 marbles and a clear plastic container to each group. Instruct students to work in groups of four to develop a model to describe the movement and attraction of the particles in each state of matter. Provide the following rules for students:

- You must demonstrate how particles become more or less attracted while changing from a solid to a liquid to a gas.
- You may use the container or the surface of your desk to demonstrate each state of matter.

Teaching Tip

Instruct students to shake their containers quietly and to make sure the floor is clear of marbles at the end of the investigation. You may want to provide a shallow box if the desks are not flat.

10. Provide time for groups to develop their models. Allow students to struggle with the challenge before intervening, but use the following question to guide students toward an understanding particle behavior:

- Think about adding energy to something, like we added heat energy to ice and water. What typically happens when something has more energy? *(Objects with more energy tend to move faster than objects with less energy. Guide students to this conclusion by asking them to describe the behavior of a person who has a lot of energy.)*

11. Allow each group to share its model. Draw attention to similarities and differences among the models, but identify models that accurately show particles becoming less attracted and moving faster. Once all groups have shared, ask:

- What happens to particles' attraction and movement as energy is added to a system of matter? *(The particles become less attracted and move faster.)*
- Relate the models to the definitions of each state of matter. *(Students' models will vary, but they should be able to describe how their model represents the following: Solids keep their shape, so their particles are strongly attracted and do not move very much. Liquids maintain the same volume but can take the shape of their container, so their particles have less attraction and more movement. Gases have no definite shape or volume and can spread out, suggesting they are less attracted and move around the most.)*

12. Draw on the board a simple diagram of these particle arrangements. Use Figure 2.1 as a reference.

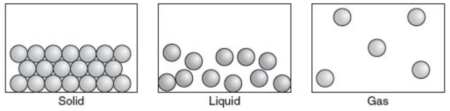


Figure 2.1: Particles are arranged differently in solids, liquids, and gases.

Graphic Organizer in instructional resources

Student Investigation Sheet 2A **Name** ____________________

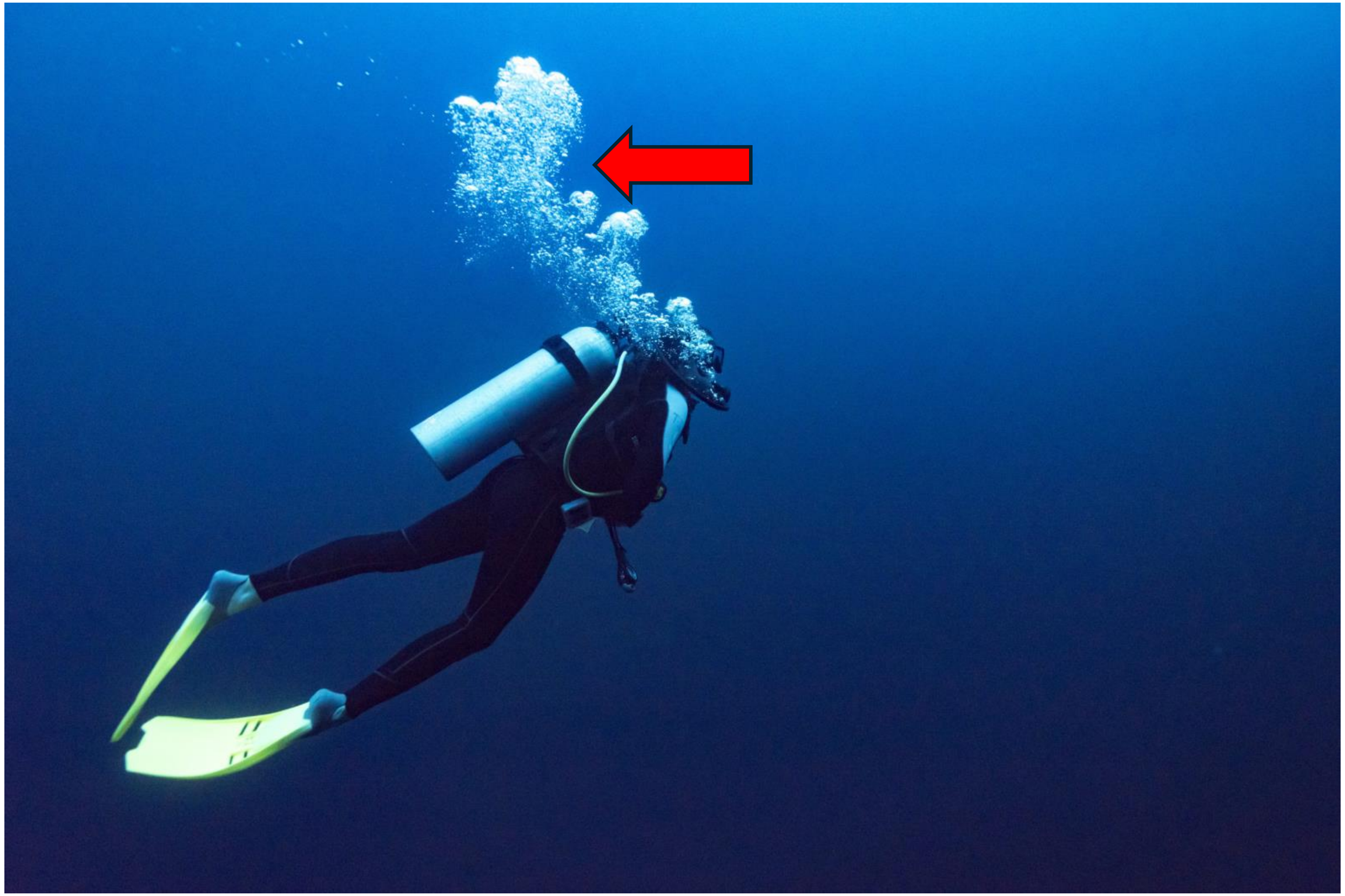
What Are the States of Matter? **Date** ____________________

