Introduction
Modified Units for English Language Learners

Title: Balanced and Unbalanced Forces

Grade Level: 7th-8th Grade, Science

Target Group: Mainstream Class with Integrated ELL Students

Reading Materials:


Source of Original Lessons:

This lesson was created and adapted by a middle school science teacher in New Haven, CT (Suzanne Botta-Sullivan).  
http://newhavenscience.org/81unit.htm  
http://www.nextgenscience.org/next-generation-science-standards

Goals of the Unit:

- I want my students to know the difference between balanced and unbalanced forces.
- I want my students to know how to develop, proposed, and carry out an investigation.
- I want my students to know how to draw conclusions from their own investigations.
Lesson 1
# Lesson One: Balanced and Unbalanced Forces

7th and 8th Grade – Science

## Content Objectives

1. Students will be able to investigate and define balanced and unbalanced forces.
2. Students will be able to develop a physical model demonstrating balanced and unbalanced forces.
3. Students will be able to analyze the outcome of their physical model.

## Language Objectives

1. In whole group, students will write self-described definitions about balanced and unbalanced forces.
2a. In small groups, students will orally come to agreement on one method to create their balanced model.
2b. In small groups, students will draw a visual representation of their model, labeling and describing in writing the parts of the model.
3a. Individually, student will write in a paragraph the things they manipulated on their model to achieve balance.
3b. In small groups, students will orally hypothesize causes/effects in the outcome of their balanced models.

## Task/Domain

<table>
<thead>
<tr>
<th>Writing – Defining balanced and unbalanced forces.</th>
<th>Fluent Bridging Level 5</th>
<th>Expanding Fluency Level 4</th>
<th>Speech Emerging Level 3</th>
<th>Early Production Level 2</th>
<th>Preproduction Level 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students will produce definitions of the terms using full and complete sentences. Students will work in a small group.</td>
<td>Students will produce definitions of the terms using content related phrases/short sentences. Students will work in small groups.</td>
<td>Students will fill in blanks of definitions using sentence starters with blanks provided by the teacher. Students will work in small groups.</td>
<td>Students will fill in blanks of a definition in a provided sentence starters, using a word bank. Students will work in pairs.</td>
<td>Students will match the correct term to a visual representation, with a provided definition. Students will work in pairs with the students of the same first language, using prompts from the teacher.</td>
<td></td>
</tr>
</tbody>
</table>

<p>| Speaking/Writing – Creating a balanced model. | In small groups, students will be able to orally describe the 4 steps to create a balanced model, using sequence words and full/complete sentences. Students will be able to create and label the 3 parts of their own model, explaining what each part was used for, in complete sentences. | In small groups, students will be able to orally describe the 4 steps to create a balanced model, using some sequence words and phrases/short sentences. Students will be able to create and label the 3 parts of their own model, explaining what each part was used for, using phrases/short sentences. Students will be provided a graphic organizer. | In pairs, students will be able to orally describe the steps they used to create their model, using provided sentence starters with blanks. Students will use a provided graphic organizer with visuals and blanks to fill in labeled parts of the model they created. Students will provide 1 word to describe what each part was used for. | In pairs, students will be able to orally describe the steps they used to create their model, using provided sentence starters and a word bank. Students will use a filled out graphic organizer, as well as sentence starters with a word bank, to label and explain each part of their model. | In pairs with the same first language, students will orally describe the steps they used to create their model, using provided visuals. Students will use cut out labeled pictures to visually describe their model. They will have sentences to match with each picture to describe its use. Students will work in pairs with students sharing the same first language. |</p>
<table>
<thead>
<tr>
<th>Speaking/Writing – Analyzing the success of the model.</th>
<th>Students will discuss in small groups and then individually write 2 complete sentences, explaining what they changed on their model and why.</th>
<th>Students will discuss in small groups and then individually write 2 complete sentences, using phrases or short sentences, explaining what they changed on their model and why. Students will use teacher-modeled questions.</th>
<th>Students will write 2 things they changed on their model. Students will work in pairs, and use sentence starters with blanks provided by teacher.</th>
<th>Students will write 1 thing they changed on their model. Students will be provided sentence starters with visuals. Students will work in pairs.</th>
<th>Students will visually show what they changed on their model to achieve balance. Students will work in pairs with students of the same first language.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students will offer 1 reason why their model did not balance, and 1 reason why their model balanced. They will use complete/full sentences. Students will discuss in small groups, and write sentences individually.</td>
<td>Students will offer 1 reason why their model did not balance, and 1 reason why their model balanced, using example sentences provided by teacher. Students will use phrases or short sentences, and work in small groups.</td>
<td>Students will write 1 reason why their model was balanced or unbalanced. They will work in pairs, and use sentence starters and a word bank provided by the teacher.</td>
<td>Students will provide 1 reason why their model was balanced or unbalanced. They will use 1-2 word answers. Students will work in pairs.</td>
<td>Students will verbally explain 1 reason their model balanced or did not balance, using 1-2 word answers, along with prompts from the teacher. Students will do this in pairs with students sharing the same first language.</td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>Situation</td>
<td>Expression</td>
<td>Words</td>
<td>Grammar</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
<td>--------------------------</td>
<td></td>
</tr>
<tr>
<td>Identify</td>
<td>Defining a balanced and unbalanced force.</td>
<td>A <strong>1</strong> force has two forces acting in opposite directions. The two forces are <strong>2</strong> in size.</td>
<td>1 – balanced, unbalanced</td>
<td>Adjectives</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 – equal, not equal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formulate and</td>
<td>Create a model of a balanced force.</td>
<td><strong>1</strong>, our group <strong>2</strong>.</td>
<td>1 – First, Second, Third, Next, Finally</td>
<td>Transitions to show</td>
<td></td>
</tr>
<tr>
<td>Explain</td>
<td>Label the method to create a balanced force.</td>
<td>The <strong>3</strong> was/were used to <strong>4</strong>.</td>
<td>2 – tied washers to the pipe cleaner, wrapped the pipe cleaner around the craft stick, put the stick on the finger, balanced the stick on the finger</td>
<td>sequence</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 – pipe cleaner, washers, craft stick</td>
<td>Nouns</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 – hold the washers, balance the stick, balance on the finger</td>
<td>Phrases</td>
<td></td>
</tr>
<tr>
<td>Analyze and</td>
<td>What was manipulated on the model?</td>
<td>Our group changed <strong>1</strong>. We did this because <strong>2</strong>.</td>
<td>1 – location of the craft stick, length of the pipe cleaner, placement of the washers</td>
<td>Adjectives</td>
<td></td>
</tr>
<tr>
<td>Conclude</td>
<td>Cause and Effect.</td>
<td>The <strong>3</strong> because the model was <strong>4</strong>.</td>
<td>2 – the model fell forward, the model was too heavy, the model did not balance</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 – model stayed on the finger, model fell off the finger</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 – balanced, unbalanced</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Lesson One: Balanced and Unbalanced Forces
7th and 8th Grade - Science

Avery Rourke

Lesson Plan

Black text is the teacher's original lesson plan.
Blue text is the modifications made to the original.

This lesson is takes place mid year and assumes that a classroom culture has been built around working through frustration, classroom discourse, and students willingness to have unresolved questions, and ideas that disturb their thinking.

Engage / Engaging phenomena

1. Day 1 (55 min) Student challenge

SW: Investigate balanced & unbalanced forces.

