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April 24, 2016

Sixth Grade Science Unit on Structures

University of Alaska Southeast

ED688

Table of Contents

Contextual Factors	page(s)	3 - 5
Learning Goals	page(s)	6
Assessment Plan	pages(s)	7 - 11
Design for Instruction	page(s)	12 - 20
Instructional Decision Making	page(s)	21- 24
Analysis of Student Learning	pages()	25 - 37
Reflection and Self Evaluation	page(s)	38 -39

Contextual Factors

My host classroom is a sixth grade class at Eagle River Elementary School in Eagle River, Alaska. It serves as a neighborhood school but has an Optional Program (lottery) in a separate wing of the building. The Optional Program has a constructivist philosophy, higher SES students, and very high parent volunteer involvement. My class is part of the neighborhood school which is not a part of the Optional Program but us under the same principal and shares in some of the same activities as the Optional students (e.g., recess and assemblies). The town of Eagle River has an "everybody-knows-everybody" feel.

My school serves breakfast every day. Because of this, students are permitted to enter the building at 8:30. Students are generally lined up outside their classroom by 8:45 and are in their seats engaged in morning work by 8:50. So much of the logistics of the day are taken care of well before the pledge of allegiance. I know other schools start that process much later which can give the day a rushed feel. My children's school doesn't allow students to even enter the building until 8:45.

The school practices "Calm Classroom" where every morning (right after the 9:00 a.m. bell) the principal or school secretary conducts a brief breathing/meditative type exercise over the PA that everyone participates in. It sets a calming mood in the classroom and the building in general. It makes for a very nice start to the day. Teachers can take a minute throughout the day and do brief "Calm Classroom" exercises as well. This is a research based program that found improved behavior, mood, and academics with the implementation of "Calm Classroom."

At the start of the semester my host class had 23 students but this week we gained one more. My host teacher was nervous because the dynamic in his class is very nice and balanced

and when you add a new student that balance can change for the better or for the worse. Time will tell. The class is made up of 15 boys and 9 girls. The class is beautifully diverse with 4 African-American students, 2 hispanic students, 2 Alaska Native students, one Asian student, and the rest are caucasian or other.

There are two female students who are in the Ignite program which is our district's gifted program. One male student finished testing for the Ignite program and is still waiting for results. There is one other male student who has been referred for Ignite testing but has not tested yet. Three of the male students go to the resource room for math support. Those same students and an additional three male students go to the resource room for reading support. A teacher assistant shows up each morning for in-room math support and another comes each afternoon for in-room reading support. There are two male students who have behavior support as part of their IEPs in addition to the math and reading support already mentioned. The school has a counselor in the building every other week who conducts SEL lessons and supports the students who require behavior and SEL support on an individual basis. The counselor is available to help students work out interpersonal relationship troubles as they arise as well. I've heard more than one person in the building say that the school is not a Title I school but it very easily could be. There is a great focus on SEL in the building and the classroom as a result. I designed a unit on teaching character so I'm looking forward to teaching it to this group of students who could especially benefit from it. My unit on character entails lots of choice (self-selection, self-reflection) which will allow for differentiated assessment. The character unit won't be the unit for my TWS, however.

I'm leaning toward doing a science unit for the TWS since their science unit is upcoming but my host teacher doesn't want to use the science kits they were given by the district. The unit has students literally digging through bags of garbage from lunch in the cafeteria. My host teacher would like to meet the standards without having to go through that. A science unit would be a great unit to do a pre and post assessment with fun stuff in the middle. This group of sixth graders responds well to the use of technology (each one has a netbook assigned to them to use for spelling on spellingcity.com; coolmath-games.com and Khan Academy for math; and other resource sites for language arts and reading) so I'll use technology in the science unit. Besides the "garbage" unit my host teacher mentioned "structures" as being an upcoming science lesson. I think this class would really enjoy a STEM lesson on column structures and weight distribution that I've done in previous practicum classes. It's a hands-on and a collaborative lesson that fits well with the enthusiasm and learning style of this particular group.

Learning Goals

Learning Goals	Assessments	Format of	Adaptations
Learning Goal 1 *Students will discover that a circular tower is stronger than a square or triangular tower structure.*	Pre-Assessment: students write their hypothesis on the experiment hand out and the reasoning for their hypothesis. Formative Assessment: students test their hypothesis. Post-Assessment: students write their findings on the experiment form and indicate why the circular structure is the strongest.	Experiment: Students build three different shaped towers using 8.5 x 11 paper folded lengthwise, and tape. Once circular (no edges), one square, and one triangular. Each group stacks books on the towers one at a time, recording the number of books each tower can hold before collapsing. They will test the circular one last. Each student pair will use the same set of books.	Repeat and clarify instructions, as needed. Demonstrate and assist with folding and taping the towers. Provide model of towers and demonstrate how to stack books. Provide one piece of paper at a time so students don't create all three towers and spoil the experiment. Ensure that students fold each paper lengthwise. Monitor students to ensure they are using the same set of books for their experiment to ensure experiment integrity.
Learning Goal 2 *Students will identify the difference between a live load and a dead load.*	Pre-Assessment: students write what they think the terms mean on a pre-test. Formative Assessment: students give examples of dead load/live load combinations. Post-Assessment: students will write the definition of the terms on the post test.	Lesson: Discussion of scientific terms, dead load and live load. Give some examples, students give examples. Collaborative activity: Table groups get lists of (unlabeled) dead load and live load combinations of structures (e.g. Eiffel Tower/ tourists, bookcase/ books) and students sort them into the appropriate category.	Use examples in the room. Monitor groups as they determine what items belong to which category. Discuss and clarify what the students determined belong in each category. Take it further: Which is the dead load if you are on the table? Which is the dead load if the table is on you?

Assessment Plan

Learning Goals	Assessments	Format of	Adaptations
Learning Goal 1 *Students will discover that a circular tower is stronger than a square or triangular tower structure.*	Pre-Assessment: students write their hypothesis on the experiment hand out and the reasoning for their hypothesis. Formative Assessment: students test their hypothesis. Post-Assessment: students write their findings on the experiment form and indicate why the circular structure is the strongest. Class discussion will also gauge understanding of findings.	Experiment: Students build three different shaped towers using 8.5 x 11 paper folded lengthwise, and tape. Once circular (no edges), one square, and one triangular. Each group stacks books on the towers one at a time, recording the number of books each tower can hold before collapsing. They will test the circular one last. Each student pair will use the same set of books.	Repeat and clarify instructions, as needed. Demonstrate and assist with folding and taping the towers. Provide model of towers and demonstrate how to stack books. Provide one piece of paper at a time so students don't create all three towers and spoil the experiment. Ensure that students fold each paper lengthwise. Monitor students to ensure they are using the same set of books for their experiment to ensure experiment integrity.
Learning Goal 2 *Students will identify the difference between a live load and a dead load.*	Pre-Assessment: students write what they think the terms mean on a pre-test. Formative Assessment: students give examples of dead load/live load combinations. Post-Assessment: students will write the definition of the terms on the post test. Students will write examples of each term as well.	Lesson: Discussion of scientific terms, dead load and live load. Give some examples, students give examples. Collaborative activity: Table groups get lists of (unlabeled) dead load and live load combinations of structures (e.g. Eiffel Tower/ tourists, bookcase/ books) and students sort them into the appropriate category.	Use examples in the room. Monitor groups as they determine what items belong to which category. Discuss and clarify what the students determined belong in each category. Take it further: Which is the dead load if you are on the table? Which is the dead load if the table is on you?

Pre-Assessment:

My assessment plan includes a pre-assessment to gauge what students already understand about the terms we are going to be learning in our science unit. Student responses to the pre-assessment will show what they know in general, but the handout for the first activity has a pre-assessment built into it as well. Students will write their hypothesis about what they think will be the outcome of the experiment after I explain what we will be testing. They will state their reasoning as well. Some students will be right; some students will learn their theory was wrong.

Formative Assessment:

The first activity in the unit readies the students to learn the concepts of compression and tension by using those forces in the paper tower experiment before we name them. When we name the forces, we can refer back to our experiment and what they discovered about the weak points in the square and triangular shaped paper towers. The stacked books create a compression force down on the tower and the creases experience tension (pull apart) which makes the tower collapse.

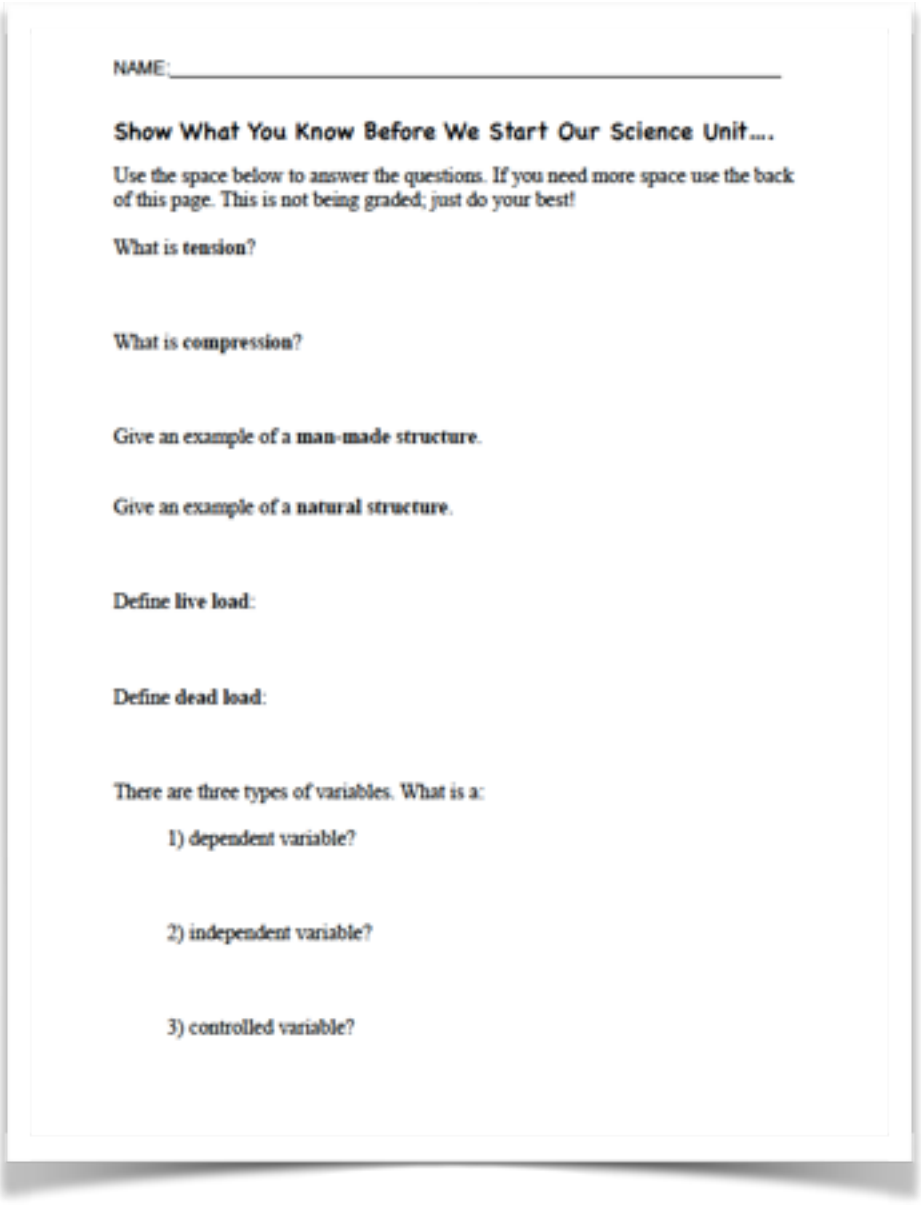
The first learning goal will be achieved by the end of the experiment. Each student pair will find that their circular tower was the strongest. Our class discussion will help them to understand why. I will include a question on the post-assessment about the results of the experiment to gauge understanding and retention of this concept about structures.