	Solid	**Liquid**	**Gas**
Definition			
Examples			
Description of arrangement of particles			
Drawing of arrangement of particles			

Learning Standard: 5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen	**Tasks and Activities to show Learning**	**Differentiation of Evidence**			
		Written	Oral	Kinesthetic	Visual
1. I can create and improve a model 2. I can use a model to show an idea 3. I can use a model to solve a problem 4. I know that matter can be broken apart into tiny particles that are too small to see 5. I know that even if tiny particles are too small for my eyes to see, there are other ways to observe them 6. I know that a model is a way to observe tiny particles too small to see 7. I know some examples of models that can help me observe tiny particles that are too small to see 8. I understand that there are things that are very tiny and very large	• Demonstration • Graphic organizer	X			

Learning Standard: 5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen	**Tasks and Activities to show Learning**	**Differentiation of Evidence**			
		Written	Oral	Kinesthetic	Visual
1. I can create and improve a model 2. I can use a model to show an idea 3. I can use a model to solve a problem 4. I know that matter can be broken apart into tiny particles that are too small to see 5. I know that even if tiny particles are too small for my eyes to see, there are other ways to observe them 6. I know that a model is a way to observe tiny particles too small to see 7. I know some examples of models that can help me observe tiny particles that are too small to see 8. I understand that there are things that are very tiny and very large	• Picture Set		X		X
	• Experiment		X	X	
	• Graphic Organizer	X	X		X

Describe what you see.



What do you notice?

This is activity is connected to: 5-PS1-1 (NGSS)

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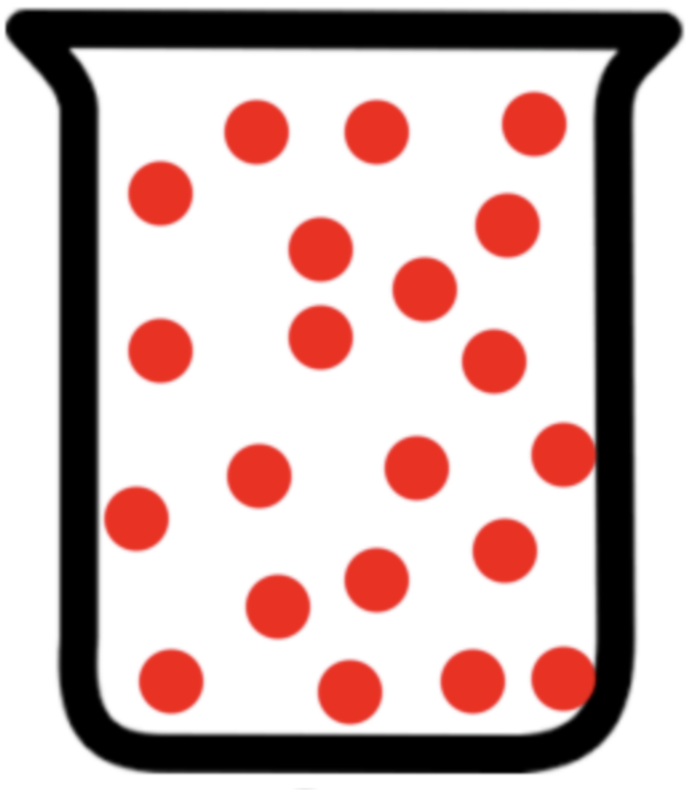
Describe what you see.