Teacher will address the whole class and tell them “Today we are going to be learning about 2 kinds of forces: balanced (Teacher will use the hand gesture of both hands, palm up, at an equal level in front of them) and unbalanced (Teacher will be using the hand gestures of both hands, palms up, at unequal levels in front of them, moving hands up and down at opposite levels).” Teacher will initially ask the question “What do you think it means for a force to be balanced?” Teacher will ask this using the hand gesture of both hands, palm up, at an equal level in front of them. Students, in pairs, will turn and talk with their partner about what they think a balanced force is. After about 1 minute, teacher will ask the class “What do you think it means for a force to be unbalanced?” Teacher will ask this using the hand gestures of both hands, palms up, at unequal levels in front of them, moving hands up and down at opposite levels. Again, students will turn and talk in pairs for about 1 minute about their ideas. Then, teacher will write a given definition for each term on the front board. Teacher will have a scale, as well as several objects (a stone, a piece of paper, a notebook, a cup of water, etc.) in front of them. Teacher and students will all guess which objects may be heavier or lighter, and which may be equal weight. Using the scale, the teacher will try the student guesses. Several of their guesses will be unbalanced weights, and some may be balanced. They will see the difference of balanced and unbalanced through this activity. Teacher will give students a handout (Definition: Levels 5-1) for them to write down what the definition of a balanced/unbalanced force is based on their proficiency level.

* Note: level 1 will have 2 different worksheets

*SW: develop a model demonstrating balanced/ unbalanced forces

W.U. Balance toy maker

* (1) Craft stick
* (2) washers - * the washers are used as weights other material can be used in lieu of washers

* (1) Pipe cleaner

(Teacher will hold up and pass around each material when introducing them to the class. The words of the materials being used will be written on the front board. The teacher will point to the word, hold up the object in their hand, and have all the students repeat the name after the teacher.)

Introduce task /challenge:

Using the materials (hold up and show them to the students) the students need to craft a toy that where the very end of the craft stick will balance on the very tip of a finger (repeat hand gesture from before about balanced (both hands, palms up, equal level)). They can arrange the pipe cleaner and washers how ever they need to get the craft stick to balance. After taking about a 10 second pause, be sure to repeat these directions.
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Restrictions: They may not attach any part to their finger. It must be freely perched on the finger, the craft stick must be all the way out (like a diving board.) Be sure to model what these restrictions are, i.e., tie the pipe cleaner to teachers finger, show a visual of what a diving board looks like. Make sure to repeat these restrictions more than 1 time.

Demonstrate the position of the craft stick but do not show them a picture of the completed task. They generally think it’s impossible, remind them, you’d only give them an achievable task.

*Sometimes (depending on the group, and point in the year I like to mention to them, they will likely start to feel a level of frustration and that it is really normal and when they feel the frustration begin to well up to take a couple of deep breaths, remind themselves they have struggled before and successfully overcome challenges, e.g. video game levels, sports maneuvers, dance steps, hand movement with an instrument. They will be successful and today they will engage with productive struggle. This is a classroom cultural aspect that needs to be targeted many times for students to trust in the process.

Teacher will post an “Emotion Board” on the wall in the classroom. This board will have some of the emotions listed about that may be experienced during the experiment. As this is a concept that is going to be built upon throughout the year, the students should already be familiar with what these emotions are. There are visuals to help describe them, so students can express how they feel during the experiment. (See “Emotions Board for classroom” in handouts)

Finally, let them know they are going to be discussing their finding later so pay attention (point to eyes) to the changes (Use unbalanced gesture of both hands, palms up, moving at different levels) that make your model successful (switch from unbalanced gesture to balanced gesture used earlier in the lesson).

*This image is for the teacher for clarity. Note, when balanced well, you can touch even less of the craft stick. Also this is one way to set it up to make it balance. There are many iterations that will work.*
Before releasing the students to work (in groups of 2 or fewer) (students will work in pairs, lower level ELs will work with students of their same first language, if possible) have the students tell each other what they are going to do when they are released. If needed model, “when she says go we are gonna...” (Teacher will provide this example of a sentence starter to students before they turn and talk with a partner)

After a (approximately 30 seconds) ask, does anyone have any questions? If none, release them to work. Repeat one last time what the goal of the experiment is. Then, release pairs of students to work on the experiment.

Guidelines for Modeling

- Address a question about something in the real world
- Include entities (sometimes invisible or hypothetical) and rules for how they interact
- Must be consistent with the evidence we have and make predictions about future observations
- Are revisable
- Are public

Teacher should take the above Guidelines for Modeling and create it into a poster that can remain on the wall in the classroom. This guideline can be used on different activities and experiments throughout the school year.

As students are working, continue to walk around the room encouraging students to persist through their frustrations. There will be a point where groups start to get close to success. Remember to push them to get the craft stick on to the tip of their finger, like a diving board.
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They’ll want to claim success before they cross the finish line, encourage them, they are almost there. You will on occasion get a student who solves it very quickly.

After completing the experiment, students will use the modified handouts according to their proficiency levels to describe the steps they used to create their model (Steps: Levels 5-1).

Once students achieve balance, let them have their moment. Give a round of applause to the class for finishing their experiment and persisting through the challenges and frustrations. Pass out large chart paper (Modified handouts according to proficiency levels (Model: Levels 5-1)). Have students create on paper a model of their balance toy. The “model” (an NGSS Science and Engineering Practice) is an illustration of their creation, all its parts, and other components, seen and unseen. At this point very few students will include gravity or forces.

As they are drawing, ask them how did you get it to balance, what is going on? In your model in addition to the objects include
* all the parts in the system
  * causes
  * effects
  * things you manipulated.

In pairs, students will then think about how they achieved their balanced model and what they did and changed to achieve this. Students will use modified handouts (Exploring: Levels 5-1), as well as come to a conclusion on their experiments (Conclusion: Levels 5-1).

Close:
Something you learned, something you liked, a question you have.
Teacher will pass out exit cards to reflect upon and conclude the lesson. Modified handouts are based on students’ proficiency levels (Exit Cards: Level 5-1).

For tomorrow be prepared to discuss your findings. **Remind students they will have a chance to add any last changes to their model during the next lesson.**
Write a definition for each bolded word, using full and complete sentences.

What is a balanced force?

What is an unbalanced force?
Write the correct word for the definition in the blank space provided.

1. A _______ force has two forces acting in opposite directions. The two forces are ______ in size.

2. A _______ force has two forces acting in opposite directions. The two forces are ______ in size.
Write the correct vocabulary term, using the provided word bank, in the blank space. Each word will only be used 1 time.

1. A _____ force has two forces acting in opposite directions. The two forces are _____ in size.

2. A _____ force has two forces acting in opposite directions. The two forces are _____ in size.

<table>
<thead>
<tr>
<th>balanced</th>
<th>not equal</th>
</tr>
</thead>
<tbody>
<tr>
<td>unbalanced</td>
<td>equal</td>
</tr>
</tbody>
</table>
Definitions: Level 1

Draw a line connecting the correct vocabulary word on the right to the picture it defines on the left. Then, write the correct vocabulary term under the picture.

Unbalanced

Balanced
Draw a line connecting the correct vocabulary word on the right to the picture it defines on the left. Then, write the correct vocabulary term under the picture.

