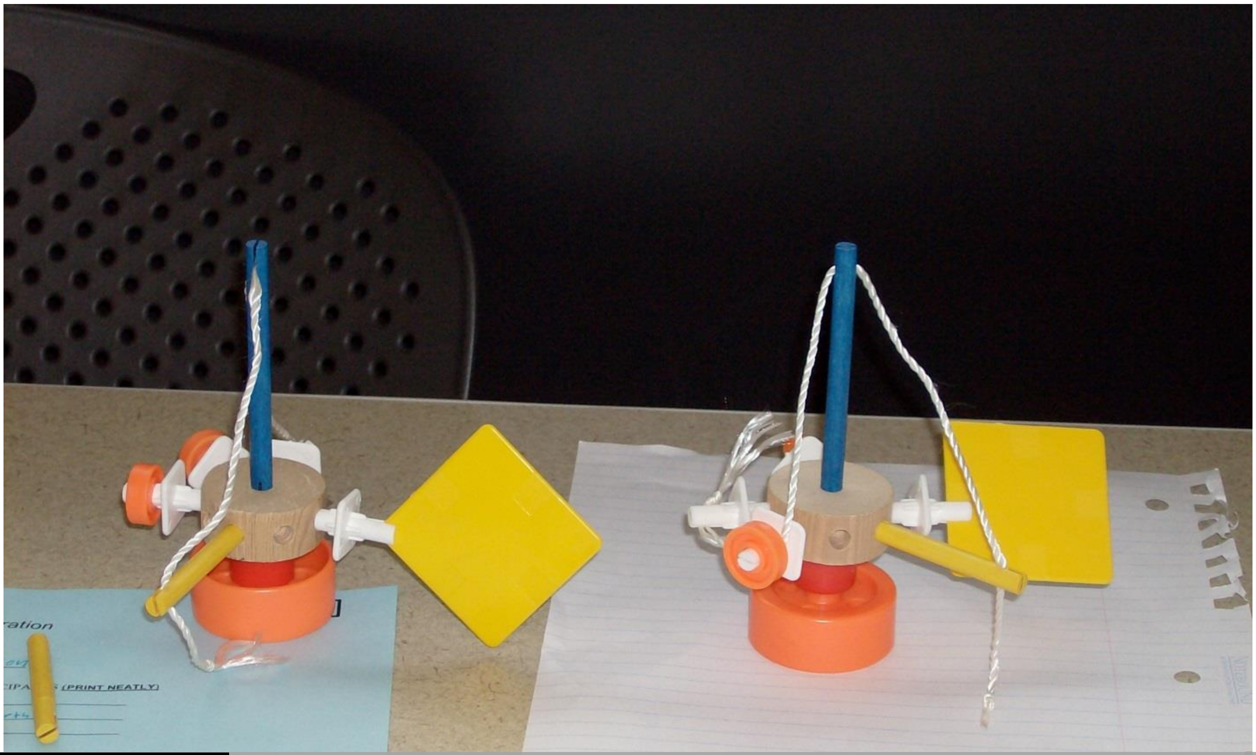
4/25/2014



Assessing with Learning Progressions in Science

FOSS Models & Designs

Instructional Tools | **Contributors: Laura Cross, Caitlin Gregory, Carrie Henderson, Kassie Kaptein, Sandra Krause, Linda Varner and Anjeannette Hammer**

Northwest Educational Service District 189
Together We Can

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366B

Instructional Tools

In this packet you will find a set of instructional supports for science materials. These documents represent the work-in-progress of teachers in the Assessing with Learning Progressions in Science Project, a Math Science Partnership through the Northwest Educational Service District in Washington State. While we encourage others to use the materials, please know the power of these tools lies in the collaborative discussion and analysis that occurs during their creation. We strongly suggest that anyone utilizing these tools make them your own, adjusting them to fit your teaching context and district priorities. Professional development tools to aid you in this process are available on the ALPS project web page www.nwesd.org/nwalps. For access to editable versions of these documents please contact Nancy Menard nmenard@nwesd.org.

Overview of the Tools (not every unit tool-set will include all of these tools)

Unit Overview

The unit overview grid lays out learning targets or important scientific ideas from Washington State Standards for each investigation in the module and clarifies the success criteria for each learning target. It also details the formative assessments that have been designed to assess each target in the investigation.

Learning Progressions

A learning progression is a graphical representation of the path students take toward mastery of a science "big idea". The ALPS *Learning Progression* documents include a description of an important big idea from the *Washington State Science Learning Standards* and the progression of building-block learning targets that students master on their way toward an understanding of that big idea. For each building-block learning target the student success criteria is identified and one or more formative assessment tasks to elicit evidence of student understanding are suggested.

Formative Assessment Tasks

The suggested formative assessment tasks are examples of tools used by the teachers in the ALPS project to gather evidence of student understanding. The *Assessment Task Cover Sheet* details each assessment and gives administration tips and suggestions for instructional adjustments based on some of the common student struggles they encountered.

Student Work Samples

Selected student work samples from students in ALPS classrooms give a picture of the range of student responses gathered from sample formative assessments. The *Student Work Sample Cover Sheet* describes the student work samples and the teacher's interpretation of student understanding.