The second learning goal will be gauged by the activity and discussion during the lesson on tension, compression, dead load, and live load. Students should be able to successfully identify dead load examples and live load examples after viewing the BrainPop video, direct instruction, and participating in the classroom activity. Understanding and retention of these terms will be assessed in the quiz as well.

Post-Assessment:

I will give students a written vocabulary quiz on most of the same terms as the pre-assessment. The quiz will ask students to give examples of dead load and live load in a addition to the definition since our lesson will include learning the definition as well as examples of the two terms. This assessment is appropriate because it will clearly illustrate student understanding of the scientific terms taught in this unit. It will determine their readiness to move on to building their straw structures and testing them with tension and compression.

Pre-assessment tool:



NAME:_____

Show What You Know Before We Start Our Science Unit….

Use the space below to answer the questions. If you need more space use the back of this page. This is not being graded; just do your best!

What is **tension**?

What is **compression**?

Give an example of a **man-made structure**.

Give an example of a **natural structure**.

Define **live load**:

Define **dead load**:

There are three types of variables. What is a:

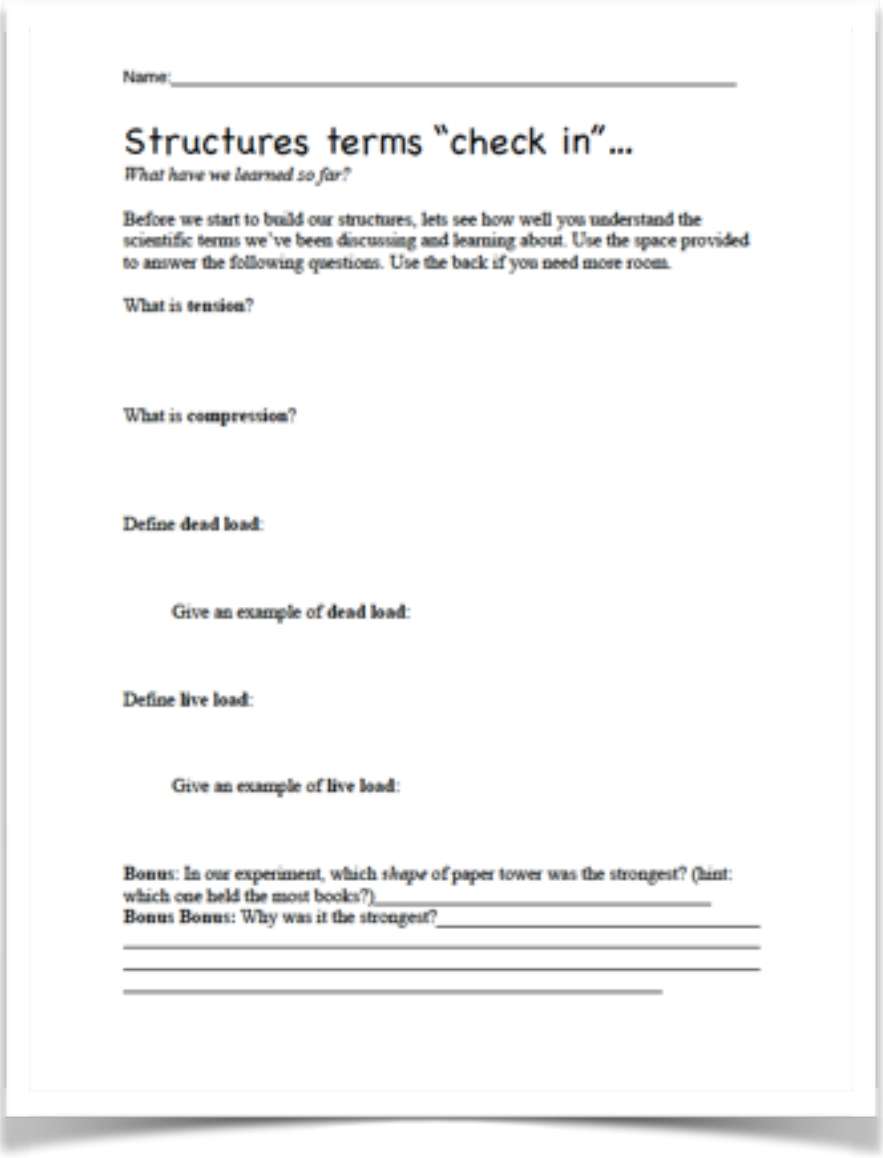
1) dependent variable?

2) independent variable?

3) controlled variable?

Post-Assessment tool:

I removed the questions about man-made and natural structures from the post-assessment because based on the pre-assessment, the students do not need instruction in this area. They all identified a type of man-made structure and the most common answer for a natural structure was, tree. One student gave "underground cave system" as his answer of a natural structure. The emphasis in the structures unit is on the forces and the weights so I removed the variables questions as well. This quiz will be worth 6 points and the bonuses will be worth 2 points. The items that will be measured for analysis will only be the terms: tension, compression, dead load, and live load. There will be 4 points possible on both the pre and



Name:_____

Structures terms "check in"...

What have we learned so far?

Before we start to build our structures, lets see how well you understand the scientific terms we've been discussing and learning about. Use the space provided to answer the following questions. Use the back if you need more room.

What is **tension**?

What is **compression**?

Define **dead load**:

Give an example of **dead load**:

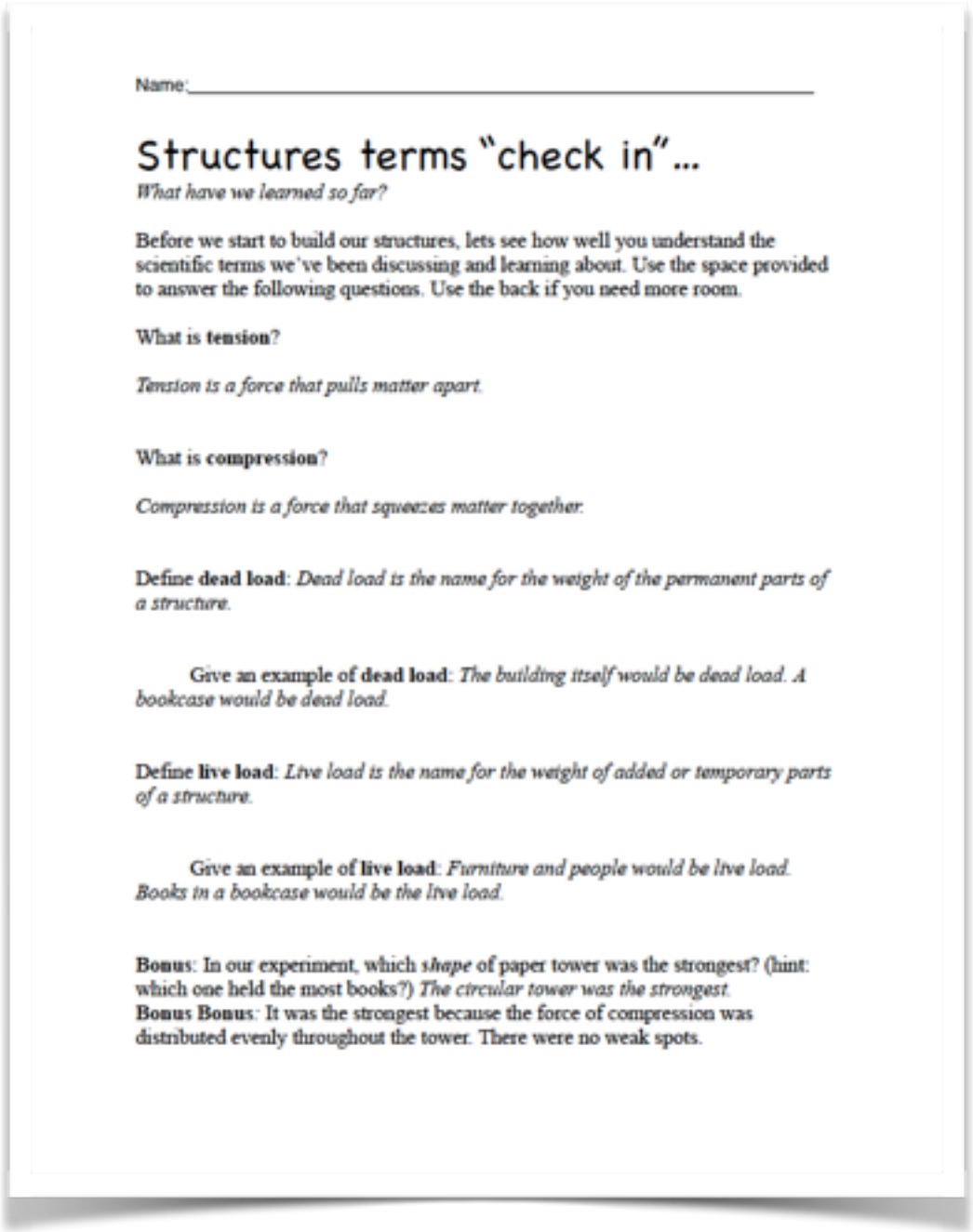
Define **live load**:

Give an example of **live load**:

Bonus: In our experiment, which *shape* of paper tower was the strongest? (hint: which one held the most books?)_____
Bonus Bonus: Why was it the strongest?_____
_____
_____
_____

post test in order to measure progress. The bonus section is to confirm understanding of our previous lesson.

Post-assessment answer key:



Name:_____

Structures terms "check in"...

What have we learned so far?

Before we start to build our structures, lets see how well you understand the scientific terms we've been discussing and learning about. Use the space provided to answer the following questions. Use the back if you need more room.

What is **tension**?

Tension is a force that pulls matter apart.

What is **compression**?

Compression is a force that squeezes matter together.

Define **dead load**: *Dead load is the name for the weight of the permanent parts of a structure.*

Give an example of **dead load**: *The building itself would be dead load. A bookcase would be dead load.*

Define **live load**: *Live load is the name for the weight of added or temporary parts of a structure.*

Give an example of **live load**: *Furniture and people would be live load. Books in a bookcase would be the live load.*

Bonus: In our experiment, which *shape* of paper tower was the strongest? (hint: which one held the most books?) *The circular tower was the strongest.*
Bonus Bonus: It was the strongest because the force of compression was distributed evenly throughout the tower. There were no weak spots.