How does this image connect to the other image?

Describe what you see.

How is this image different or the same as the other images?

This is activity is connected to: 5-PS1-1 (NGSS)

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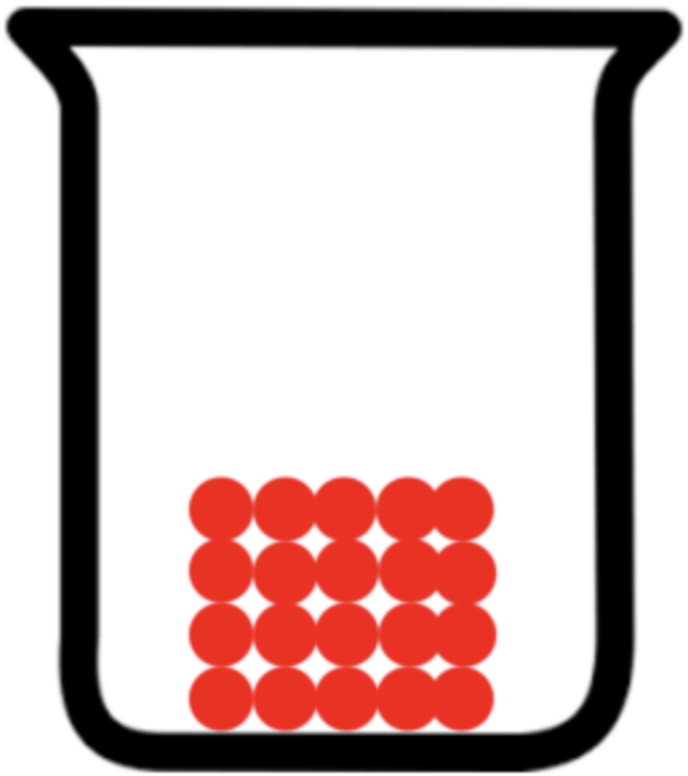
Describe what you see.

How is this image different or the same as the other images?

Describe what you see.



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Describe what you see.