**Unbalanced force:** The two Forces are **unequal**.

**Balanced force:** The two Forces are **equal**.
Write the steps that you took to create your balanced model. Be sure to use sequence words and full/complete sentences.

How did we make our model balance?

1. 

2. 

3. 

4. 
Write the steps that you took to create your balanced model. Including a sequence word and activity, use the provided sentence starter to create your steps.

_______, our group ________________.

1. __________________________________________
   __________________________________________
   __________________________________________

2. __________________________________________
   __________________________________________
   __________________________________________

3. __________________________________________
   __________________________________________
   __________________________________________

4. __________________________________________
   __________________________________________
   __________________________________________
Using the word banks below, pick the correct word to correspond to the blank in the sentence provided. Each word will only be used 1 time.

___1___, our group _____2_____.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>balanced the craft stick on the finger.</td>
</tr>
<tr>
<td>Next</td>
<td>tied the washers to the pipe cleaner.</td>
</tr>
<tr>
<td>Then</td>
<td>wrapped the pipe cleaner around the craft stick.</td>
</tr>
<tr>
<td>Last</td>
<td>put the craft stick on the finger.</td>
</tr>
</tbody>
</table>
Cut out each picture of the steps to make your balanced model. Then, paste each picture in the blank square on the following page, in order of what you did.

Steps: Level 1

- Wrapped the pipe cleaner around the craft stick.
- Balanced the craft stick on the finger.
- Put the craft stick on the finger.
- Tied the washers to the pipe cleaner.
Steps: Level 1

Cut out each picture of the steps to make your balanced model. Then, paste each picture in the blank square on the following page, in order of what you did. Please rewrite the sentences you create, in order, on a separate piece of paper.

<table>
<thead>
<tr>
<th>1. First,</th>
<th>2. Next,</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Then,</th>
<th>4. Last,</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Draw and label your balanced model.

Explain what each part of the model was used for, and why. Use complete sentences.

1. 

2. 

3. 

Label the parts of your balanced model.

Explain what each part of the model was used for, and why. Use phrases/short sentences.

1. ____________________________

2. ____________________________

3. ____________________________
Label the parts of your balanced model.

Provide 1 word to explain what each numbered part of the model was used for, and why.

1. _______ was used for _______.

2. _______ was used for _______.

3. _______ was used for _______.
Describe what the parts of your balanced model are used for. Use the provided word bank with the sentence starters. Each word will only be used 1 time.

The _______ was used for _______.

The _______ was used for _______.

The _______ was used for _______.

<table>
<thead>
<tr>
<th>Pipe Cleaner</th>
<th>balance the craft stick.</th>
</tr>
</thead>
<tbody>
<tr>
<td>balance on the finger.</td>
<td>Craft Stick</td>
</tr>
<tr>
<td>hold the washers.</td>
<td>Washers</td>
</tr>
</tbody>
</table>
Cut out the phrases. Paste them under the picture that matches with what their use was for creating your model.

- Pipe Cleaner
- Craft Stick
- Washers

- hold the washers.
- balance the craft stick.
- balance on the finger.
Rewrite the sentences you created to describe what the parts of your model were used for. Use the following sentence starters and word bank to create your sentences.

The ___1____ was used to ___2_____.

The ___1____ was used to ___2_____.

The ___1____ were used to ___2_____.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Craft stick</td>
<td>Hold the washers.</td>
</tr>
<tr>
<td>Pipe cleaner</td>
<td>Balance the craft stick.</td>
</tr>
<tr>
<td>Washers</td>
<td>Balance on the finger.</td>
</tr>
</tbody>
</table>
Answer the question, using full and complete sentences.

What did you change on your model? Why did you change this?
Answer the following question using the provided sentence starter. Your answer should contain short sentences or phrases.

**What did you change on your model and why?**

**Example:**
Our group changed ________. We changed this because ____.
Use the word bank to fill in the sentence starters to describe what you changed on your model. Each word will only be used 1 time.

Our group changed _____1_____. We did this because _____2_____.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>the location of the craft stick.</td>
<td>the model fell forward.</td>
</tr>
<tr>
<td>the placement of the washers.</td>
<td>the model was too heavy.</td>
</tr>
<tr>
<td>the length of the pipe cleaner.</td>
<td>the model did not balance.</td>
</tr>
</tbody>
</table>
Pick 1 of each picture to fill out the provided sentence starter about what you changed to make your model balance.

<table>
<thead>
<tr>
<th>The location of the craft stick.</th>
<th>The length of the pipe cleaner.</th>
<th>The placement of the washers.</th>
</tr>
</thead>
</table>

Our group changed ____________.

<table>
<thead>
<tr>
<th>The model fell forward.</th>
<th>The model was too heavy.</th>
<th>The model did not balance.</th>
</tr>
</thead>
</table>

We did this because ____________.
Exploring: Level 1

Circle YES or NO on changes you made to your model.

<table>
<thead>
<tr>
<th>What did you change on your model?</th>
<th>The location of the craft stick.</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES     NO</td>
<td>YES     NO</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Length of the pipe cleaner.</th>
<th>Placement of the washers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES     NO</td>
<td>YES     NO</td>
</tr>
</tbody>
</table>
Discuss these questions in small groups. Then individually answer the following questions using full and complete sentences.

What happened to your model that tells you it was balanced?

What happened to your model that tells you it was not balanced?
Discuss these questions in small groups. Then individually answer the following questions using short sentences and phrases.

**What happened to your model that tells you it was not balanced?**

Example: The model fell off the finger because the model was unbalanced.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

**What happened to your model that tells you it was balanced?**

Example: The model stayed on the finger because the model was balanced.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
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Conclusion: Level 3

Pick 1 of the phrases from the word bank to describe what happened to your model. Then, circle the correct word to describe your model. Write the phrase or word in the blank space.

The model _______________ ...

- stayed on the finger.
- fell off the finger.

... because the model was ____________.

Balanced          Unbalanced
Pick one of the correct phrases for what happened to your model. Then, circle the reason for what happened to your model, using the provided visuals. Then, write the phrase and word in the blank spaces.

The model ________________ ... 

A. stayed on the finger.
B. fell off the finger
C. was too heavy.

...because the model was _______.

Balanced  Unbalanced
Pick the word and picture that matches what happened to your model. Then, write the word below the picture.

The model was
(balanced/unbalanced) because:

The model stayed on the finger.  The model fell off the finger.
Write 1 sentence to the question in each box, using full and complete sentences.

<table>
<thead>
<tr>
<th>List something you learned during this experiment.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>List something you liked about this experiment.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>List a question you still have about this lesson.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>
Write 1 sentence to the question in each box, using the provided sentence starter.

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>What did you learn during this experiment?</td>
<td>I learned...</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>What did you like about this experiment?</td>
<td>I liked...</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>What is 1 question you still have about this lesson?</td>
<td>I have a question about...</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Circle 1 phrase in each box that answers the following questions:

<table>
<thead>
<tr>
<th>Something you learned.</th>
<th>Something you liked.</th>
<th>A question you have.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>I learned:</th>
<th>I liked:</th>
<th>I have a question:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) What a balanced force is.</td>
<td>A) Making my own model.</td>
<td>A) How do I balance a heavier object?</td>
</tr>
<tr>
<td>B) What an unbalanced force is.</td>
<td>B) Working in a group.</td>
<td>B) What happens if I change ____ on my model?</td>
</tr>
<tr>
<td>C) How to make a balanced force.</td>
<td>C) Trying different ideas.</td>
<td>C) What forces are making my model unbalanced?</td>
</tr>
</tbody>
</table>

---

Exit Cards: Level 2
Lesson One: Balanced and Unbalanced Forces
7th and 8th Grade – Science

Avery Rourke

Exit Cards: Level 1

Circle YES or NO to respond to each statement, following each question.