Design for Instruction

TWS Science Unit: MAT/Certification Elementary

Candidate Name: Alison Annis	**Host Teacher Name: Alex Hahn**	
School: Eagle River Elementary	**Grade Level: 6**	**# of Students: 25**
Date Range Unit: 3/10 - 4/12	**Length of Unit: Span of three weeks**	
Theme of Unit: Structures	**Content Area: Science**	
Materials: Include all materials including technology: Lesson 1: Three pieces of paper per group, tape, and stacks of books, science notebooks and a pencil. Teacher supplies: document camera, whiteboard, dry erase marker. Lesson 2: MacBook, whiteboard, document camera, BrainPop video https://www.brainpop.com/technology/scienceandindustry/bridges/, students' science notebooks, pencils, table, classroom furniture, classroom items (for demonstrations and examples of live load and dead load). Lesson 3: Straws, paper clips, science notebooks, pencils.		

Alaska Content and Subject area Standards:

A1—Science as Inquiry and Process
The student demonstrates an understanding of the processes of science by
[6] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating*
[6] SA1.2 collaborating to design and conduct simple repeatable investigations (L)
B1— Concepts of Physical Science
SB Students develop an understanding of the concepts, models, theories, universal principles, and facts that explain the physical world.
SB4 Students develop an understanding of motions, forces, their characteristics and relationships, and natural forces and their effects.
The student demonstrates an understanding of motions, forces, their characteristics, relationships, and effects by
[5] SB4.1 investigating that the greater the force acting on an object, the greater the change in motion will be (L)
B: Concepts of Physical Science
A student should understand and be able to apply the concepts, models, theories, universal principles, and
facts that explain the physical world.
A student who meets the content standard should:
1) develop an understanding of the characteristic properties of matter and the relationship of these properties to their structure and behavior;
SB4 Students develop an understanding of motions, forces, their characteristics and relationships, and natural forces and their effects.

TRANSFER GOALS (Unpacked Standard(s)
1. Students will discover that a circular tower is stronger than a square or triangular tower structure. 2. Students will identify the difference between a live load and a dead load in structures 3. Students will describe tension and compression in structures..

STAGE 1 – Essential Questions and Enduring Understandings

Enduring Understanding(s) **Students will understand that….**	**What Essential Questions will be Considered? (Q)**
• Round column support structures are stronger than triangular or square shaped column support structures. • Gravity, tension, and compression are forces that act upon structures. • Structures need to be able to support their own weight (dead load) as well as added weight (live load).	• How do structures stand? • What are the forces that act upon them? • What keeps structures from falling over? • What is the difference between a structure's own weight and weight added to it?

STAGE 1 – Objectives/ Key Learning

What students should know….	***What students should be able to do…….***
• *That structure design is critical to structure stability and weight bearing ability.* • *The difference between a structure's dead load and live load.*	• Build paper towers and simulate compression by stacking books. • Determine strongest structure design based on experiment outcome. • Give examples of dead load and live load. • Define tension and compression.

STAGE TWO: Assessment (Identify Desired Results)

Other Evidence	**Culminating Performance Task**
Pre-assessment - written short answer assessment **Formative - experiment participation, inquiry, class discussion.** **Summative - written short answer post-assessment.** **Performance - construction, experimentation, and verbal participation.** **Student Self Assessment- form hypothesis, make observations, record results.**	G.R.A.S.P.S. **(For ED621B &C)** **Students will build and test paper towers to determine which shape is the strongest, (round, triangular, square)** **Students will identify a structure's dead load and live load.** **Students will describe tension and compression.** **Students will build structures with straws and paperclips.** **Rubrics (attached) (ED 621C)** **Pre-assessment** **Post-assessment**

STAGE THREE: Opportunities to Learn

Standards Addressed	**Learning Activities**	**Learning/Instructional Strategies**
	1. Pre-assessment - written short answer quiz. 3/4/2016.	
	1. Introduction / Hook	
[6] SA1.2	**We are going to start our science unit on structures with a building activity and an experiment.**	Carefully partner students with mentors to accommodate IEP/SPED students.

	Pre-Assessment: students write their hypothesis on the experiment hand out and the reasoning for their hypothesis. Formative Assessment: students test their hypothesis. Post-Assessment: students write their findings on the experiment form and indicate why the circular structure is the strongest.	Repeat and clarify instructions, as needed. Demonstrate and assist with folding and taping the towers. Provide model of towers and demonstrate how to stack books. Provide one piece of paper at a time so students don't create all three towers and spoil the experiment. Ensure that students fold each paper lengthwise.
	Experiment: Students build three different shaped towers using 8.5 x 11 paper folded lengthwise, and tape. Once circular (no edges), one square, and one triangular. Each group stacks books on the towers one at a time, recording the number of books each tower can hold before collapsing. They will test the circular one last. Each student pair will use the same set of books.	Monitor students to ensure they are using the same set of books for their experiment to ensure experiment integrity. Students learn by doing. Note: this is a hands-on activity and technology (document camera and whiteboard) is only needed in the demonstration portion of the lesson.
SB1 SB4	**Lesson 2 - Tension, Compression, Dead Load, Live Load 4/8/2016**	
	• Students get science notebooks and pencil to take video notes.	
	• BrainPop video - https://www.brainpop.com/technology/scienceandindustry/bridges/	**Technology needed: MacBook, internet, document camera.**
	• Stop video so students can write down definitions of terms: tension, compression, dead load, live load. Repeat definition for students and rewind video to repeat visual demonstration.	Give plenty of processing time to accommodate slower processors. Repeat definition. Rewind video to show definition and demonstration.
	• Discuss dead load. Give examples • Discuss live load. Give examples.	Gradual release of responsibility: I do, we do, you do.
	• Students work in table groups and think of dead load and live load combinations in the classroom (outside the classroom as well) e.g. bookshelves/books, walls/ bulletin boards, floors/furniture.	

	• Class discussion of dead load/live load combinations. • Give examples (e.g. hotel/furniture, Eiffel Tower/ tourists) and have students label each. • Show youtube video of "Galloping Gertie" to spark interest in structures that fail as a result of the structure failing to support itself under live load conditions. (weather).	
	Lesson 3- Building straw structures to explore tension and compression: 4/11/2016	
	• Review terms: tension, compression, live load, dead load • Explain activity: build a triangle to test and visualize compression and tension • Materials: Three straws (cut in the middle), 9 paper clips, science notebooks, pencil. • Demonstrate how to connect paper clips and straws. • Students work in partnerships to construct triangles and problem solve. • Students use their finger to press down on the top of the triangle and note what happens to the two gaps on the vertical sides of the triangle (squeeze together); note what happens to the gap on the horizontal side (pulls apart). • Students note their observations about their structures in their science notebooks.	Note: this is a hands-on activity and technology (document camera and whiteboard) is only needed in the demonstration portion of the lesson.
	1. Post-assessment - 4/12/2016	Written quiz
	Conclusion: Compression is a force that makes matter squeeze together and tension is a force that makes matter pull apart. Structures carry their own weight (dead load) and sometimes added wThese forces are present in structures and structures must be built to account for these forces.	
	Closure: Mr. Hahn will continue this science unit with you; exploring more aspects of structures; building and testing your structures in other exciting ways; using different materials and with different goals in mind.	

Differentiation

Learner Variability based on content pre-assessment and class demographics:

Pre-assessment indicates students understand the difference between man-made and natural structures because they cited (with accuracy) examples of each. A large focus on these terms in this unit is therefore unnecessary. (Will do a brief review of examples to reinforce.)

Contextual Factors: Three students have severe self-control problems so lessons will be designed to be flexible. The goal will be to engage these students in the activity with mentor students to increase the likelihood of engagement. Disrupting others is usually a problem for these students so carefully partnering them or giving them helper jobs during building activities may help. Alternately, the activities may be engaging enough that disruption may not be a problem.

There are two other students with IEPs who will need to be partnered with mentors with strong skills but they should not be students who will work past them or leave them behind. The teacher will create balanced partnerships.

Differentiated Assessments:
Lower level students and students with slower processing speeds can work with peers on performance tasks. Students with IEPs can answer their post-assessment quiz using key words or shorter, short-answer answers. Examples of the terms tension, compression, live load, and dead load will be accepted in lieu of the full definition.

Differentiated Instruction:
Use of visual aids, mindful pauses, hands on learning, repetition, peer support, collaboration, and accommodation will help students with slow processing speed and need for accommodations.

Higher achieving students will have the opportunity to use their leadership skills by being partnered with and mentoring slower students or students with behavior interventions in place who look up to those higher achieving students.

Culture and Language connections

- Cultural relevance - structures are universally present in every student's life.
- Access to cultural capital
- Language proficiency - The hand's on nature of the lessons in this unit help students who struggle with language skills to grasp the concepts. Scientific concepts are universal and cross-cultural concepts. My March 29th language arts lesson will be a root word study including the root words: struct, ten, com, arch, con, and grav to further deepen student understanding of the terms in this science unit. I plan for 'tension' and 'compression' to be included in our spelling list the week of April 4th to increase familiarity with the terms and to make cross curriculum connections.

Attachments: Graphic Organizers:
(Please do not attach GOs from your commercial curriculum if there are more than 3!)

Pre-Assessment tool:

NAME:_____

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Give an example of a **natural structure**.

Define **live load**:

Define **dead load**:

There are three types of variables. What is a:

1) dependent variable?

2) independent variable?

3) controlled variable?

NAME:_____

There should be three categories of **variables** in every experiment: dependent, independent, and controlled.

Dependent -- is what will be measured; it's what the investigator thinks will be affected during the experiment.
*In this experiment the **dependent variable** is:*

_____

Independent -- is what is varied during the experiment; it is what the investigator thinks will affect the dependent variable.
*In this experiment the **independent variable** is:*

_____

Controlled -- the variables held constant. Since the investigator wants to study the effect of one particular independent variable, the possibility that other factors are affecting the outcome must be eliminated.