Models & Designs Unit Overview

Lesson		Learning Targets & Success Criteria	Assessment	Vocabulary	Materials
Investigation 1: Black Boxes					
1-1 Black Box Investigations *Everyday Mysteries*	**Application**	Engineers work in teams to generate different ideas for solving a problem. ✓ Given a problem, I can collaborate with a team to generate ideas for solutions.	Steps 14-15: Teacher listens in on student conversations as they meet in consensus groups. Students present consensus models.	○ Black Box ○ Model	○ Black Boxes (A, B, C, D)
	Inquiry	Scientific reports and investigations should be replicable and clearly communicate findings. ✓ I can use a systematic approach to record and communicate data so that my experiment can be replicated.	Step 18: Students draw and label consensus diagrams on the board.		
1-2 Building Black Boxes *Scientists and Models*				○	○ Student Sheet 4 ○ Black Boxes (A, B, C, D) ○ Empty Black Boxes ○ Marbles ○ Cardboard Rectangles & Triangles ○ Masking Tape
1-3 The Drought Stopper *Life on Earth 150 Million Years Ago*				○ Siphon	○ Drought Stopper ○ Basins ○ 1-liter Beaker ○ 100-ml Beaker ○ Water

Lesson		Learning Targets & Success Criteria	Assessment	Vocabulary	Materials
Investigation 2: Hum Dingers					
2-1 Exploring Hum Dingers *Simulations*	**Application**	Possible solutions need to be tested to see if they solve the problem. Building a model is one way to test a possible solution. ✓ Given a problem, I can build a model to test possible solutions.	Teacher walks around as students build model Hum Dingers. Teacher checks that students have built a model that can hum and ding.	○ Conceptual Models ○ Physical Models ○ Circuit ○ Switch	○ Student Sheet 8 ○ Parts Inventory ○ Construction Board and Base ○ Zip Bag ○ D-cell Battery ○ Cell Holder ○ Motor ○ Short, Medium & Long Sticks ○ Wooden Hubs ○ Rubber Bands ○ Lg. Paper Clips ○ Binder Clips ○ Bell ○ Clothespins ○ Hum Dinger ○ Masking Tape ○ String ○ Wire ○ Scissors ○ Pliers ○ Lg. Paper Bag
	Inquiry	Scientific reports and investigations should be replicable and clearly communicate findings. ✓ I can use a systematic approach to record and communicate data so that my experiment can be replicated.	Step 13: Students draw and label a diagram on a sticky note of their current Hum Dinger model. Teacher collects and provides feedback.		
2-2 Model Hum Dingers *The Path to Invention*				○	○ See 2-1
2-3 Reveal and Replicate				○	○ See 2-1 ○ Teacher Sheet #6
Investigation 3: Go-Carts					

Lesson	Learning Targets & Success Criteria		Assessment	Vocabulary	Materials
3-1 Free-Rolling Go-Carts *Early Autos*	**Application**	Engineers identify problems that need to be solved. ✓ Given a scenario, I can identify the problem that needs to be solved.	Step 2: Pose the challenge to students and have them record the problem in their notebooks. Walk around while they're working on the carts to check.	○ Design ○ Engineer	○ Parts Inventory ○ Zip Bags ○ Short, Medium & Long Sticks ○ Wooden Hubs ○ Rubber Bands ○ Binder Clips ○ Paper Fasteners ○ Lg. Paper Clips ○ Clothespins ○ Construction Board & Base ○ Scissors ○ Masking Tape ○ Wire ○ String ○ Cardboard ○ Pliers
	Application	Engineers identify criteria for success. ✓ Given a problem, I can identify the criteria for success.	Step 2: Students record the success criteria for making a free-rolling go cart in their notebooks. While checking for the problem, teacher also looks at criteria for success.		
3-2 Self-Propelled Go-Carts *Henry Ford and His Model T*	**Inquiry**	A valid investigation has one manipulated (independent) variable while other variables are controlled (dependent). ✓ I can identify the controlled and manipulated variables in my investigation.	Step 9: Ask students, "If we want to know the impact that the wheel size will have on the distance our carts will travel, what variables should be controlled and what should be manipulated?" Students answer on sticky notes.	○ Axle ○ Bearing ○ Friction ○ Hub ○ Traction ○ Wheel	○ See 3-1 ○ Student Sheet 10 ○ Student Sheet 11 ○ Meter Tape ○ Rubber-Band-Power Demonstration
3-3 The Two-Meter Run *On the Line*	**Application**	Results are used to modify the design. ✓ After testing a solution, I can use the results to modify or redesign a model.	Students will design and modify a go-cart to travel two meters. Teacher walks around to see that students are making changes based on how their design is performing.	○	○ See 3-1
	Inquiry	A conclusion needs to be supported by the data gathered. ✓ I can generate a scientific conclusion to a specific problem based on the data gathered.	Students record conclusions in their notebooks. Teacher reviews notebooks to check for understanding.		

Lesson		Learning Targets & Success Criteria	Assessment	Vocabulary	Materials
Investigation 4: Cart Tricks					
4-1 The Run-Around Cart *Smart Cars and Space Planes*	**Inquiry**	Investigations involve identifying the problem, gathering information and exploring ideas in order to make a plan. ✓ Given a problem, I can create a plan for how to solve it.	Step 4: Students use the Design Plan sheet to identify the engineering problem they want to solve and make a plan.	○ Technology	○ Student Sheet 10 ○ Student Sheet 12 ○ See 3-1
4-2 Advanced Tricks				○ Variable	○ Student Sheet 13 ○ Student Sheet 14 ○ See 3-1
4-3 Choosing Your Own Investigation				○	○ Student Sheet 15 ○ Student Sheet 16 ○ Student Sheet 17

Learning Progression: Application

Materials: FOSS Models & Designs **Grade level: 5-6**

Prerequisite skill:

Learning Target: 1

Engineers identify problems that need to be solved.

(4-5 APPC)

Inv. 3, Part 1

Success Criteria:
Given a scenario, I can identify the problem that needs to be solved.

Formative Assessment:
Inv. 3-1 (Step 2): Pose the challenge to students and have them record the problem in their notebooks. Walk around while they're working on their carts to check.

Learning Target: 2

Engineers identify criteria for success.

(4-5 APPC)

Inv. 3, Part 2

Success Criteria:
Given a problem, I can identify the criteria for success.

Formative Assessment:
Inv. 3-2 (Step 3): Students record the success criteria in their notebooks for making a self-propelled go-cart. Walk around while they're working on their carts to check.

Learning Target: 3

Engineers work in teams to generate different ideas for solving a problem.

(4-5 APPD, 6-8 APPD, 4-5 APPC)

Inv. 1, Part 1

Success Criteria:
Given a problem, I can collaborate with a team to generate ideas for solutions.

Formative Assessment:
Inv. 1-1 (Steps 14-15): Teacher listens in on student conversations as they meet in consensus groups. Students present consensus models.