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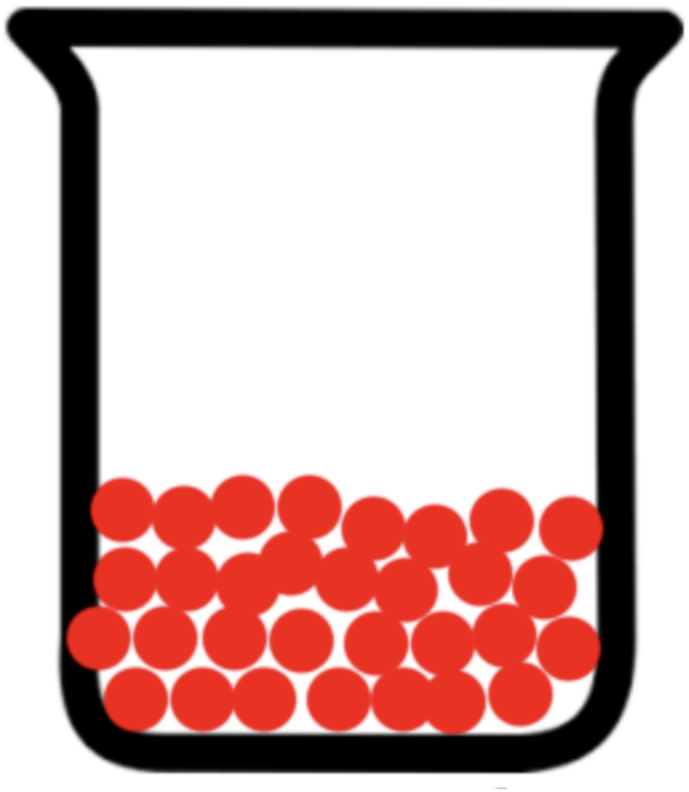
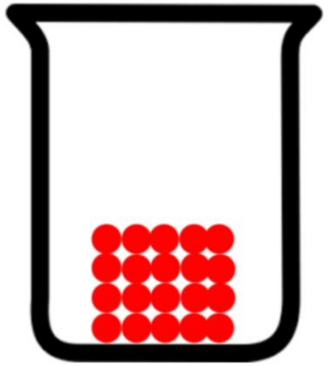
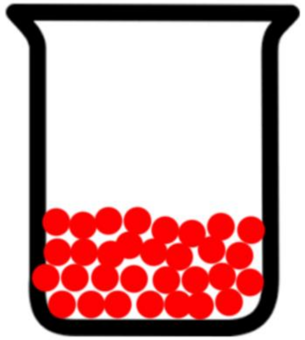
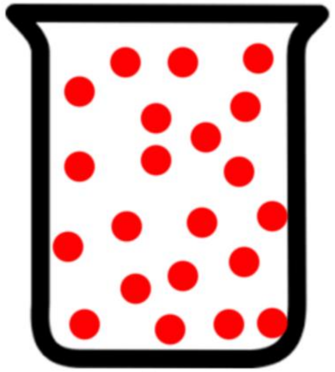


How is this image different or the same as the other images?

What do all these images have in common?







This is activity is connected to: 5-PS1-1 (NGSS)

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All the images are different

states of matter

SOLID

LIQUID

GAS

Our Learning Goal: I know that matter can be broken apart into tiny particles that are too small to see

SOLID

LIQUID

GAS

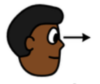
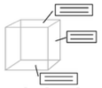
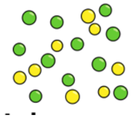
Guiding Question: How can I use a model to help me understand that some matter is made up of particles that are too small to see?

Learning Goal: I know that matter can be broken apart into tiny particles that are too small to see

Task: Observe a science demonstration

Everyone starts together

Go as far as you can!

I **NEED** to:	• Watch the science demonstration • Create a diagram that shows the science demonstration that you watched	
I **MUST**:	• Label your diagram with vocabulary words	
I **CAN**:	• For each state of matter, draw the tiny particles that are too small to see	
I **COULD**:	• Show on your drawing, how the tiny particles move	
I can **TRY** to:	• Using words and drawings, show what made the break down the tiny particles	

This is activity is evidence for: 5-PS1-1 (NGSS)

Dr. Shelley Moore, 2024

Scaffolded Lesson Graphic Organizer

Guiding Question: How can I use a model to help me understand that some matter is made up of particles that are too small to see?

Learning Goal: I know that matter can be broken apart into tiny particles that are too small to see	
Name:	Date:
Need: Watch the science demonstration. Create a diagram that shows the science demonstration that you watched.	Must: Label your diagram with vocabulary words: matter solid liquid gas beaker heat water ice steam

Guiding Question: How can I use a model to help me understand that some matter is made up of particles that are too small to see?

Learning Goal: I know that matter can be broken apart into tiny particles that are too small to see	
Name:	Date:
Can: For each state of matter, draw the tiny particles that are too small to see Could: Show on your drawing, how the tiny particles move	Can Try: Using words and drawings, show what was used to make the tiny particles move __________ __________ __________

Guiding Question: How can I use a model to help me understand that some matter is made up of particles that are too small to see?

Learning Goal: I know that matter can be broken apart into tiny particles that are too small to see

Name:

Date:

Need: Watch the science demonstration. Create a diagram that shows the science demonstration that you watched.

Must: Label your diagram with vocabulary words:

matter

solid

liquid

gas

beaker

heat

water

ice

steam

Guiding Question: How can I use a model to help me understand that some matter is made up of particles that are too small to see?