*In this experiment the **controlled variable** is:*

_____

Hypothesis

I think the _____ tower will hold the most books because:

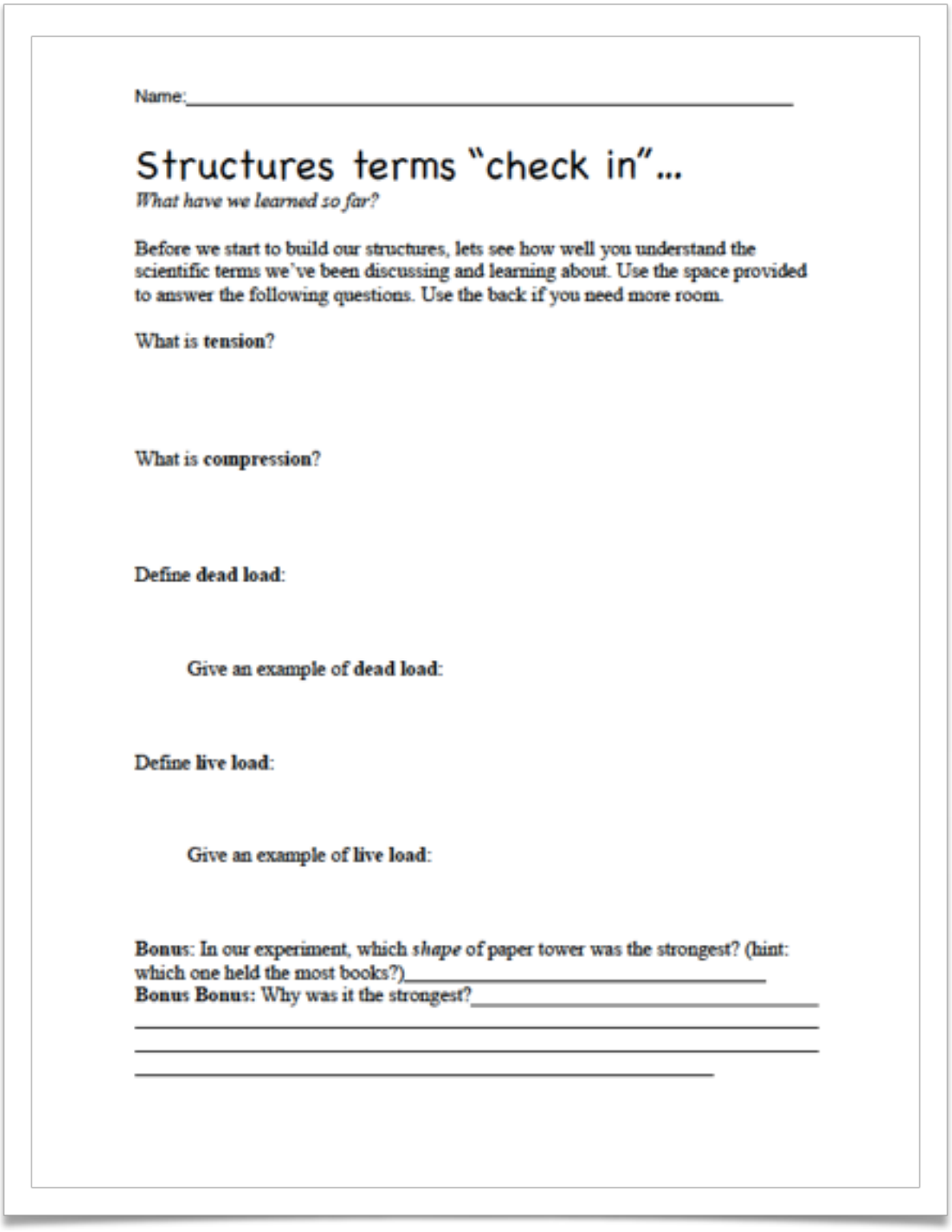
Type of Tower (Independent Variable)	# of books (Dependent Variable)
1. Square	
2. Triangle	
3. Circle	

Results:

The paper tower that held the most books was:

_____.This is because:

Post Assessment tool:



Name:_____

Structures terms "check in"...

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What is **compression**?

Define **dead load**:

Give an example of **dead load**:

Define **live load**:

Give an example of **live load**:

Bonus: In our experiment, which *shape* of paper tower was the strongest? (hint: which one held the most books?)_____
Bonus Bonus: Why was it the strongest?_____
_____
_____
_____

Instructional Decision Making

Bravo

The first lesson in my unit was designed for students to work with partners. The contextual factors for my host class include three male students who struggle with self-control. I will use the following pseudonyms for these students: Bravo, Rio, and Tango. Bravo and Rio have behavior intervention plans in place and receive support both in the classroom and in the resource room. Tango receives none of these supports because in previous years they only worsened his behavior and his academic achievement lessened. I wrote my lesson plan to include a "classroom helper" to distribute materials during the lesson should any of the three of these students struggle with participation when it came time to conduct the lesson. I really had one student in mind for this position, Bravo. I carefully chose partners based on student skill level, who's strengths could compliment another's weaknesses, and how well I thought students would work together. For this lesson, however, I partnered Bravo, Rio, and Tango with different pairs of students who would serve as mentors to them and the result was groups of three. The rest of the class worked in pairs. I hoped that these students would conduct the experiment and achieve the learning goal with the help of other students because usually they do not follow directions, do not stay on task, and they disturb their classmates to the extent that they need constant redirection and sometimes need to be asked to leave the room.

My plan was to put Bravo with a competent group but then offer him a chance to serve as my helper if he was too disruptive or struggled to stay on task. He often chooses not to participate. Often, Bravo learns by being the observer but not necessarily producing any "work." I give him choices but I make it clear to him that disrupting others is not one of his choices. To my surprise, he chose to stay in his group. He was not disruptive and he was able to complete the

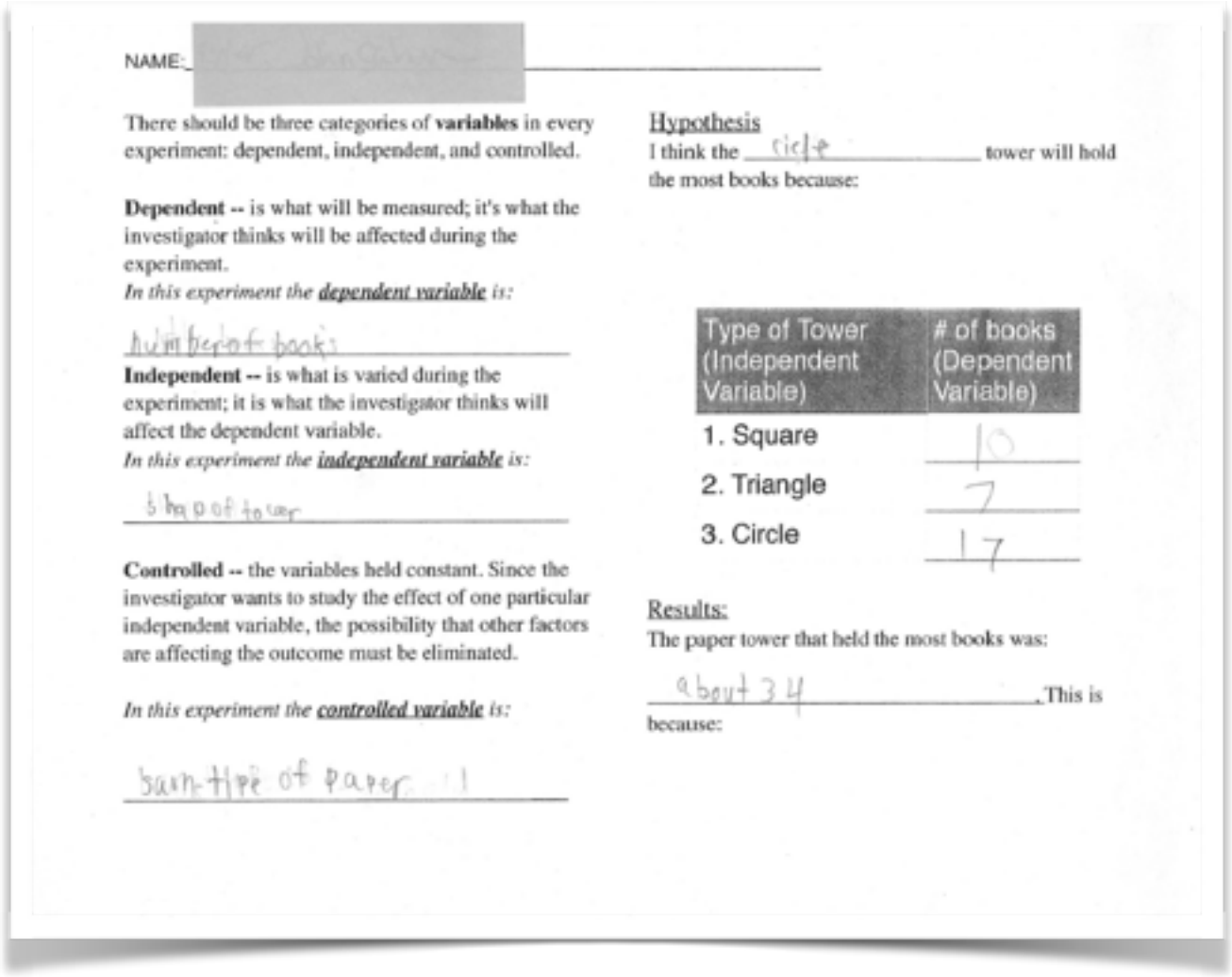
activity. He didn't complete the activity *handout* or record the results of the experiment but he was a part of the group that stacked the most books in the class on the circular paper tower. He participated in the debrief of the experiment as well, so I know he met the learning goal. During the video on tension and compression he didn't take notes but since one of the things he struggles with is refraining from blurting out answers, I know he understands these concepts. He also gave examples of dead load and live load when called on. Because he was engaged in the first construction activity, I will assign him with a really strong partner for the next hands on activity. I expect him to be engaged in the construction activity the way he was with the first one and if he chooses not to participate this time, his partner should be able to finish without his help. I won't plan in advance for Bravo to have a job during the lesson but I can fall back on it should the need arise.

Tango

I put Tango with a pair of students to form a group of three because he generally avoids work and would rather disturb his classmates and make them laugh than stay on task. I appreciate his desire to make his classmates laugh but not at inappropriate times and not in inappropriate ways. Placing Tango in a group with strong mentors was a plan to incentivize him to stay engaged in the lesson and increase the likelihood that he would achieve the learning goal. I grossly underestimated his interest in this activity. I put him with good students (people he gets along with even) but it wouldn't matter who I partnered him with; he wanted to do this himself. He needed to be the leader in his own partnership. I didn't know this going in. Building and using his hands is his thing! After trying to stay with his group for the first tower, he asked me if he and Rio could work together on the floor. I was stunned because, one, he asked permission;

and two, Rio wanted to do it too! Usually, Rio doesn't participate in anything. (He is getting support, new interventions, and mom is on board so he is slowly making progress). When pairing students for this lesson I would have never put these two together but it turned out to be a successful partnership. They completed the experiment together, followed directions, and Tango even completed the experiment handout. It's not completely accurate but it's more than he usually does as far as work goes. Now that I know his enthusiasm for hands-on activities I will trust him with his own partnership for the next activity in the unit. I might even partner him with Rio for the next activity since Rio will be happy to let Tango be the lead. I think he will remain engaged and may even do a better job fitting the parts together than his peers. I think Tango will enjoy the next activity as it requires use of smaller parts and constructing more complex structures. The paper towers in the first lesson collapsed and were destroyed. The next lesson activity will allow Tango to make his structure to experiment with compression and tension and then he can keep it. If every subject could be taught this way he would experience more success and would be more engaged in his own learning.

Sample of Tango's work:



NAME: [redacted]

There should be three categories of **variables** in every experiment: dependent, independent, and controlled.

Dependent -- is what will be measured; it's what the investigator thinks will be affected during the experiment.
*In this experiment the **dependent variable** is:*

number of books

Independent -- is what is varied during the experiment; it is what the investigator thinks will affect the dependent variable.
*In this experiment the **independent variable** is:*

shape of tower

Controlled -- the variables held constant. Since the investigator wants to study the effect of one particular independent variable, the possibility that other factors are affecting the outcome must be eliminated.