Learning Target: 4

Possible solutions need to be tested to see if they solve the problem. Building a model is one way to test a possible solution.

(4-5 APPE, 6-8 APPE)

Inv. 2, Part 1

Success Criteria:
Given a problem, I can build a model to test possible solutions.

Formative Assessment:
Inv. 2-1: Teacher walks around as students build model Hum Dingers. Teacher checks that students have built a model that can hum and ding.

Learning Target: 5

Results are used to modify the design.

(6-8 APPF)

Inv. 3, Part 3

Success Criteria:
After testing a solution, I can use the results to modify or redesign a model.

Formative Assessment:

Inv. 3-3: Students will design and modify a go-cart to travel two meters. Teacher walks around to see that students are making changes based on how their design is performing.

Big Idea:

Engineers collaborate to identify problems, generate and test possible solutions and use the results to modify the design.
(4-5 APPD-F, 6-8 APPD-F)

Later big ideas that build on this big idea include:

Northwest Educational Service District 189
Together We Can

This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

MODELS & DESIGNS

Big Idea: Engineers collaborate to identify problems, generate and test possible solutions and use the results to modify the design. (4-5 APPD-F, 6-8 APPD-F)

Formative Assessment Task Cover Sheet

Learning Target 1	
Assessment Task Details	**Teacher Background**
Brief Description of the Assessment Task: Inv. 3-1 (Step 2): Pose the challenge to students and have them record the problem in their notebooks. Walk around while they're working on their carts to check. **Learning Target:** Engineers identify problems that need to be solved. (4-5 APPC) Inv. 3, Part 1 **Success Criteria:** Given a scenario, I can identify the problem that needs to be solved. Student Task Sheet Included: no Student Work Samples Included: no	**Administration Tips:** Some students may need more scaffolding in order to identify the problem. FOSS does a good job of outlining the problem in the section titled, "Pose the Go-Cart Problem." **Suggestions for Instructional Adjustments:** You might choose to discuss the problem with the class or have students pair-share before writing down the problem.

Learning Target 2	
Assessment Task Details	**Teacher Background**
Brief Description of the Assessment Task: Inv. 3-2 (Step 3): Students record the success criteria in their notebooks for making a self-propelled go-cart. Walk around while they're working on their carts to check. **Learning Target:** Engineers identify criteria for success. (4-5 APPC) Inv. 3, Part 2 **Success Criteria:** Given a problem, I can identify the criteria for success. Student Task Sheet Included: no Student Work Samples Included: no	**Administration Tips:** When teaching 3-1, make sure to brainstorm and record success criteria for making a free-rolling cart. In this way, students will have a model to use when they do 3-2. **Suggestions for Instructional Adjustments:** Some students may try to build slingshot carts. In classroom discussions, direct students back to their success criteria to determine the appropriateness of this design.

MODELS & DESIGNS

Big Idea: Engineers collaborate to identify problems, generate and test possible solutions and use the results to modify the design. (4-5 APPD-F, 6-8 APPD-F)

Learning Target 3	
Assessment Task Details	**Teacher Background**
Brief Description of the Assessment Task: Inv. 1-1 (Steps 14-15): Teacher listens in on student conversations as they meet in consensus groups. Students present consensus models.	**Administration Tips:** Remind students that consensus doesn't mean majority rules. It is also possible that some students will not come to consensus. **Suggestions for Instructional Adjustments:** This is a great teachable moment about how there are different theories in science. If students can't come to consensus, let them present different models. While students are collaborating, remind them to support their ideas with evidence and keep an open mind.
Learning Target: Engineers work in teams to generate different ideas for solving a problem. (4-5 APPD, 6-8 APPD, 4-5 APPC) Inv. 1, Part 1	
Success Criteria: Given a problem, I can collaborate with a team to generate ideas for solutions.	
Student Task Sheet Included: no Student Work Samples Included: yes	

Learning Target 4	
Assessment Task Details	**Teacher Background**
Brief Description of the Assessment Task: Inv. 2-1: Teacher walks around as students build model Hum Dingers. Teacher checks that students have built a model that can hum and ding.	**Administration Tips:** If you have additional educational support for high need students, be sure to give them a look at the diagram or original Hum Dinger so they can help prompt students. **Suggestions for Instructional Adjustments:** For fast finishers, bring them back up to the original Hum Dinger and have them compare it to their model. They should listen to the hum, feel the tension and decide what modifications they can make to come closer to the original.
Learning Target: Possible solutions need to be tested to see if they solve the problem. Building a model is one way to test a possible solution. (4-5 APPE, 6-8 APPE) Inv. 2, Part 1	
Success Criteria: Given a problem, I can build a model to test possible solutions.	
Student Task Sheet Included: no Student Work Samples Included: no	

MODELS & DESIGNS

Big Idea: Engineers collaborate to identify problems, generate and test possible solutions and use the results to modify the design. (4-5 APPD-F, 6-8 APPD-F)

<table>
<tr><th colspan="2">Learning Target 5</th></tr>
<tr><th>Assessment Task Details</th><th>Teacher Background</th></tr>
<tr><td>Brief Description of the Assessment Task: Inv. 3-3: Students will design and modify a go-cart to travel two meters. Teacher walks around to see that students are making changes based on how their design is performing.</td><td rowspan="4">Administration Tips: The flooring surface in your room may inhibit the movement of the cart. Try some different locations if it's not working out. For example, cafeteria, stage, hallway, or gym. Some students may find that their go-cart runs better on one surface than another. Students do not necessarily need to use the big wheels to make it two meters. The cardboard is difficult to cut, make perfect circles and attach to the hubs. If you can find larger wooden wheels, they would probably work better and would reduce the number of variables you're changing.