<table>
<thead>
<tr>
<th>Something you learned.</th>
<th>Something you liked.</th>
<th>A question you have.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Emoji reading" /></td>
<td><img src="image2" alt="Heart-Eyes" /></td>
<td><img src="image3" alt="Confused" /></td>
</tr>
<tr>
<td>About balanced forces.</td>
<td>Making my own model.</td>
<td>About balanced forces.</td>
</tr>
<tr>
<td>YES NO</td>
<td>YES NO</td>
<td>YES NO</td>
</tr>
<tr>
<td>About unbalanced forces.</td>
<td>Working in groups with my classmates.</td>
<td>About unbalanced forces.</td>
</tr>
<tr>
<td>YES NO</td>
<td>YES NO</td>
<td>YES NO</td>
</tr>
<tr>
<td>How to balance my model.</td>
<td>Trying different ideas on my model.</td>
<td>About how my model balanced.</td>
</tr>
<tr>
<td>YES NO</td>
<td>YES NO</td>
<td>YES NO</td>
</tr>
<tr>
<td>I am feeling...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Frustrated</td>
<td>Tired</td>
<td></td>
</tr>
<tr>
<td>Excited</td>
<td>Sad</td>
<td></td>
</tr>
<tr>
<td>Confused</td>
<td>Happy</td>
<td></td>
</tr>
<tr>
<td>Mad</td>
<td>Proud</td>
<td></td>
</tr>
</tbody>
</table>
Lesson One: Balanced and Unbalanced Forces
7th and 8th Grade – Science

Lesson One: Reflective Narrative

The original lesson plan I received from Suzanne was very thorough and well planned out. There were still, however, several modifications I implemented in order to more meaningfully and effectively teach English Language learners of different language proficiency levels in the classroom. In the beginning of the lesson when the class begins to explore the definitions of what is a balanced and an unbalanced force, I chose to explicitly tell the teacher to use hand gestures and show other images of what balance looks like. Though it may seem like common sense to native speaker, the teacher with an EL learner needs to understand that the student may know the concept, just is unable to express their knowledge using English. It is important for the teacher to use a lot of repetition and hand gestures to make mental connections with the student. I also chose to include a lot of visuals, both posted around the classroom, as well as in the modified handouts provided for the lesson. The student is just learning the new vocabulary words and needs these visuals to connect. It will be much more effective for the student to see the word “balanced” with a picture of an even scale below it, or the phrase “What did you learn” with a thinking face next to it, rather than just the word. The same goes for providing sentence starters to the student. It is a support that they can use when they have the content knowledge in their head, and just no language to start to express what they know. Lastly, I chose to try and pair the lower proficiency students in my lesson with speakers of their same first language. Though English may be the target language, it is very important to allow these lower level students to communicate and produce in their first language. By pairing same L1 students together, they can negotiate, discuss, and produce language, a stepping-stone to get them to produce in the target language of English.
Lesson 2
Lesson Two: Balanced and Unbalanced Forces

<table>
<thead>
<tr>
<th>Content Objectives</th>
<th>Language Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Students will be able to draw conclusions about forces.</td>
<td>1a. In small groups, students will orally ask questions about what made their model balance, and write down their group questions created.</td>
</tr>
<tr>
<td>2. Students will be able to develop a model and propose explanations/describe phenomena.</td>
<td>1b. In small groups, students will orally explain what made their model balance, and write in paragraph form the answers to their generated questions.</td>
</tr>
<tr>
<td></td>
<td>2a. In small groups, students will individually write what each part of their system/model is for, and orally hypothesize what rules/changes explain the phenomena of balance.</td>
</tr>
<tr>
<td></td>
<td>2b. In small groups, students will orally discuss what they need to know to explain their model and will write in paragraphs what they understand about force/gravity.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Task/Domain</th>
<th>Fluent Bridging Level 5</th>
<th>Expanding Fluency Level 4</th>
<th>Speech Emerging Level 3</th>
<th>Early Production Level 2</th>
<th>Preproduction Level 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Writing/Speaking - What causes balance?</td>
<td>Students will orally brainstorm and generate questions about why their model balanced. They will write these questions out on a piece of paper. Students will then provide thoughts and explanations to their questions,</td>
<td>Students will orally brainstorm and generate questions about why their model balanced. They will write these questions out on a piece of paper. Students will then provide thoughts and explanations to their questions,</td>
<td>Students will orally brainstorm and generate questions about why their model balanced. They will be provided with 1 example question, and must create 2 of their own. They must write these questions on a separate sheet of paper. Students will answer these questions on a separate sheet of paper, using provided sentence starters and a</td>
<td>Students will orally brainstorm about their model, using teacher provided questions. Students will answer these questions on a separate sheet of paper, using provided sentence starters and a</td>
<td>Students will be provided 2 teacher generated questions for them to explore why their model balanced. Each question will have multiple-choice answers for students to choose their answers. Each multiple-</td>
</tr>
</tbody>
</table>
**Lesson Two: Balanced And Unbalanced Forces**

**7th and 8th Grade – Science**

<table>
<thead>
<tr>
<th><strong>Speaking/Writing - The phenomena of force and gravity.</strong></th>
<th><strong>Students will draw and label what each part of the model was used for, and will orally hypothesize what reasons caused their model to balance. These will be done using full, complete sentences and content-related vocabulary.</strong></th>
<th><strong>Students will draw and label what each part of the model was used for, and will orally hypothesize what reasons caused their model to balance. These will be done using full, complete sentences and content-related vocabulary terms.</strong></th>
<th><strong>Students will be given a picture of the parts of their model, which they must label and describe, using provided sentence starters. They will orally hypothesize what reasons caused their model to balance using prompts from the teacher.</strong></th>
<th><strong>Students will be given a picture of the parts of their model, already labeled. They must write under each picture the use for the part. They will orally hypothesize what reasons caused their model to be balance, using provided questions and sentence starters.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Students will work in small groups.</strong></td>
<td><strong>Students will work in small groups.</strong></td>
<td><strong>Students will work in small pairs.</strong></td>
<td><strong>Students will work in small pairs.</strong></td>
<td><strong>Students will have to rewrite the sentence they circle on a separate piece of paper. Students will work in small pairs, with a student of their same L1 if possible.</strong></td>
</tr>
<tr>
<td><strong>Responding with complete sentences using content-based vocabulary. They will also write these responses out on a separate sheet of paper. Students will work in small groups.</strong></td>
<td><strong>Responding with short sentences and phrases, using at least 2 content-based vocabulary terms. They will also write these responses out on a separate sheet of paper. Students will work in small groups.</strong></td>
<td><strong>Students will then provide thoughts and explanations to their questions, using sentences starters to model their responses. Students should use some content vocabulary. They will also write these responses out on a separate sheet of paper. Students will work in pairs.</strong></td>
<td><strong>Word bank with content-based vocabulary. Students will work in small pairs.</strong></td>
<td><strong>Choice answer will have visuals to describe it. Students will have to rewrite the sentence they circle on a separate piece of paper. Students will work in small pairs, with a student of their same L1 if possible.</strong></td>
</tr>
</tbody>
</table>