*In this experiment the **controlled variable** is:*

same type of paper

Hypothesis
I think the circle tower will hold the most books because:

Type of Tower (Independent Variable)	# of books (Dependent Variable)
1. Square	10
2. Triangle	7
3. Circle	17

Results:
The paper tower that held the most books was:

about 34 .This is because:

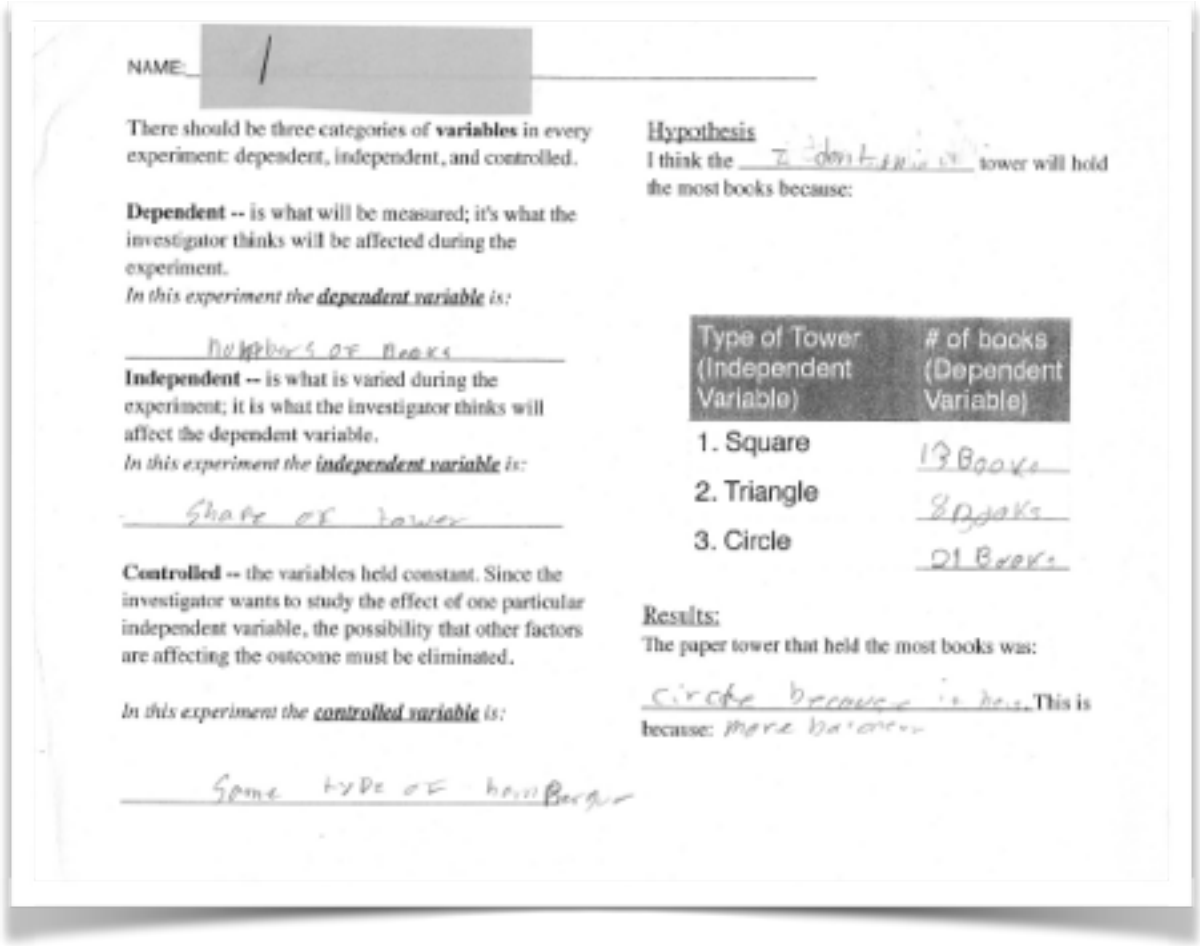
Analysis of Student Learning

Whole Class

There are 25 students in this class but only 23 were available for the pre-assessment. Twenty-two were available for the post-assessment so that is the number I analyzed. The first activity in our unit had a pre-assessment built into it by asking students for their hypothesis about what they thought would be the outcome of our experiment. They made an educated guess about what shape of paper tower they thought would support the weight of the most books and why: the square tower, the rectangular tower, or the circular tower. There was a mix of responses to the question. There were two students who said they had already done this experiment in the Ignite program and they knew the outcome. I asked them not to reveal the answer to their classmates and they agreed. They kept their promise and the experiment retained its integrity. Every student found that the circular tower was the strongest, thus achieving learning goal number one at a rate of 100%.

I have included three samples of student work from the first lesson in the unit. Student #1 didn't think that any paper tower would support the weight of any books at all. Student #2 had their hypothesis overturned by the results of their experiment. Student #3 thought the square tower would hold the most books and prided himself on his results (as evidenced by the "go me" written next to the circled 39 on his record sheet) since his circular paper tower supported the most books of all the other student experimenters. He didn't write the explanation below his results but I made sure he understood the reason during the class discussion after the lesson clean up. Through the class discussion it was revealed that his success had more to do with the shape of the tower. Students made the connection between the strength of these paper towers to the

pillars in their basements, supports in parking garages, the columns of the Colosseum, the structure of grain silos, etc..



NAME: [redacted]

There should be three categories of **variables** in every experiment: dependent, independent, and controlled.

Dependent -- is what will be measured; it's what the investigator thinks will be affected during the experiment.
*In this experiment the **dependent variable** is:*

Number of Books

Independent -- is what is varied during the experiment; it is what the investigator thinks will affect the dependent variable.
*In this experiment the **independent variable** is:*

Shape of tower

Controlled -- the variables held constant. Since the investigator wants to study the effect of one particular independent variable, the possibility that other factors are affecting the outcome must be eliminated.

*In this experiment the **controlled variable** is:*

Some type of hamburger

Hypothesis
I think the [illegible] tower will hold the most books because:

Type of Tower (Independent Variable)	# of books (Dependent Variable)
1. Square	13 Books
2. Triangle	8 books
3. Circle	21 Books

Results:
The paper tower that held the most books was:

circle because it has. This is because: more balance

Student 1 - from Lesson 1

NAME: 2

There should be three categories of **variables** in every experiment: dependent, independent, and controlled.

Dependent -- is what will be measured; it's what the investigator thinks will be affected during the experiment.
*In this experiment the **dependent variable** is:*

the # of books

Independent -- is what is varied during the experiment; it is what the investigator thinks will affect the dependent variable.
*In this experiment the **independent variable** is:*

the type of tower

Controlled -- the variables held constant. Since the investigator wants to study the effect of one particular independent variable, the possibility that other factors are affecting the outcome must be eliminated.

*In this experiment the **controlled variable** is:*

Same type of paper folded hamburger

Hypothesis
I think the square tower will hold the most books because: it was the most stable

Type of Tower (Independent Variable)	# of books (Dependent Variable)
1. Square	5
2. Triangle	5
3. Circle	21

Results:
The paper tower that held the most books was:

the circle tower. This is because: I think the weight was distributed and it had more stability.

Student 2 - from Lesson 1

NAME: 3

There should be three categories of **variables** in every experiment: dependent, independent, and controlled.

Dependent -- is what will be measured; it's what the investigator thinks will be affected during the experiment.
*In this experiment the **dependent variable** is:*

number of books

Independent -- is what is varied during the experiment; it is what the investigator thinks will affect the dependent variable.
*In this experiment the **independent variable** is:*

Shape of tower

Controlled -- the variables held constant. Since the investigator wants to study the effect of one particular independent variable, the possibility that other factors are affecting the outcome must be eliminated.

*In this experiment the **controlled variable** is:*

Same type of paper folded hamburger

Hypothesis
I think the square tower will hold the most books because: it is even on all sides.

Type of Tower (Independent Variable)	# of books (Dependent Variable)
1. Square	13
2. Triangle	7
3. Circle	39

Results:
The paper tower that held the most books was:

circle. This is because:

Student 3 - from Lesson 1

Each student had a different hypothesis about which paper tower would hold the most books but every student learned that the strongest one was the round paper tower. I added a question about the first learning goal to the post-assessment and every student answered correctly with “the circle tower.” This learning goal was achieved by every student (because every student pair discovered that the circular paper tower was indeed the strongest one), but I didn’t do a separate pre-assessment for it, so there isn’t a comparison chart for Learning Goal One.

Learning Goal Two was more complex because it required that students learn the definitions of scientific terms: live load and dead load, and/or be able to give an example of each. In other words, if they couldn’t give the definition but knew the relationship (such as a bridge itself is the dead load and the cars and people are the live load) I would consider that as having achieved Learning Goal Two.

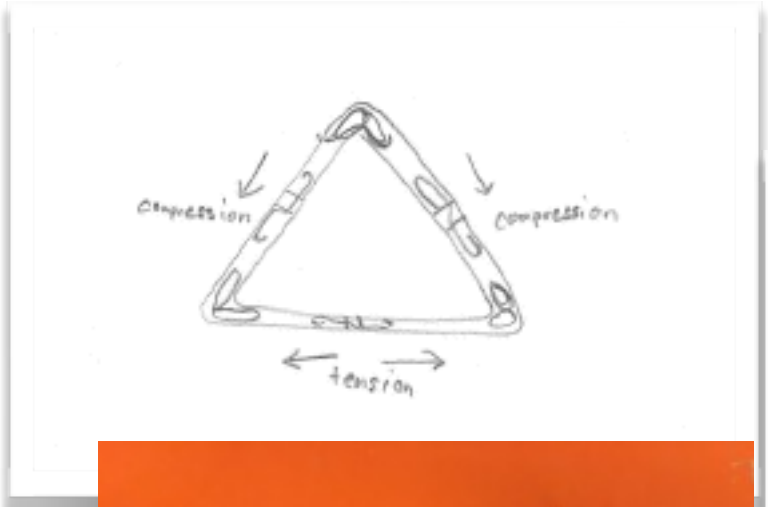
Also, though not specified in Learning Goal Two, it was important to me that students understood the concepts of tension and compression. The unit for my TWS is really a set-up unit so that my host teacher can continue through the end of the school year with larger, more complex, and more time consuming structures lessons. I designed my unit to get the students familiar with the terms and the forces they would be dealing with so that when they build their larger structures their trial and error will be out of the way already. The post-assessment, by and large, shows that my instruction worked to that end.