Suggestions for Instructional Adjustments: Some students may stick with their same design and just try to keep winding it up over and over again, expecting luck to prevail. Talk with them about the design process and how they need to be changing variables and testing the effects of those changes.</td></tr>
<tr><td>Learning Target: Results are used to modify the design. (6-8 APPF) Inv. 3, Part 3</td></tr>
<tr><td>Success Criteria: After testing a solution, I can use the results to modify or redesign a model.</td></tr>
<tr><td>Student Task Sheet Included: no
Student Work Samples Included: no</td></tr>
</table>

MODELS & DESIGNS

Big Idea: Engineers collaborate to identify problems, generate and test possible solutions and use the results to modify the design. (4-5 APPD-F, 6-8 APPD-F) Inv. 1-1, Steps 14-15

Target 3, Assessment: Black Box Diagrams

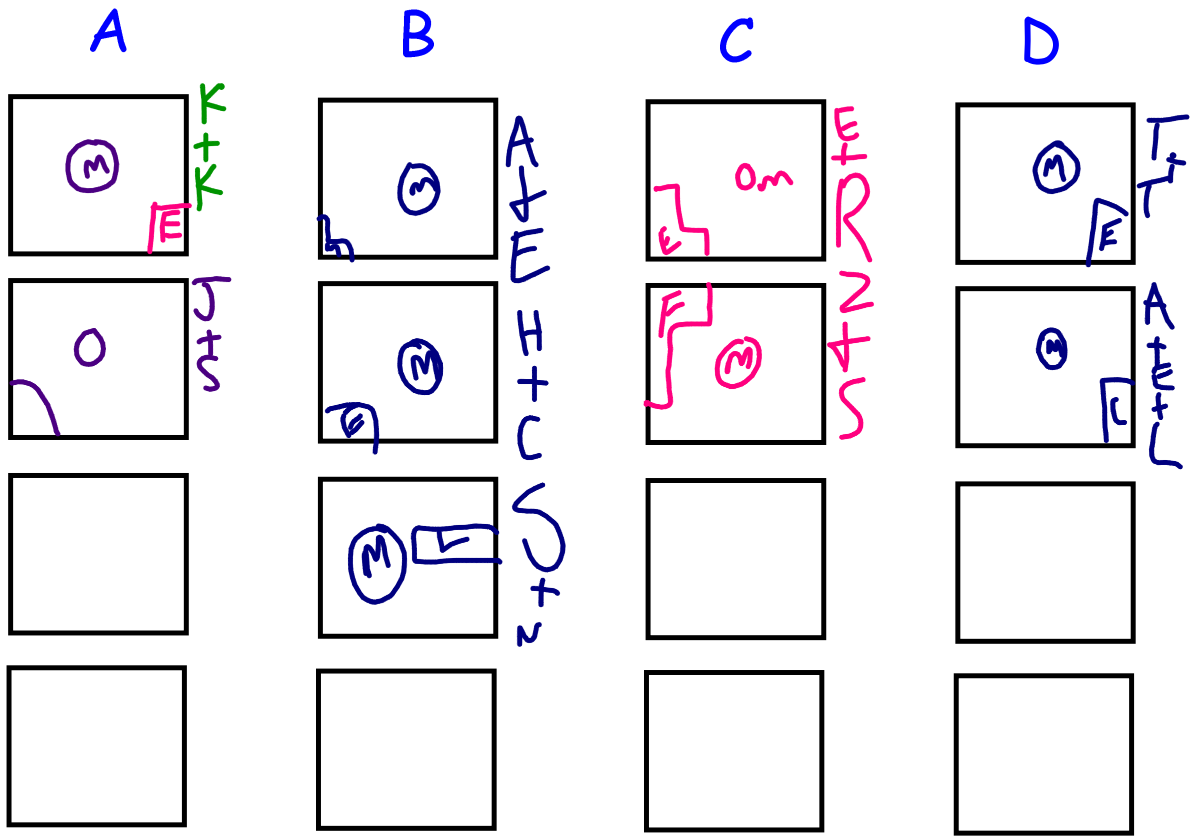
Formative Assessment Student Work Cover Sheet

Student Work Description

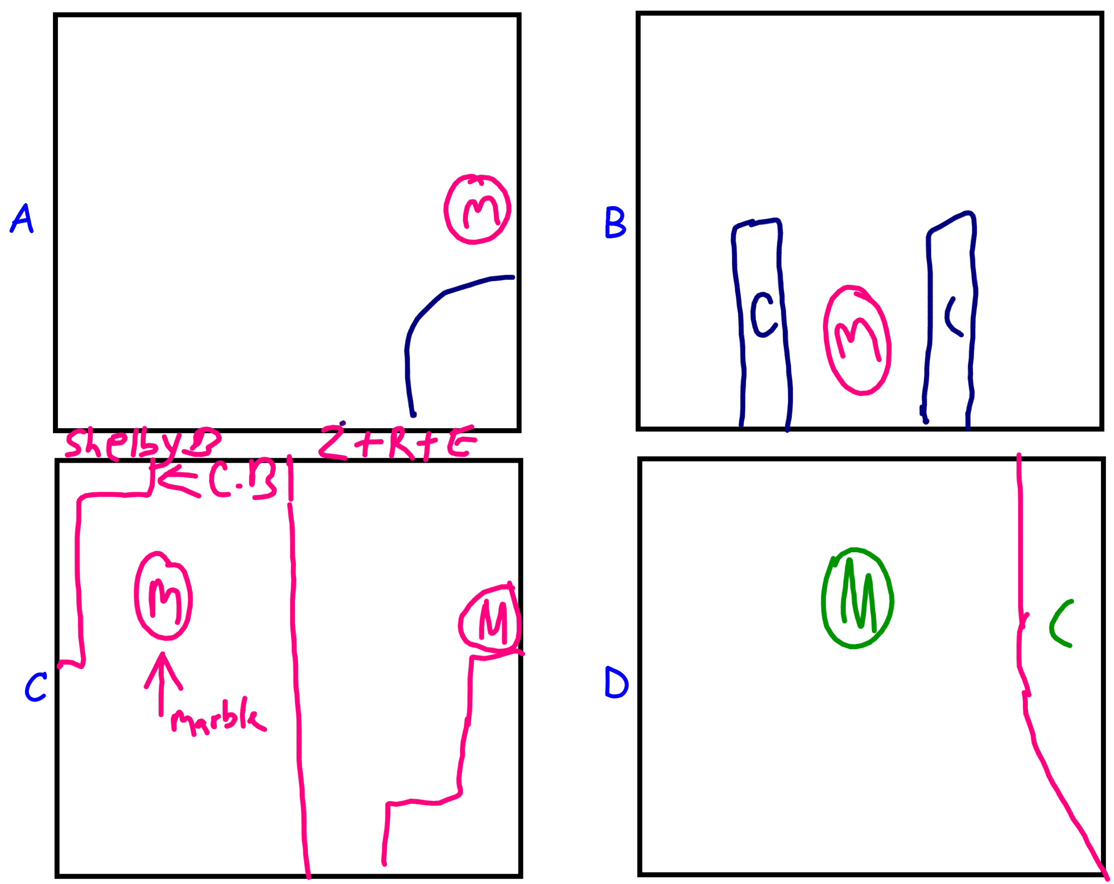
Sample 1: Most students demonstrated that they could reach a consensus on their black box models. The students in group C could not agree, so they presented two models.