Using a KWL chart provided by the teacher.
<p>| Teacher, students will fill out the Know and Want to know sections about force and gravity. This will be done using full, complete sentences and content-related vocabulary. All students will talk in small groups, but do the writing individually. | Provided by the teacher, students will fill out the Know and Want to know sections about force and gravity. This will be done using short sentences and phrases and at least 2 content-related vocabulary terms. All students will talk in small groups, but do the writing individually. | With provided sentence starters, students will fill out the Know and Want to know sections about force and gravity. Students should use some content vocabulary. Students will both discuss and complete their writing in pairs. | Using a KWL chart from the teacher that is partially filled out, students will fill out the Know and Want to know sections about force and gravity. Students will both discuss and complete their writing in pairs. | Using a KWL chart from the teacher that is partially filled out, students will fill out 1 reason of the Know and Want to know sections about force and gravity. Students will both discuss and complete their writing in pairs, with a student of the same L1 if possible. |</p>
<table>
<thead>
<tr>
<th>Function</th>
<th>Situation</th>
<th>Expression</th>
<th>Words</th>
<th>Grammar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conclude</td>
<td>What made their model balanced</td>
<td>I think the craft stick balanced because <em>1</em>.</td>
<td>1 – it did not fall forward, something held it up, forces pushed at equal amounts on the object</td>
<td>Cause and effect</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>2</em> is working on our model. We think this because <em>3</em>.</td>
<td>2 – force, gravity</td>
<td>Nouns</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>4</em> with <em>5</em> because <em>1</em>.</td>
<td>3 – the model fell off the finger, the model stayed balanced on the finger</td>
<td>Phrases</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 – agree, disagree</td>
<td>Agree/Disagree</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5 – (student’s name)</td>
<td>statements</td>
</tr>
<tr>
<td>Propose and Describe</td>
<td>What the parts of their model are for</td>
<td>The pieces of our system are the <em>1</em>, the <em>2</em>, and the <em>3</em>.</td>
<td>1 – craft stick, washers, pipe cleaner</td>
<td>Cause and effect</td>
</tr>
<tr>
<td></td>
<td>How force/gravity create balance</td>
<td>Would the model still be <em>2</em> if we moved the <em>1</em> <em>3</em>?</td>
<td>2 – balanced, unbalanced</td>
<td>Nouns</td>
</tr>
<tr>
<td></td>
<td></td>
<td>My model is <em>4</em> as <em>5</em> because <em>6</em>.</td>
<td>3 – forward, backward, up, down, to the left, to the right, higher, lower</td>
<td>Phrases</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I need to know more about <em>7</em> to explain why my model was <em>2</em>.</td>
<td>4 – the same, different</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5 – (student’s name)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7 is 8.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 – it did not fall forward, something held it up, forces pushed at equal amounts on the object</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7 – force, gravity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8 – a strength or energy as part of a physical action or movement, a force that attracts a body toward any other physical body having mass</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Lesson Two: Balanced And Unbalanced Forces
7th and 8th Grade – Science

Black text is the teacher's original lesson plan.
Blue text is the modifications made to the original.

2. Day 2 (55 min)

SW: Investigate balanced & unbalanced forces.

SW: Draw conclusions about forces
SW: Develop a model and propose explanations / describe phenomena

Warm up  Look back at your drawing from day 1. Have small groups of students get together and discuss what they did with their model in the last lesson.

Discuss with your table: What was the goal?

How did you achieve the goal?
Draw out, how did you get it to balance, what is going on?
* causes
* effects
* manipulations

Remind students how hard they worked yesterday, and that they have time now to add any last touches to model. Have students hand the (drawn) model close to each other on a board / wall. Have the students form a semi-circle around the wall with the models. This will get students prepared to work in small groups/pair discussions for the class today where they will explore what happened with their model and the phenomena of gravity and force.

Review discussion guidelines
*teacher note, a class discussion like this can be the best part of teaching, it can also be a mess. Be sure your class has practice in class discussion routines (track the speaker, respond to what was said, etc.) Wait-time, wait-time, wait-time. It WILL start out painfully slow, know that, relax and allow room for the process to unfold. Do not save the kids from silence, someone else will feel the need to fill the space, let them. As a whole group, teacher will ask the class what they think are good rules to remember for during discussions. Teacher will write the ideas students come up with on the front board. In the end, teacher and student will pick the most important guideline rules, and put them on a large chart paper that will be displayed around the room.
Add: Be prepared to feel disturbed and un-resolved. Make sure to have students refer back to the emotions chart used in the previous lesson. Be sure to have this chart hanging up at the end of your whole class discussion, for all students to see during the discussions and work today.

Go through guidelines, have students give concrete examples of what respectful looks like, what it sounds like. What does connecting to each others’ ideas sound like. What does it mean to feel unresolved? (This can be a part of the whole class discussion where the students come up with ideas of what they feel are proper, respectful, and appropriate behaviors for discussions.

Begin the discussion by having them list out all the items in the system. Chart their responses (you’ll need this paper later.) Once they have a comprehensive list, begin asking them more probative questions to explore what is going on with their model and why they have achieved balance. Why does the craft stick stay balanced, what else is going on the model that we can not see? For this, students will use the handout Explanations, depending on their proficiency level (Explanations: Levels 5-1).

Students will next explore in small groups/pairs what caused their model to balance, what phenomena is happening to their model, how are they being successful? The teacher will use the following questions to prompt the students, along with modified handouts (Causes: levels 5-1).

Would it work if you moved the washers....
Do you see any commonalities among the models? Differences?
Are there rules you can create that explain what’s going on and can those rule also explain this phenomena
neither an illusion, or a trick, it's physics at its awesomist

Create space for students to agree with something that someone else has said, even if it’s redundant, just so as everyone speaks. Before this step, the teacher will model on the board, in written sentence starters, what the proper language and respectful language would be to agree/disagree with a classmate. The teacher will have students come to the front of the room and model an appropriate way to agree with someone’s statement, and an inappropriate way.

As your approaching the end of your time. Ask the students, what they next need to know in order to better, and more fully explain what’s going on with the craft stick model? They (hopefully) will have said, they need to understand more about forces, or gravity, they may have even mentioned Newton’s law. Students will discuss these ideas in small groups/pairs, and will use a teacher prepared KWL chart to write out these answers. (KWL: Levels 5-1). Students will be told they are only working on the K and W sections now, and will save the L for a later point in the lessons.

Have them take their model back and add one thing, or rule based on the class discussion. This will be their “exit” procedure. Teachers will ask students in their small group/pair working partners to talk to their partner and decide one thing they’d be interested in adding to their model or a rule that they learned during this lesson. All students will use the same exit card (Exit Card) from the teacher to write down the 1 thing they came up with. Teacher will walk around to the level 2/1 students to prompt them and help in filling out their exit cards.
Brainstorm questions you have as to what happened to make your model balance. Below each question you generate, write an explanation as to why it balanced.

1. ___________________________________________?

2. ___________________________________________?

3. ___________________________________________?

4. ___________________________________________?
Brainstorm questions as to why your model balanced. Use the following example as a reference to how you should model your own questions.