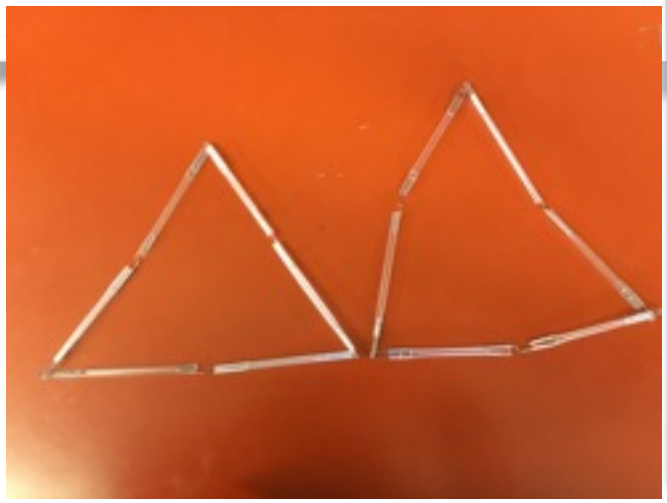
The third lesson required using building materials to get familiar with working with them as well as experimenting with tension and compression. Students were to digram their straw

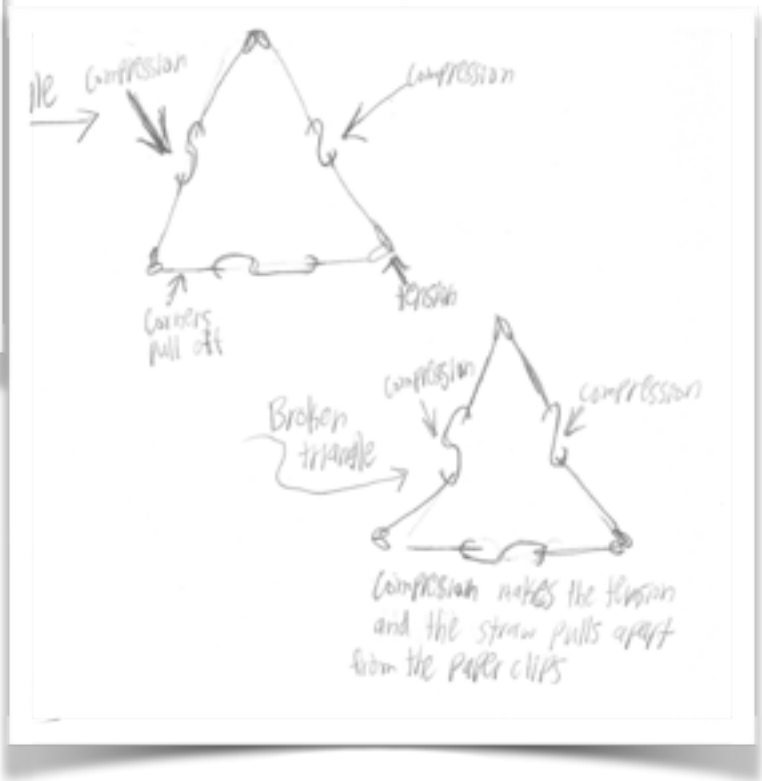
triangles and note the location of compression and tension when they applied pressure to the tip of the triangle when balancing the bottom line segment on the table.

The post-assessment was given the following day and students were not forewarned or asked to study. I wanted to measure how much they had learned from the lessons we had already done.

Overall, two students did worse on the post-test than on the pre-test (both going from 25% to 0%); two students did the same (0% on both tests); while the rest of the class showed signs of learning; most of them significant. The whole class, overall learning gain score was 67.05%.





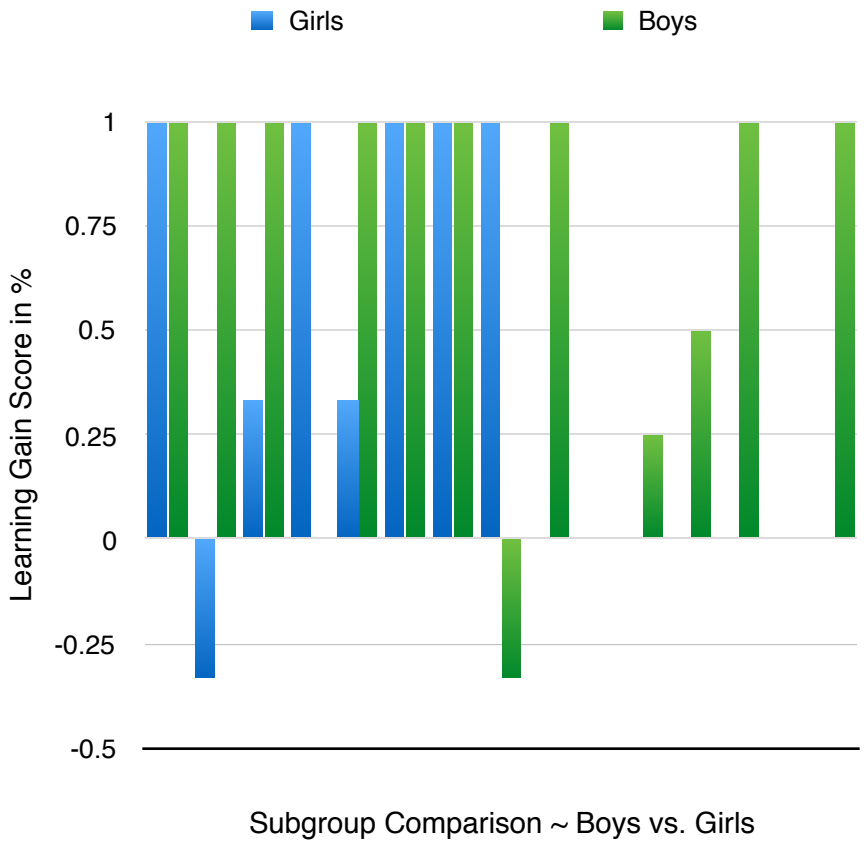


Whole Class Learning Gain Score ~ Goal #2 Analysis:

Students N=22	Raw Score Pretest Top possible= 4 points	Raw Score Post Test Top possible = 4 points	Pretest percentage	Post Test Percentage	Actual Gain Score	Potential Gain Score	Learning Gain Score
1	0	4	0/4=0%	4/4=100%	100	100	100%
2	1	4	1/4=25%	4/4=100%	100-25=75	100-25=75	100%
3	0	4	0/4=0%	4/4=100%	100-0=100	100-0=100	100%
4	1	4	1/4=25%	4/4=100%	100-25=75	100-25=75	100%
5	2	4	2/4=50%	4/4=100%	100-50=50	100-50=50	100%
6	1	0	1/4=25%	0/4=0%	-25	75	-33%
7	0	4	0/4=0%	4/4=100%	100	100	100%
8	1	2	1/4=25%	2/4=50%	50-25=25	100-25=75	33%
9	1	4	1/4=25%	4/4=100%	100-25=75	100-25=75	100%
10	1	0	1/4=25%	0/4=0%	-25	75	-33%
11	0	4	0/4=0%	4/4=100%	100-0=100	100-0=100	100%
12	0	0	0/4=0%	0/4=0%	0-0=0	100-0=100	0%
13	0	1	0/4=0%	1/4=25%	25-0=25	100-0=100	25%
14	0	4	0/4=0%	4/4=100%	100-0=100	100-0=100	100%
15	1	2	1/4=25%	2/4=50%	50-25=25	100-25=75	33%
16	0	2	0/4=0%	2/4=50%	50-0=50	100-0=100	50%
17	0	4	0/4=0%	4/4=100%	100-0=100	100	100%
18	0	4	0/4=0%	4/4=100%	100-0=100	100	100%
19	1	4	1/4=25%	4/4=100%	100-25=75	100-25=75	100%
20	0	0	0/4=0%	0/4=0%	0-0=0	100-0=100	0%
21	0	4	0/4=0%	4/4=100%	100-0=100	100-0=100	100%
22	0	4	0/4=0%	4/4=100%	100-0=100	100-0=100	100%
Overall Learning Gain Score							67.0454545

Subgroup

The subgroup, boys vs. girls, shows the boys with a slightly better average but their result is only better by .7% so the difference in learning is relatively unremarkable as it pertains to gender. This subgroup has equal representation of high and low SES students, high and low effort and ability students, and gifted students. Of the two subgroups, the boys' is the only group with students receiving in class and out of class resource support. I do find it interesting, however, that given this fact, the boys' average was higher than the girls'. Perhaps the subject matter was more interesting to the boys and therefore achievement was that much higher.



This graph illustrates the difference in learning gain scores for the subgroup boys vs. girls. It shows 8 scores for girls but only 12 scores for boys as two boys had a LGS of 0%. There is one negative score from each gender; cancelling each other out.

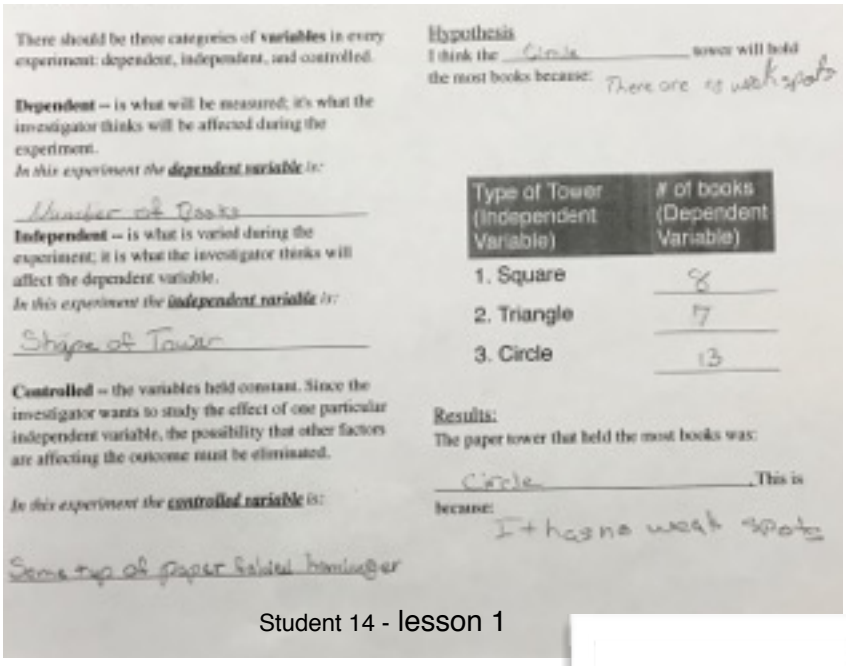
The chart below shows the average LGS for the boys was 67.3% and the LGS for the girls was 66.6%. The difference of .7% is not a very remarkable difference in achievement between genders.

Learning Gain Score for Learning Goal Two:
Subgroup, Boys vs. Girls

Student #	Boys	Girls
1	100%	
2	100%	
3	100%	
4		100%
5	100%	
6		-33%
7	100%	
8		33%
9	100%	
10	-33%	
11	100%	
12	0%	
13	25%	
14		100%
15		33%
16	50%	
17		100%
18	100%	
19		100%
20	0%	
21	100%	
22		100%
Average %	67.2857142857143%	66.625%

Individual Student Analysis

Student #14 had a LGS of 100%. I was surprised by the outcomes of all of her assessments (formative included) as she often refuses to participate in class, doesn't do homework (particularly math), and has had trouble at home and struggles to leave it there. I partnered her with someone I knew she would work well with, for lessons 1 and 3, but the second lesson required note taking and class participation. She took the lessons and both assessments seriously and did well by the end of the unit. Her short answer responses on the post-assessment show that she achieved the learning goals despite her normal avoidance behavior. I was glad to see this as I continue to have high expectations of her.



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In this experiment the ***dependent variable*** *is:*

Number of Books

Independent -- is what is varied during the experiment; it is what the investigator thinks will affect the dependent variable.
In this experiment the ***independent variable*** *is:*

Shape of Tower

Controlled -- the variables held constant. Since the investigator wants to study the effect of one particular independent variable, the possibility that other factors are affecting the outcome must be eliminated.