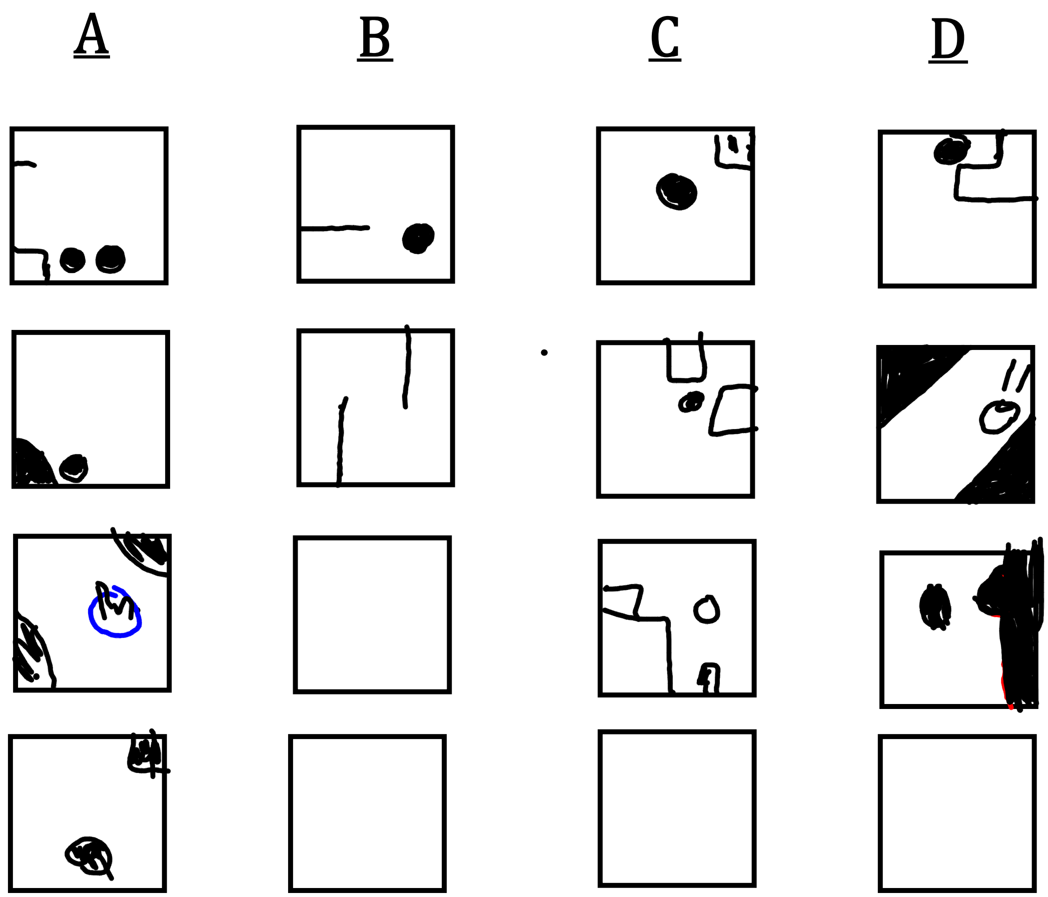
Sample 2: Most students demonstrated that they could reach a consensus on their black box models. The students in group A could not agree, so they presented two models.

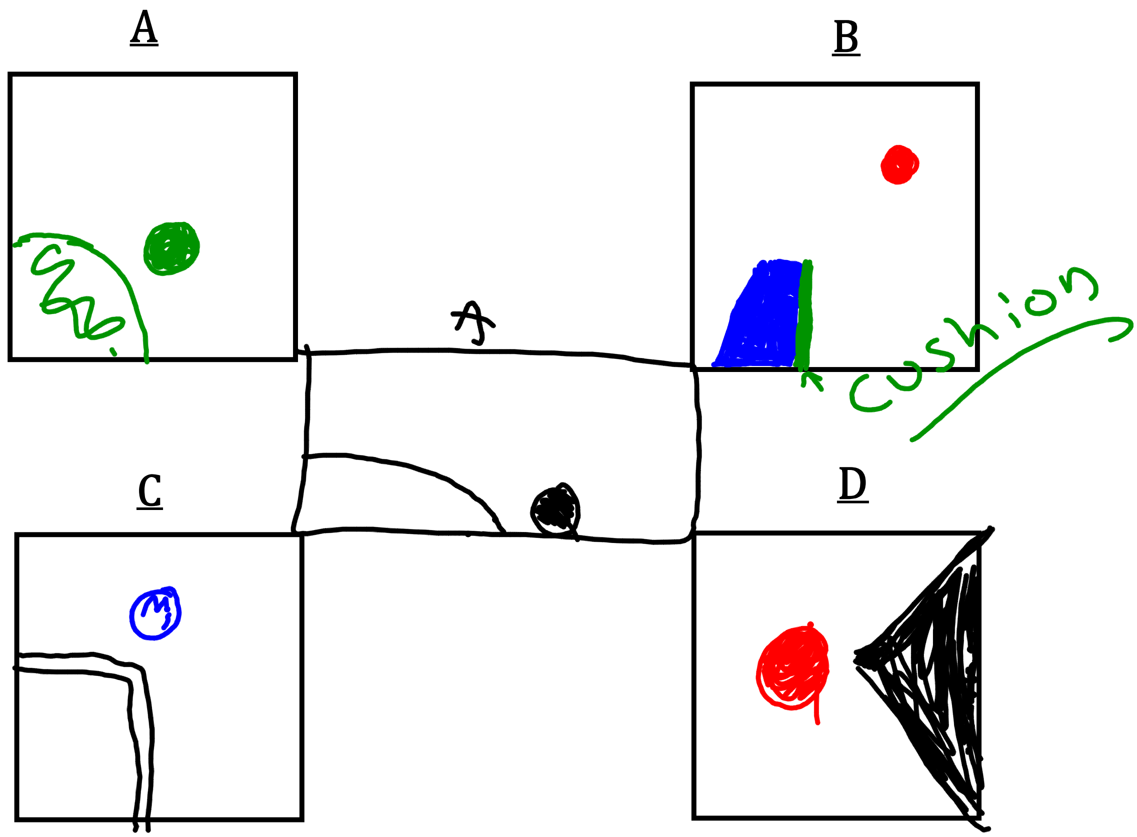
 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.