Learning Goal: I know that matter can be broken apart into tiny particles that are too small to see

Name:

Date:

Can: For each state of matter, draw the tiny particles that are too small to see

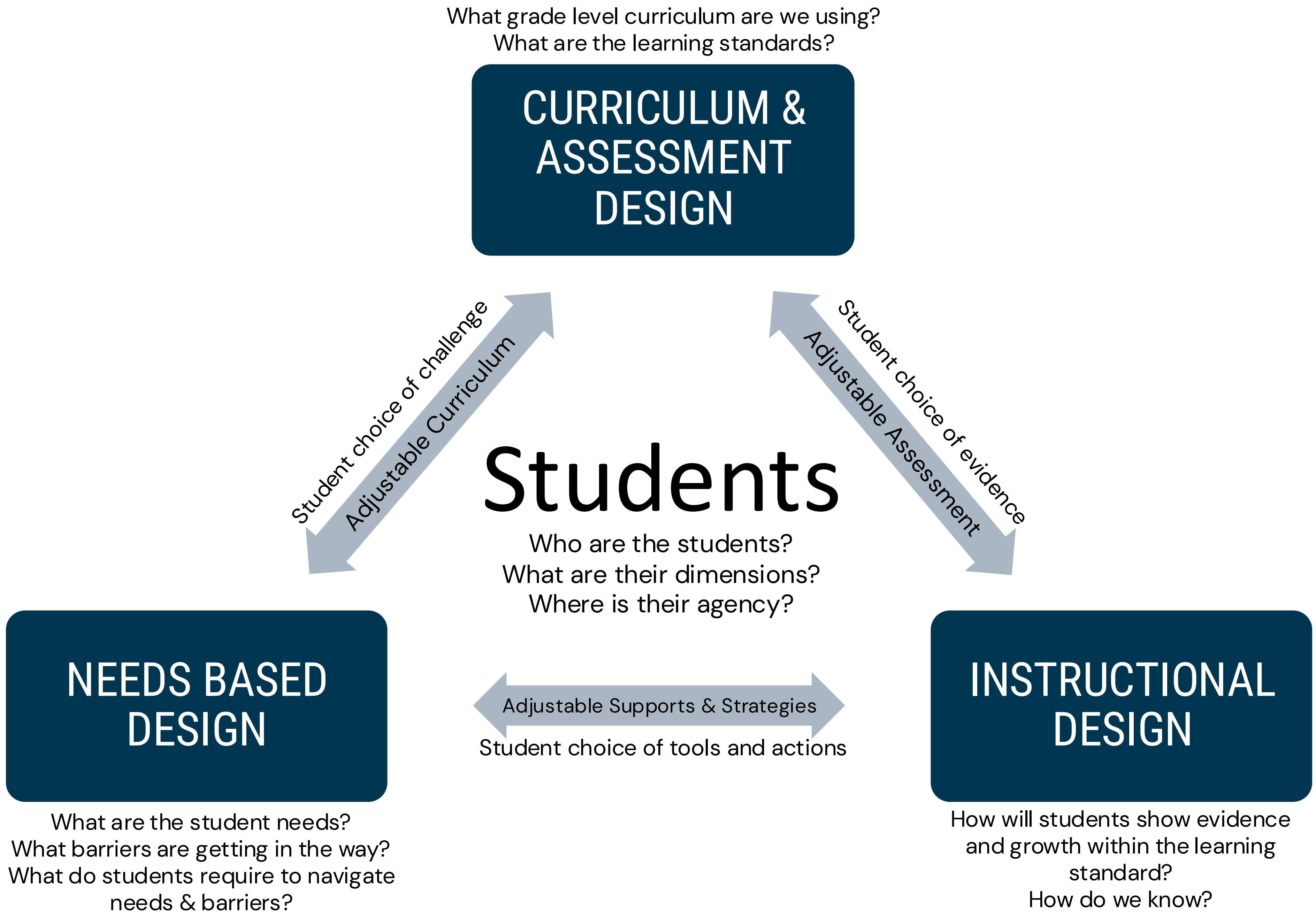
Could: Show on your drawing, how the tiny particles move

Can Try: Using words and drawings, show what was used to make the tiny particles move