In this experiment the ***controlled variable*** *is:*

Same type of paper folded hamburger

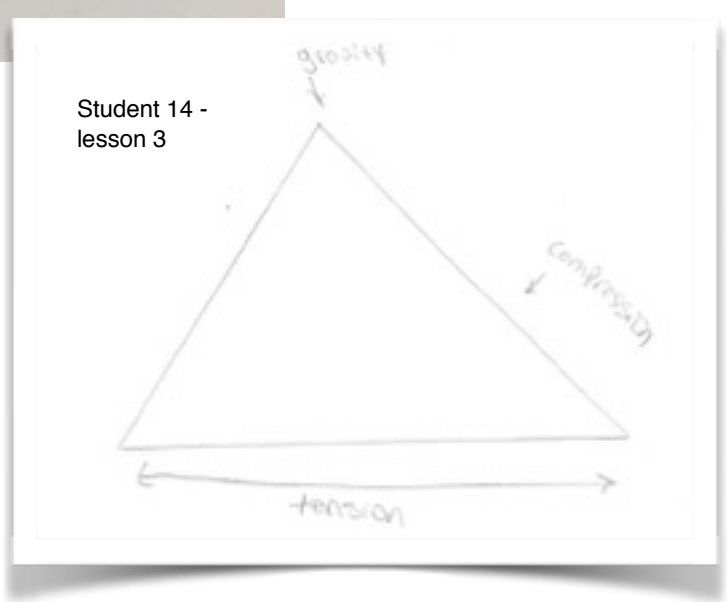
Hypothesis
I think the Circle tower will hold the most books because: There are no weak spots

Type of Tower (Independent Variable)	# of books (Dependent Variable)
1. Square	8
2. Triangle	17
3. Circle	13

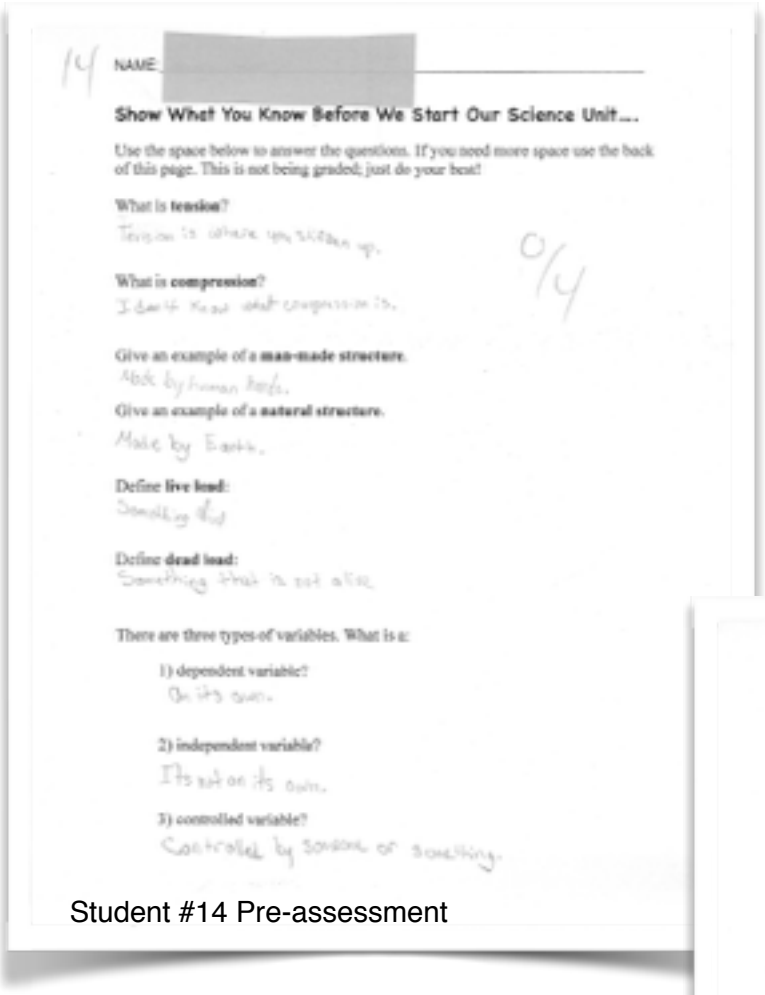
Results:
The paper tower that held the most books was:

Circle This is because: It has no weak spots

Student 14 - lesson 1



Student 14 - lesson 3



1/4 NAME [redacted]

Show What You Know Before We Start Our Science Unit....

Use the space below to answer the questions. If you need more space use the back of this page. This is not being graded; just do your best!

What is **tension**?
Tension is where you stretch up.

What is **compression**?
I don't know what compression is.

0/4

Give an example of a **man-made structure**.
Made by human hands.

Give an example of a **natural structure**.
Made by Earth.

Define **live load**:
Something live

Define **dead load**:
Something that is not alive

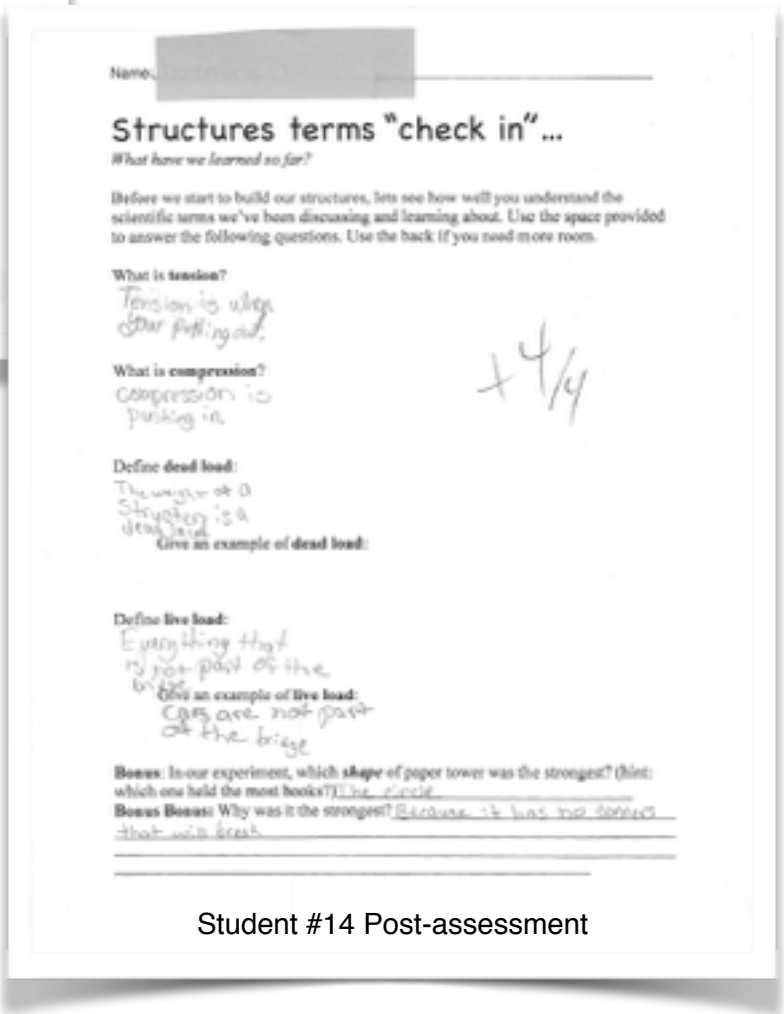
There are three types of variables. What is a:

1) dependent variable?
On its own.

2) independent variable?
It's not on its own.

3) controlled variable?
Controlled by someone or something.

Student #14 Pre-assessment



Name [redacted]

Structures terms "check in"...

What have we learned so far?

Before we start to build our structures, lets see how well you understand the scientific terms we've been discussing and learning about. Use the space provided to answer the following questions. Use the back if you need more room.

What is **tension**?
Tension is when your pulling out.

What is **compression**?
Compression is pushing in.

+4/4

Define **dead load**:
The weight of a structure is a dead load.

Give an example of **dead load**:

Define **live load**:
Everything that is not part of the bridge

Give an example of **live load**:
Cars are not part of the bridge

Bonus: In our experiment, which **shape** of paper tower was the strongest? (hint: which one held the most books?) The circle

Bonus Bonus: Why was it the strongest? Because it has no corners that will break

Student #14 Post-assessment

Student #6 had a LGS of -33%. She put effort into the pre-assessment, was engaged in the first lesson, was present for the second lesson, but did not take the third lesson or the post-assessment seriously. I am not sure why. This student normally is very concerned about getting good grades, completing work, and appearing intelligent. The post-test shows little to no effort especially when compared to her pre-assessment.

6 NAME: [redacted] March 4/16

Show What You Know Before We Start Our Science Unit....

Use the space below to answer the questions. If you need more space use the back of this page. This is not being graded; just do your best!

What is **tension**?
Tension is smashing that is very tight or ready to break
What is **compression**?
Compression is something that is pack down and smashed
Give an example of a **man-made structure.**
house
Give an example of a **natural structure.**
a tree

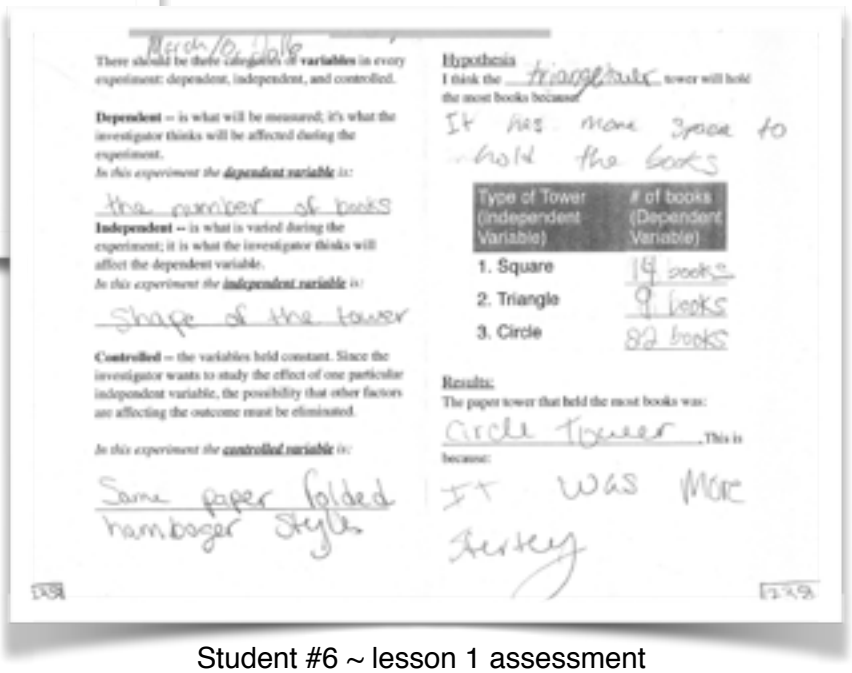
Define **live load**:
I don't know

Define **dead load**:
I don't know

There are three types of variables. What is a:

1) dependent variable?
Cars
2) independent variable?
Trees
3) controlled variable?
grass

Student #6 pre-assessment



March/April 16

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*In this experiment the **dependent variable** is:*
the number of books

Independent -- is what is varied during the experiment; it is what the investigator thinks will affect the dependent variable.
*In this experiment the **independent variable** is:*
Shape of the tower

Controlled -- the variables held constant. Since the investigator wants to study the effect of one particular independent variable, the possibility that other factors are affecting the outcome must be eliminated.