A
B
C
D
K+K
J+S
A+E
H+C
S+N
E+R
Z+S
T+T
A+E+L

Consensus Models




A
B
C
D


A
B
cushion
C
D

Learning Progression: Inquiry

Materials: FOSS Models & Designs **Grade level: 5-6**

Prerequisite skill:

There are different variables that affect our investigations. (6-8 INQD)

Learning Target: **1**

Investigations involve identifying the problem, gathering information and exploring ideas in order to make a plan.
(4-5 INQA-B, 6-8 INQA-B)
Inv. 4, Part 1

Success Criteria:
Given a problem, I can create a plan for how to solve it.

Formative Assessment:
Inv. 4-2 (Step 4): Students use the Design Plan (Student Sheet 14) sheet to identify the engineering problem they want to solve and make a plan.

Learning Target: **2**

Scientific reports and investigations should be replicable and clearly communicate findings.
(4-5 INQD, 6-8 INQC & G)
Inv. 1, Part 1
Inv. 2, Part 1

Success Criteria:
I can use a systematic approach to record and communicate data so that my design can be replicated.

Formative Assessment:
A. Inv. 1-1 Step 18: Students draw and label consensus diagrams on the board.
B. Inv. 2-1 Step 13: Students draw and label a diagram of their current Hum Dinger model. Teacher collects and provides feedback.

Learning Target: **3**

A valid investigation has one manipulated (independent) variable while other variables are controlled (dependent).

(6-8 INQD)
Inv. 3, Part 2

Success Criteria:
I can identify the controlled and manipulated variables in my investigation.

Formative Assessment:
Inv. 3-2 Step 9: Ask students, "If we want to know the impact that wheel size will have on the distance our carts will travel, what variables should be controlled and what should be manipulated?"

Learning Target: **4**

A conclusion needs to be supported by the data gathered.

(4-5 INQG, 6-8 INQF)
Inv. 3, Part 3

Success Criteria:
I can generate a scientific conclusion to a specific problem based on the data gathered.

Formative Assessment:
Inv. 3-3: Students record conclusions in their notebooks. Teacher reviews notebooks to check for understanding.

Big Idea:

Valid investigations have specific criteria: identifying problems, gathering information, exploring ideas, collecting data, analyzing and reporting.
(4-5 INQA-H, 6-8 INQA-G)

Later big ideas that build on this big idea include:

Northwest Educational Service District 189
Together We Can

This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

MODELS & DESIGNS

Big Idea: Valid investigations have specific criteria: identifying problems, gathering information, exploring ideas, collecting data, analyzing and reporting. (4-5 INQA-H, 6-8 INQA-G)

Formative Assessment Task Cover Sheet

Learning Target 1	
Assessment Task Details	**Teacher Background**
Brief Description of the Assessment Task: Inv. 4-2 (Step 4): Students use the Design Plan (Student Sheet 14) sheet to identify the engineering problem they want to solve and make a plan.	**Administration Tips:** Model the use of the design plan when you teach 4-1 with the run-around cart. This will help students understand how to use it on 4-2. **Suggestions for Instructional Adjustments:** Students may need prompting to describe how their modifications improved the performance of their carts in detail. Many students like to give short answers.
Learning Target: Investigations involve identifying the problem, gathering information and exploring ideas in order to make a plan. (4-5 INQA-B, 6-8 INQA-B) Inv. 4, Part 1	
Success Criteria: Given a problem, I can create a plan for how to solve it.	
Student Task Sheet Included: no Student Work Samples Included: no	

Learning Target 2, Assessment Task Letter A	
Assessment Task Details	**Teacher Background**
Brief Description of the Assessment Task: Inv. 1-1 Step 18: Students draw and label consensus diagrams on the board.	**Administration Tips:** **Suggestions for Instructional Adjustments:** Discuss with students what makes a diagram replicable. Talk about the diagrams on the board to see which are the most accurate or what they might add to make them better. This is a good time to discuss scale and labeling.
Learning Target: Scientific reports and investigations should be replicable and clearly communicate findings. (4-5 INQD, 6-8 INQC & G) Inv. 1, Part 1	
Success Criteria: I can use a systematic approach to record and communicate data so that my design can be replicated.	
Student Task Sheet Included: no Student Work Samples Included: no	

MODELS & DESIGNS

Big Idea: Valid investigations have specific criteria: identifying problems, gathering information, exploring ideas, collecting data, analyzing and reporting. (4-5 INQA-H, 6-8 INQA-G)

<table>
<tr><th colspan="2">Learning Target 2, Assessment Task Letter B</th></tr>
<tr><th>Assessment Task Details</th><th>Teacher Background</th></tr>
<tr><td>Brief Description of the Assessment Task: Inv. 2-1 Step 13: Students draw and label a diagram of their current Hum Dinger model. Teacher collects and provides feedback.</td><td rowspan="4">Administration Tips:

Suggestions for Instructional Adjustments: As you review student diagrams, write a question that will make them think about what they could add to make it better. For example, “What other information would I need in order to replicate this model?” Then have students either redraw or add to their original diagram in a different color based on your feedback.</td></tr>
<tr><td>Learning Target: Scientific reports and investigations should be replicable and clearly communicate findings. (4-5 INQD, 6-8 INQC & G)
Inv. 2, Part 1</td></tr>
<tr><td>Success Criteria: I can use a systematic approach to record and communicate data so that my design can be replicated.</td></tr>
<tr><td>Student Task Sheet Included: no
Student Work Samples Included: no</td></tr>
</table>

<table>
<tr><th colspan="2">Learning Target 3</th></tr>
<tr><th>Assessment Task Details</th><th>Teacher Background</th></tr>
<tr><td>Brief Description of the Assessment Task: Inv. 3-2 Step 9: Ask students, “If we want to know the impact that wheel size will have on the distance our carts will travel, what variables should be controlled and what should be manipulated?”</td><td rowspan="4">Administration Tips: Make sure students understand the difference between controlled and manipulated variables.

Suggestions for Instructional Adjustments: Some students may reverse the terms or identify more than one manipulated variable. If students are struggling with this, you can present some different scenarios and have them discuss the controlled and manipulated variables in their science teams to reinforce the terminology.</td></tr>
<tr><td>Learning Target: A valid investigation has one manipulated (independent) variable while other variables are controlled (dependent). (6-8 INQD)
Inv. 3, Part 2</td></tr>
<tr><td>Success Criteria: I can identify the controlled and manipulated variables in my investigation.</td></tr>
<tr><td>Student Task Sheet Included: no
Student Work Samples Included: yes</td></tr>
</table>

MODELS & DESIGNS

Big Idea: Valid investigations have specific criteria: identifying problems, gathering information, exploring ideas, collecting data, analyzing and reporting. (4-5 INQA-H, 6-8 INQA-G)

<table>
<tr><th colspan="2">Learning Target 4</th></tr>
<tr><th>Assessment Task Details</th><th>Teacher Background</th></tr>
<tr><td>Brief Description of the Assessment Task: Inv. 3-3: Students record conclusions in their notebooks. Teacher reviews notebooks to check for understanding.</td><td rowspan="4">Administration Tips: Be sure to emphasize the inclusion of evidence, data and/or diagrams in the conclusion.

Suggestions for Instructional Adjustments: When providing feedback, ask students a question that will cause them to think more deeply about what they could add to their conclusions.</td></tr>
<tr><td>Learning Target: A conclusion needs to be supported by the data gathered. (4-5 INQG, 6-8 INQF)
Inv. 3, Part 3</td></tr>
<tr><td>Success Criteria: I can generate a scientific conclusion to a specific problem based on the data gathered.</td></tr>
<tr><td>Student Task Sheet Included: no
Student Work Samples Included: no</td></tr>
</table>

MODELS & DESIGNS

Big Idea: Engineers collaborate to identify problems, generate and test possible solutions and use the results to modify the design. (4-5 APPD-F, 6-8 APPD-F) Inv. 1-1, Steps 14-15

Target 3, Assessment: Black Box Diagrams

Formative Assessment Student Work Cover Sheet

Student Work Description

Sample 1: Most students demonstrated that they could reach a consensus on their black box models. The students in group C could not agree, so they presented two models.

Sample 2: Most students demonstrated that they could reach a consensus on their black box models. The students in group A could not agree, so they presented two models.

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

C: Chassis, items

M: Wheel size

Controlled:
Stick Sizes
Rubber bands

Manipulated:
Wheel Sizes

What is being
Control
the rubber bands
being twist
manipulated varible
wheel size

Controlled	Manipulated
Car Design	Wheel Size

Controlled: the
Chassis, rubberbands

Varibles: designs
wheels

Controled: The Wheels
ManiPlated Variables : distance and
Speed

controlled weels
structured
Maniplated Varible
the rubber band's

Contolled:
the distence that we need to cover

variable:
the wheel size and the rubberband

controlled: rubber band
maniphlated: tires
Variable: tires

Controled: The frame

Miniplated: The axel

How long the tired rober bans gets long tirers

Larger wheel =
Longer travel

Controlled: Frame
Varied: Rubberbands

MODELS & DESIGNS

Big Idea: **Valid investigations have specific criteria: identifying problems, gathering information, exploring ideas, collecting data, analyzing and reporting. (4-5 INQA-H, 6-8 INQA-G)**

Target 3, Assessment: Identify the Variables

Formative Assessment Student Work Cover Sheet

Student Work Description

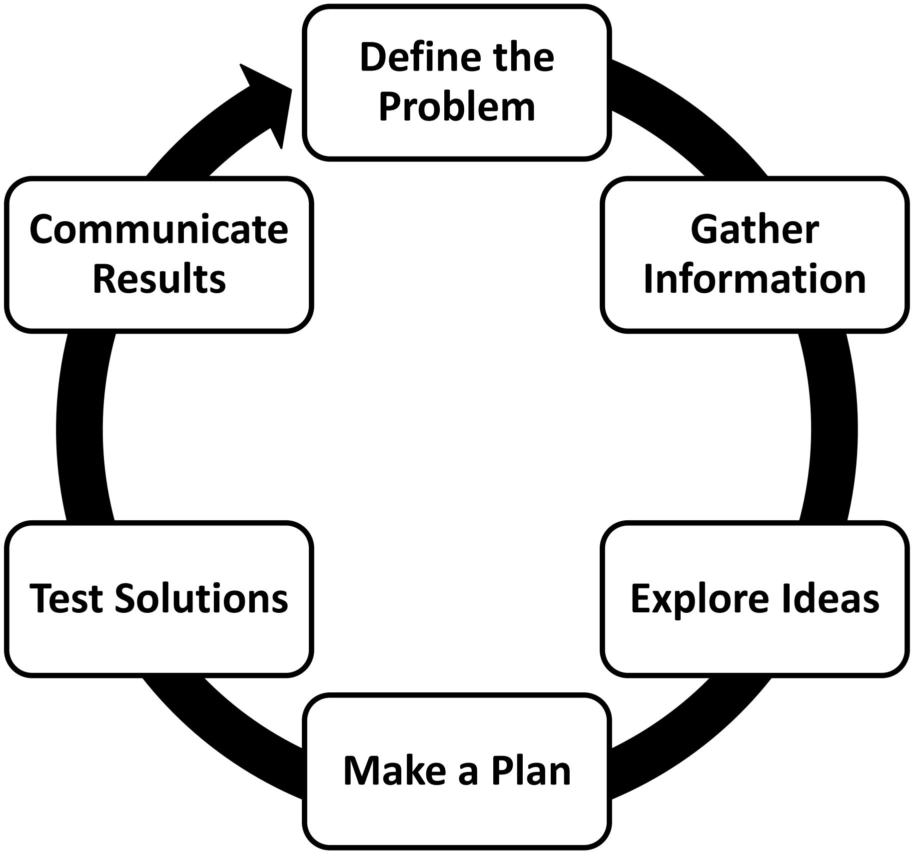
Sample 1: In these ten student samples, you can see that some students correctly identified the controlled and manipulated variables. Some reversed the terms. Two students thought that there were three terms to identify (controlled, manipulated and variable).