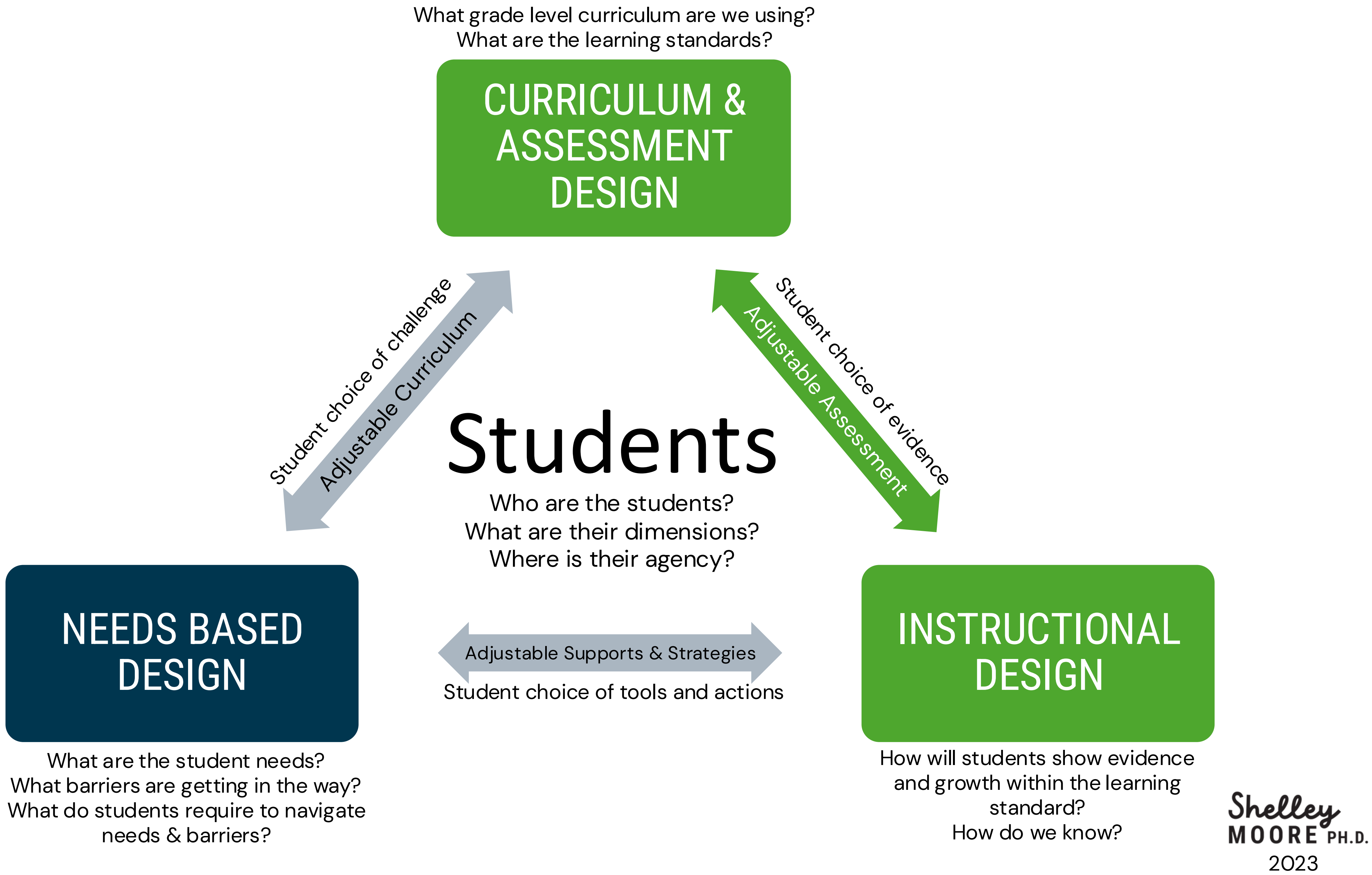
____

____

____



Shelley MOORE PH.D.
2023


What grade level curriculum are we using?
What are the learning standards?
CURRICULUM & ASSESSMENT DESIGN
Student choice of challenge
Adjustable Curriculum
Student choice of evidence
Adjustable Assessment
Students
Who are the students?
What are their dimensions?
Where is their agency?
NEEDS BASED DESIGN
Adjustable Supports & Strategies
Student choice of tools and actions
INSTRUCTIONAL DESIGN
What are the student needs?
What barriers are getting in the way?
What do students require to navigate needs & barriers?
How will students show evidence and growth within the learning standard?
How do we know?
Shelley MOORE PH.D.
2023

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Dr. Shelley Moore