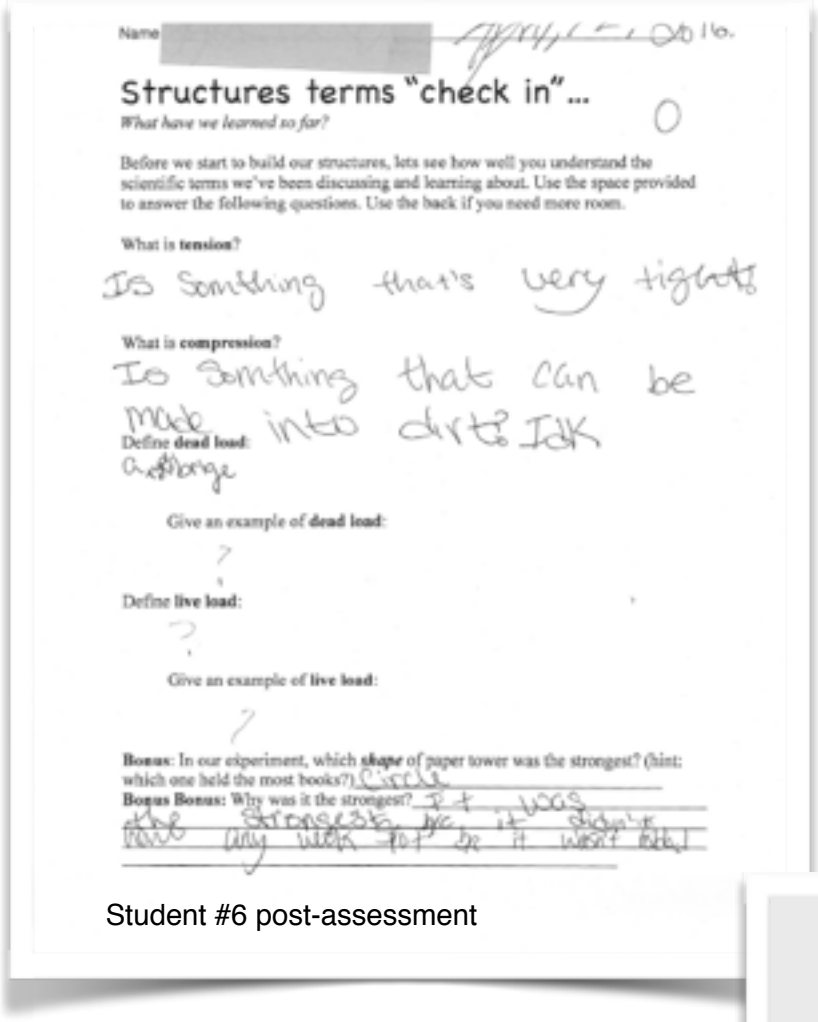
*In this experiment the **controlled variable** is:*
Same paper folded hamburger style

Hypothesis
I think the triangle tower will hold the most books because
It has more space to hold the books

Type of Tower (independent Variable)	# of books (Dependent Variable)
1. Square	14 books
2. Triangle	9 books
3. Circle	80 books

Results:
The paper tower that held the most books was:
Circle Tower. This is because:
IT WAS More Sturdy

Student #6 ~ lesson 1 assessment



Name [redacted] April 16.

Structures terms "check in"...

What have we learned so far?

Before we start to build our structures, lets see how well you understand the scientific terms we've been discussing and learning about. Use the space provided to answer the following questions. Use the back if you need more room.

What is **tension**?

Is something that's very tight

What is **compression**?

Is something that can be made into dirt? Idk

Define **dead load**:

a shape

Give an example of **dead load**:

?

Define **live load**:

?

Give an example of **live load**:

?

Bonus: In our experiment, which **shape** of paper tower was the strongest? (hint: which one held the most books?) Circle

Bonus Bonus: Why was it the strongest? It was the strongest because it didn't have any weight to be it wasn't that

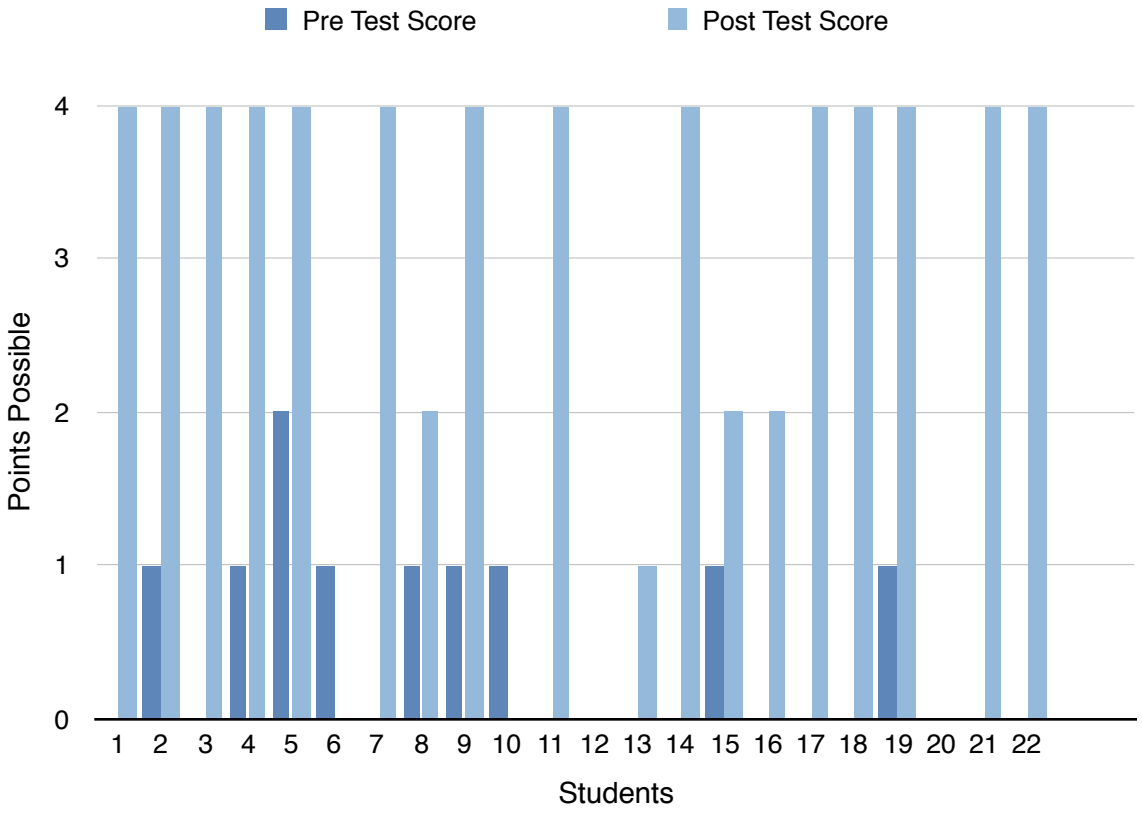
Student #6 post-assessment

This post assessment shows large writing (something this student does when she is speeding through an assignment) and question marks instead of answers. Student #6 didn't put in nearly the effort she did on the pre-assessment. She knew what compression was a month earlier but on this assessment she appears to be confusing it with compost (perhaps intentionally).

Instead of drawing a diagram of her straw triangle and labeling the compression and tension points, student #6 drew a triangle and wrote about "Alaska Grown."

Student #6 ~ lesson 3 assessment

Individual student comparison of pre and post test scores.



With the blue bar indicating a pretest score and the green representing the post-test score, this graph illustrates good overall achievement. Students 12 and 20 scored 0 on both pre and post assessments. Students 6 and 10 got one correct on the pretest and 0 on the post-test.

Reflection and Self-Evaluation

The first learning goal was the easiest to achieve for the entire class because it was a hands on activity. The success of this lesson is due partly to the fact that I had the opportunity to do this lesson twice before and had learned from earlier mistakes. The goal of the first lesson/learning goal was for students to discover that a tower (or support structure) with no creases or edges, a round support structure, will support the most weight. We used paper to test this and some students thought that *no* paper tower, regardless of shape, would support a stack of books. It is important that students discover through doing because it leads to deeper understanding. During the lesson debrief, I used inquiry to lead the students to answer the question of "why." They were able to figure out that the weight of the books would concentrate in the corners of the square and triangular paper towers and cause collapse with fewer books than the round tower. With further inquiry, students made the leap from the paper towers to structures all around them. The nature of the activity encouraged engagement, even for students who tended to disengage.

The second learning goal required that students learn scientific terms. I implemented a different approach for lesson two. I designed my lesson to include a BrainPop video which had audio and visual elements that I could pause and reinforce through repetition. The students were used to taking notes for social studies and science videos for their regular teacher so when there was a term I wanted them to know, I paused the video and made them write it down. I verbally repeated the definition and left long pauses for processing time as well. Before giving the definitions to some of the terms I gave students another opportunity to say what they thought it meant (the first time was the pre-assessment). They were grasping the concepts really quickly and I realized that I might have to abandon the rest of my lesson plan. I thought 'live load' and 'dead load' would be more challenging for the students to grasp than they actually were and I didn't want to stand there and "beat a dead horse" so I wrapped up the lesson a little sooner than planned. The post-assessment showed that, for the most part, the students learned the terms from that one lesson. Some of them quoted the definition word for word. This tells me that the combination of the video, the

audio, writing the notes, and the discussion of the terms with examples was a very effective way to teach (and students to learn) the terms. The video covered several other terms and types of structures but I kept the focus on the terms that the students would need, and would be using, in the remainder of the structures unit. Going in depth for a *few*, rather than trying to cram in *all* of the terms made for deeper, more effective learning. Lesson three helped reinforce understanding of the terms as well.

Student #6 performed really poorly on the third performance task and post-assessment. It was generally out of character for this student; at least from what I knew of her performance and attitude about other academic areas. After a great deal of reflection I realized what happened with Student #6. My theory for the poor outcomes with this particular student is lack of enthusiasm on her part and my not catching it in time to hold her accountable. I had seen a lack of enthusiasm with this student in other areas and projects earlier this semester and I was able to catch it and redirect her. With this unit, I had forgotten about her tendency to be a high ability student with occasional low effort performance/results. It had been several weeks since I had needed to push her to do her best in this way so I was assuming she was doing fine during this unit. The first learning goal was almost a given because it was very engaging and the whole class learned together. This second learning goal, learning the terms, required more individual diligence and I overlooked this student. I believed that she was one of the "ones" who didn't need monitoring or support as much as other students. It wasn't true, as the post assessment and results of lesson three showed.

The TWS showed me that you cannot base student achievement in one subject on their performance, understanding, or enthusiasm for another. As a teacher, I need to be diligent with <u>each</u> student throughout a unit and across curriculums. The TWS taught me never to take student performance for granted. It does students a disservice to assume they will "get it" because they always have before. If that were true for students, they wouldn't need me in the first place. As a teacher, I will never make that assumption about my students again.