MODELS & DESIGNS GLOSSARY

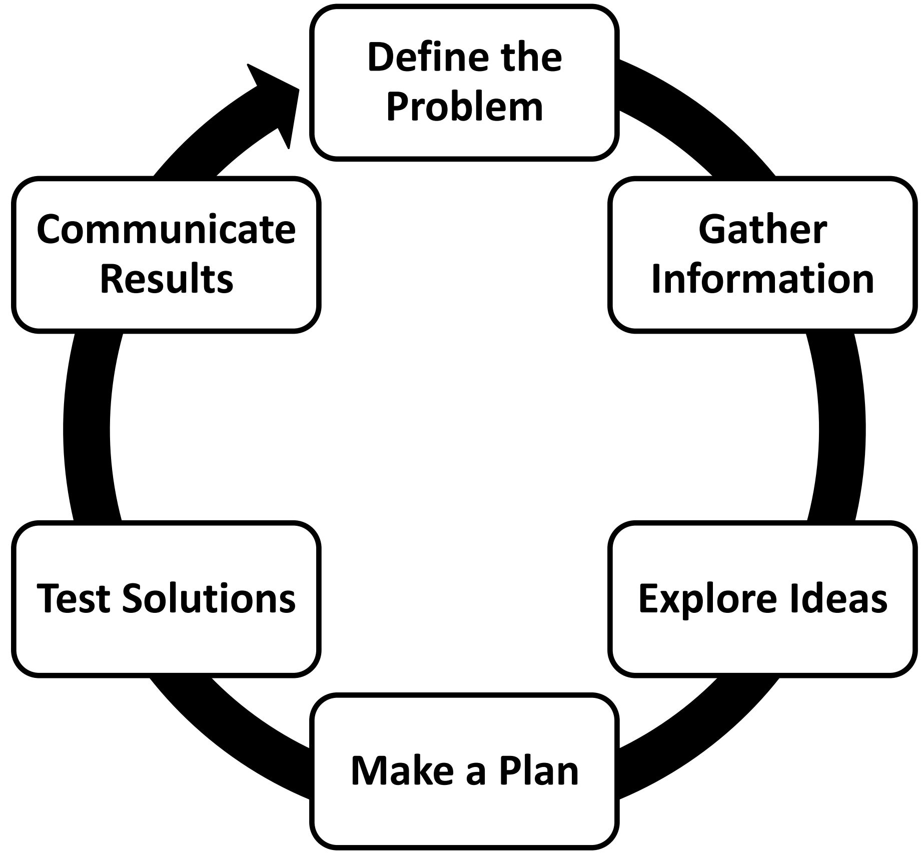
1. Axle: The rod that connects the wheels so the turn together.
2. Bearing: other parts of a device revolve or rotate on the bearing.
3. Black Box: Any system that cannot be directly observed and easily understood.
4. Circuit: A pathway through which an electric current flows.
5. Conceptual Model: Explanations expressed in drawings, words or math.
6. Design: the way something is put together.
7. Engineer: Someone who uses scientific knowledge to design useful things.
8. Friction: the resistance to movement on surfaces that touch.
9. Hub: the center part of the wheel – fastened to the axle.
10. Model: A representation that explains how something is built or how it works.
11. Physical Model: a 3-D construction designed to explain or represent how something works.
12. Siphon: A tube that moves liquid out of a container by gravity, provided the outflow end is lower than the intake end.
13. Switch: a device that connects and disconnects a circuit.
14. Traction: a kind of friction that allows wheels to turn without slipping on a surface.
15. Wheel: the disk that turns on a central axle

 This work is funded by the Washington State Office of Superintendent of Public Instruction Mathematics & Science Partnership under Title II, Part B Program Code: 62CFDA 84.366.

Technological Design Process



Technological Design Process



MODELS & DESIGNS

Bibliography

Dylan, Wiliam. *Embedded Formative Assessment.* Bloomington, IN: Solution Tree, 2011. Print.

Keeley, Page. *Science Formative Assessment: 75 Practical Strategies for Linking Assessment, Instruction, and Learning*. Thousand Oaks, CA: Corwin, 2008. Print.

Keeley, Page and Tugel Joyce. *Uncovering Student Ideas in Science, Volume 4: 25 New Formative Assessment Probes*. Arlington, VA: NSTA Press, 2009. Print.

Popham, W. James. *Transformative Assessment*. Alexandria, VA: Association for Supervision and Curriculum Development, 2008. Print.

Additional Information

Use the "Is it a Model?" probe from *Uncovering Student Ideas in Science, Volume 4: 25 New Formative Assessment Probes* (Pg. 73) as a pre- and post-assessment. One variation to take this probe deeper is to have students identify which of the models are conceptual or physical.

Also included in the documents:

- Glossary of Terms
- Technological Design Process