**Example:** What else is going on with the model that we cannot see?

1. ________________________________________________
   ____________________________________________
   ____________________________________________
   ?

2. ________________________________________________
   ____________________________________________
   ____________________________________________
   ?

3. ________________________________________________
   ____________________________________________
   ____________________________________________
   ?
Rewrite the questions you generated about what happened to make your model balance. Then in the spaces below, use the sentence starters to answer your brainstormed questions.

1. ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________?

Response: I think the craft stick balanced because ______________________________________.

2. ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________?

Response: ___________ is working on our model. We know this because ________________________________.

3. ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________?

Response: We think that ________________________________
   ________________________________ caused our model to balance.
Discuss what you think about the questions written below. Then on a separate sheet of paper, rewrite these questions and write what your answer is. Use the provided word bank and sentence starters to help you answer these questions.

1. Why does the craft stick stay balanced?
2. What else is going on with the model that we cannot see?
3. What phenomena is happening to our model to cause balance?

1. ________________________________?

Response: I think the craft stick balanced because ________________________________.

2. ________________________________?

Response: _________ is working on our model. We know this because __________________________.

3. ________________________________?

Response: We think that ___________ caused our model to balance.

| force    | it stayed on the finger |
| gravity  | forces held up the model |
| it did not fall forward | a phenomena |
Lesson Two: Balanced And Unbalanced Forces
7th and 8th Grade – Science

Avery Rourke

Explanations: Level 1

Read the questions provided. Circle the answer that you think best fits what your model did to balance. Then, write the question and answer you selected on a separate sheet of paper.

1. Why does the craft stick balance?

   a. I think that craft stick balanced because forces pushed the craft stick off the finger.

   b. I think the craft stick balanced because forces pushed against one another, holding the craft stick up on the finger.

   c. I think the craft stick balanced because gravity weighed down on the craft stick.
2. What else is going on with the model that we cannot see?

a. Gravity is working on our model. We know this because the craft stick fell off the finger.

b. Force is working on our model. We know this because the craft stick did not fall off the finger.

c. Nothing is working on our model. We know this because it stayed still and did not move.
1. ____________________________
   ____________________________
   ____________________________
   ____________________________?

Response:
   ________________________________________________
   ________________________________________________
   ________________________________________________
   ________________________________________________
   ________________________________________________
   ________________________________________________
   ________________________________________________

2. ____________________________
   ____________________________
   ____________________________?

Response:
   ________________________________________________
   ________________________________________________
   ________________________________________________
   ________________________________________________
   ________________________________________________
   ________________________________________________
   ________________________________________________
Draw each part of your model. Then, label what each part is.

Discuss with your group what reasons caused your model to balance. Write down these reasons you come up with.

1. _______________________________________________________________________________________

2. _______________________________________________________________________________________

3. _______________________________________________________________________________________

4. _______________________________________________________________________________________
For now, fill out the "Know" and "Want to know" sections of your KWL chart. We will use the "Learned" section later.

What do you know and want to know more about force and gravity?
Label what each part of your model is. Then, using the sentence starters below, describe what phenomena each part of the model used to help create balance.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Circle</td>
<td>Line</td>
<td>Triangle</td>
</tr>
</tbody>
</table>

The ________________ were used for __________________________.

The ________________ was used for __________________________.

The ________________ was used for __________________________.
Lesson Two: Balanced And Unbalanced Forces
7th and 8th Grade – Science

For now, fill out the "Know" and "Want to know" sections of your KWL chart. We will use the "Learned" section later.

What do you know and want to know more about force and gravity?

Use the provided sentence starters to help you write your answers.

<table>
<thead>
<tr>
<th>Know</th>
<th>Want to know</th>
<th>Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>I know ________________________________</td>
<td>I want to know more about ________________________</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I know ________________________________</td>
<td>I want to know more about ________________________</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I know ________________________________</td>
<td>I want to know more about ________________________</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I know ________________________________</td>
<td>I want to know more about ________________________</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Using the labeled picture and the sentence starters below, describe what phenomena each part of the model used to help create balance. Use the word bank to help you with your answers.

**Washers**  
**Craft Stick**  
**Pipe Cleaner**

The ______ 1_______ were used to  
_________ 2______________________.

The ______ 1_______ was used to  
_________ 2______________________.

The ______ 1_______ was used to  
_________ 2______________________.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washers</td>
<td>Create a weighted force.</td>
</tr>
<tr>
<td>Craft stick</td>
<td>Support the other materials from gravity.</td>
</tr>
<tr>
<td>Pipe cleaner</td>
<td>Balance the force being applied.</td>
</tr>
</tbody>
</table>
For now, fill out the “Know” and “Want to know” sections of your KWL chart. We will use the “Learned” section later.

What do you know and want to know more about force and gravity?

Using the example as a reference, use the provided sentence starter to help you write your answer.

<table>
<thead>
<tr>
<th>Know</th>
<th>Want to know</th>
</tr>
</thead>
<tbody>
<tr>
<td>I know that force can be balanced or unbalanced.</td>
<td>I want to know more about what gravity affects in my every day.</td>
</tr>
<tr>
<td>I know ____________________________</td>
<td></td>
</tr>
<tr>
<td>____________________________</td>
<td></td>
</tr>
<tr>
<td>____________________________</td>
<td></td>
</tr>
<tr>
<td>about ____________________________</td>
<td></td>
</tr>
<tr>
<td>____________________________</td>
<td></td>
</tr>
</tbody>
</table>

Learned
A. Create a weighted force.

B. Support the other materials from gravity.

C. Balance the force being applied.

The ________________ were used to ________________.

The ________________ was used to ________________.

The ________________ was used to ________________.
Talk with your partner about what made your model balance. List any reasons that you come up with to explain what is happening to your model.

I think that ________________ because
______________________________
______________________________.

I think that ________________ because
______________________________
______________________________.

I think that ________________ because
______________________________
______________________________.

I think that ________________ because
______________________________
______________________________.
For now, fill out the "Know" and "Want to know" sections of your KWL chart. We will use the "Learned" section later.

What do you know and want to know more about force and gravity?

Using the example as a reference, write 1 thing you know, and want to know, about force and gravity.

<table>
<thead>
<tr>
<th>Know</th>
<th>Want to know</th>
<th>Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>I know that force can be balanced or unbalanced.</td>
<td>I want to know more about how gravity holds us on the earth.</td>
<td></td>
</tr>
<tr>
<td>I know gravity can make my model unbalanced.</td>
<td>I want to know more about what makes a force unbalanced.</td>
<td></td>
</tr>
<tr>
<td>I know __________________ about ____________</td>
<td>I want to know more about __________________________</td>
<td></td>
</tr>
<tr>
<td>___________________________________________</td>
<td>_____________________________________________________</td>
<td></td>
</tr>
</tbody>
</table>
Exit Cards

Use this exit card to fill out 1 thing: either something you'd be interested in testing/changing on your model, or something you learned during today's lesson.

<table>
<thead>
<tr>
<th>What is 1 thing I would add to my model...?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What is one thing I learned during today’s activities?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>
Lesson Two: Reflective Narrative

For this lesson, I included a lot more small group and pair work for the students. As with the first lesson, it’s so important to have the students working together. This gives them the opportunities to negotiate meanings and understandings, discuss and share ideas, as well as hear the ideas of other students they may not have explored themselves. This lesson especially is important to have the students work together in small groups/pairs because it is primarily focused on exploring causes and effects of what they are doing to their model, and what phenomena is behind it. I also have the students work on exploring what they already know about force and gravity, as well as what they’d like to know more about, using a KWL chart. For the level 5 and 4 students, they are able to fill these two sections out on their own. For the level 3, 2, and 1 student, they have KWL charts with sentence starters and are partially filled out. The KWL chart is a great resource I added because the student is able to brainstorm, discuss, and write out what they already know and want to know. They will be able to refer back to this chart throughout the unit as they learn new facts about gravity and force, and as they discover things they questioned beforehand. One thing I kept from the original lesson, but modified slightly, was the discussion guidelines poster. I love this idea to model for the students how to hold a complete conversation. However, I modified it to have the students’ share the ideas of what they think proper discussion guidelines should be. From there, the whole class and teacher can pick and choose what they think would work best for the lesson. This discussion will allow the whole class to feel like they had a part in deciding the guidelines for the discussion, and will make it feel more meaningful. Displaying in the classroom will make it accessible all the time to students.
Lesson 3
Lesson Three: Balanced and Unbalanced Forces

<table>
<thead>
<tr>
<th>Content Objectives</th>
<th>Language Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Students will be able to understand the use of and be able to operate a spring scale.</td>
<td>1a. In small groups, students will orally discuss and explain the function of a spring scale.</td>
</tr>
<tr>
<td></td>
<td>1b. In small groups, students will be able to explain how to use a spring scale.</td>
</tr>
<tr>
<td>2. Students will be able to carry out an investigation using a spring scale and draw conclusions about forces.</td>
<td>2a. In pairs, students will orally negotiate how to carry out their investigation.</td>
</tr>
<tr>
<td></td>
<td>2b. In pairs, students will orally discuss plans for their investigation and write answers to questions in their guided learning packet.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Task/Domain</th>
<th>Fluent Bridging Level 5</th>
<th>Expanding Fluency Level 4</th>
<th>Speech Emerging Level 3</th>
<th>Early Production Level 2</th>
<th>Preproduction Level 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speaking/Writing - What is a spring scale?</td>
<td>In small groups, students will orally discuss what a spring scale is and what it can be used for. They will use full, complete sentences and content-related vocabulary. Students will then individually write out the answers.</td>
<td>In small groups, students will orally discuss what a spring scale is and what it can be used for. They will use short sentences and phrases, and some content-related vocabulary. Students will then individually write out the answers.</td>
<td>In pairs, students will orally discuss what a spring scale is and what it can be used for. They will use sentence starters provided from the teacher. They will then write out their answers on a separate sheet of paper, using the.</td>
<td>In pairs, students will orally discuss what a spring scale is and what it can be used for. They will use sentence starters provided from the teacher, as well as a word bank. They will then write out their answers on a separate sheet of.</td>
<td>In pairs (with students of the same L1 if possible), students will orally discuss what a spring scale is and what it can be used for, using prompts from the teacher. They will then match pictures with vocabulary words.</td>
</tr>
<tr>
<td>and definitions they come up with, again using full, complete sentences and content-related vocabulary.</td>
<td>and definitions they come up with, again using short sentences and phrases, and some content-related vocabulary.</td>
<td>sentence starters from the teacher.</td>
<td>paper, using the word bank and sentence starters from the teacher.</td>
<td>and definitions. They will rewrite these matches they create, using sentence starters from the teacher.</td>
<td></td>
</tr>
<tr>
<td>---</td>
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<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Speaking/Writing - How to carry out an investigation using a spring scale.</td>
<td>In small groups, students will orally discuss how to carry out their investigations. They will then fill out the guided learning packet, provided by the teacher. Students are expected to use full, complete sentences and content-related vocabulary.</td>
<td>In small groups, students will orally discuss how to carry out their investigations. They will then fill out a modified version of the guided learning packet, provided by the teacher. Students are expected to use short sentences and phrases, and some content-related vocabulary.</td>
<td>In pairs, students will orally discuss how to carry out their investigation. They will then fill out a modified version of the guided learning packet, provided by the teacher. They will have sentence starters to model their responses, and will produce 1-2 word responses and use some content-related vocabulary.</td>
<td>In pairs (with students of the same L1 if possible), students will orally discuss how to carry out their investigation, using prompts from the teacher. They will then fill out a modified version of the guided learning packet, provided by the teacher. They will have sentence starters to model their responses, as well as a filled out example. Student answers will be 1-2 word responses.</td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>Situation</td>
<td>Expression</td>
<td>Words</td>
<td>Grammar</td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------</td>
<td>------------------------</td>
<td></td>
</tr>
</tbody>
</table>
| Describe and Operate    | What a spring scale is an how to use it        | A spring scale is _1_.  
_2_ is used to _3_.  
The force of an extended spring is _4_ to the _5_ of a spring extended from _6_.  
A spring scale measures _7_ in _8_. | 1 – a type of weighing scale, an object that measures weight by force  
2 – A spring scale, calibration  
3 – weigh an object by force, zero the scale to get an even initial reading  
4 – proportional, different  
5 – distance, space, location  
6 – rest position, movement  
7 – force, gravity, weight  
8 – Newtons, pounds, grams | Nouns, Phrases                      |
| Negotiate and Conduct   | How to carry out an investigation              | The force _1_ is _2_ than/as the force _1_.  
The object not moving _3_ exert force because _4_.  
The scale readings are _5_ when _6_.  
After our observations, we conclude that _7_ | 1 – pulling, being pulled on, of the immovable object  
2 – larger, smaller, the same  
3 – can, cannot  
4 – the scale moved, the scale | Nouns, Phrases, Cause and Effect, Predictions |
<table>
<thead>
<tr>
<th>Do you think we should <strong>8</strong>?</th>
<th>did not move</th>
</tr>
</thead>
<tbody>
<tr>
<td>What would happen if we <strong>9</strong>?</td>
<td>5 - different, the same</td>
</tr>
<tr>
<td>I think <strong>10</strong> will happen because <strong>11</strong>.</td>
<td>6 - one member is pulling harder, when members pull the same</td>
</tr>
<tr>
<td></td>
<td>7 - (model of negotiation/prediction for students)</td>
</tr>
<tr>
<td></td>
<td>8 - (model of negotiation/prediction for students)</td>
</tr>
<tr>
<td></td>
<td>9 - (model of negotiation/prediction for students)</td>
</tr>
<tr>
<td></td>
<td>10 - (model of negotiation/prediction for students)</td>
</tr>
<tr>
<td></td>
<td>11 - (model of negotiation/prediction for students)</td>
</tr>
</tbody>
</table>
Lesson 3: Balanced and Unbalanced Forces
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Black text is the teacher’s original lesson plan.
Blue text is the modifications made to the original.

Day 3: Balanced Forces Investigation

Teacher will create (before class) a list of different questions that students wrote out on their KWL sheets from the previous lesson. The teacher will write each question on a piece of paper, and post them around the room. The teacher will present this to the class, and have students walk around in pairs or small groups, reading and discussing what they think, or answers they have, to each question posted. After each group has a few minutes to respond to each posted question, the teacher will bring the class back together. The teacher will tell the class, “Based on your questions and ideas, I have for you another investigation.” Students will be given a modified instructional worksheet to describe their investigation for the class (Instructions: Levels 5-1)

Review the use of spring scales (calibration.) A science program covering forces, should have access to spring scales. The teacher will show the students what a spring scale looks like, and pass it around the room for each student to hold. The teacher will also show Youtube videos that demonstrate how a spring scale works. (https://www.youtube.com/watch?v=FkRZCQhgcqq) . After watching the video, students will be given a few minutes to turn and talk to their partners about where they may have seen or who would use a spring scale (the grocery store, another class, scientist, etc.) After this, the teacher will provide a written definition of a spring scale and calibration, written on the white board at the front of the class. It will remain there for the remainder of the lesson. As the teacher provides the definition, they will ask students to repeat after them: spring scale, calibration, and the definitions. They will record their definitions on a prepared handout, provided by the teacher (Definitions: Levels 5-1)

Below is a guided learning packet (students should work in pairs, maybe 3s, in groups of 4, someone will be note have a role.) Students will be given each part of the guided learning packet,
Lesson 3: Balanced and Unbalanced Forces
7th and 8th Grade - Science

modified according to their proficiency levels. There are 2 parts to the worksheet that students will work in small groups/pairs on. (Investigation: Levels 5-1) and (Extension: Levels 5-1)

*In the packet below, there is no correct number, except that the pairs of numbers should always be the same as each other, e.g. Do not share this point with the students yet. Let them explore, find frustration, and catch on to this solution to answer the asked questions.

5 Newtons
5 Newtons (the student’s measured results)

I generally don’t tell the students much, except that... (I would not share this point with the students. I think they can negotiate with their partner/group members to come up with this conclusion. Unless the teacher sees extreme frustration that is interrupting the group work they can share this point, otherwise let the students discuss and find trial/error).

The tool is a spring scale. Show the students the spring scale again. It measures force (we’ll get to a definition later) Remind students of the experiments and conclusions they have drawn on force in the past 2 lessons. Force is measured in Newtons, abbreviated as N. Write “Newtons = N” on the board so students can see. Ask them to repeat the word “Newtons” several times. Remind them to calibrate with every measurement. Write “Calibrate = 0” on the board, so they know that they need to measure the force from an even, zeroed out balance every time.

Something to Think About
Think about what happens during a rocket launch. The rocket is propelled into the air by combustion in the engine creating thrust. How does the creation of thrust move the rocket through the air? Let’s conduct an investigation of Newton’s third law of motion to discover the answer!
• To every action (force applied) there is an equal and opposite reaction (equal force applied in the opposite direction).

Materials
• A partner
• 2 Spring scales measured in Newtons
• Chair
• Scientific notebook to record observations
(The above “Something to Think About” and “Materials” are the original product of the teacher’s initial lesson. These examples will be used for Level 5/4 students. Following are modified versions based on proficiency for Levels 3-1)

At the end of the lesson as an “Exit Card” activity, students will participate in a “Share Bear” Activity. In the same groups they worked on during class (or combine pairs of students to have small groups of 4), students will sit around a table with a Share Bear (small, stuffed animal/ball) in the middle of the table. The teacher will pose 3 questions on the front white board:
1. What did you learn about spring scales during today’s lesson?
2. What did you like about today’s investigation? What did you not like?
3. What else would you like to experiment on using a spring scale?
The student holding the Share Bear gets to share their personal response to the group. They then will pass the bear around, until each student gets to share multiple times. The teacher will walk around during the sharing, listening and commenting on each group.
Discuss with your group the following questions. Then, write down your answers in the spaces provided. Remember to use full, complete sentences and scientific vocabulary learned in the lesson.

**What is a spring scale?**

**What does a spring scale measure?**

**What is calibration? Why do we need to use this?**

**What can a spring scale be used for?**

**How do we use a spring scale?**
Discuss with your group the following questions. Then, write down your answers in the spaces provided. Use short sentences and phrases to answer each question. Use some scientific vocabulary learned in the lesson.

**What is a spring scale?**

**What does a spring scale measure?**

**What is calibration? Why do we need to use this?**

**What can a spring scale be used for?**

**How do we use a spring scale?**
Lesson 3: Balanced and Unbalanced Forces
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Definitions: Level 3

Discuss with your group the following questions. Then, write down your answers on a separate sheet of paper. Use the provided sentence starters to help form your answers to each question.

What is a spring scale?

A spring scale is ____________________.

What does a spring scale measure?

A spring scale measures ___________ in ________________.

What is calibration? Why do we need to use this?

Calibration is _________________. Calibration is used to ________________________________.

What can a spring scale be used for?

A spring scale can be used to ________________, ______________, and ________________.

How do we use a spring scale?

To use a spring scale, first we have to ________________. Then, we ________________. After that, we ________________. Finally, we have to ________________.
Lesson 3: Balanced and Unbalanced Forces
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Definitions: Level 2

Discuss with your group the following questions. Then, write down your answers on a separate sheet of paper. Use the provided sentence starters and word bank to help form your answers to each question.

- **What is a spring scale?**

  A spring scale is ____________________.

- **What does a spring scale measure?**

  A spring scale measures ___________ in ________________.

- **What is calibration? Why do we need to use this?**

  Calibration is ________________. Calibration is used to ____________________.

- **What can a spring scale be used for?**

  A spring scale can be used to ________________, ________________, and ________________.

- **How do we use a spring scale?**

  To use a spring scale, first we have to _______________. Then, we _______________. After that, we _______________. Finally, we have to _______________.

<table>
<thead>
<tr>
<th>A type of weighing scale</th>
<th>Measure weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Force needed to extend a spring</td>
<td>Predict force needed.</td>
</tr>
<tr>
<td>Newtons</td>
<td>Calibrate the weight to 0</td>
</tr>
<tr>
<td>Even out a scale</td>
<td>Hook the scale onto an object</td>
</tr>
<tr>
<td>Get an accurate reading on a balance.</td>
<td>Pull to exert force</td>
</tr>
<tr>
<td>Measure force</td>
<td>Gather force exerted from it's scale.</td>
</tr>
</tbody>
</table>
Match each picture with the correct vocabulary word, definition, or question. Then, using sentence starters provided, write out the answer to each question on a separate sheet of paper.

<table>
<thead>
<tr>
<th><strong>Spring Scale</strong></th>
<th>Evening out a scale to equal 0 to get an equal, accurate reading on a scale.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Calibration</strong></td>
<td>Science experiments, in the grocery store, by a scientist.</td>
</tr>
<tr>
<td><strong>Newtons</strong></td>
<td>Energy exerted from a physical action or movement.</td>
</tr>
<tr>
<td><strong>Force</strong></td>
<td>Type of weighing scale used to measure force.</td>
</tr>
<tr>
<td><strong>Use of a Spring Scale</strong></td>
<td>Unit of measurement to calculate force.</td>
</tr>
</tbody>
</table>
Lesson 3: Balanced and Unbalanced Forces
7\textsuperscript{th} and 8\textsuperscript{th} Grade – Science

Definitions: Level 1

Use the following sentence starters to answer each question, based off of the definitions you matched to each picture on the other worksheet.

- What is a spring scale?

    A spring scale is ________________________.

- What does a spring scale measure?

    A spring scale measures ______________ in ________________.

- What is calibration? Why do we need to use this?

    Calibration is _________________. Calibration is used to
    ________________________________.

- What can a spring scale be used for?

    A spring scale can be used to ________________,
    _______________, and ________________.

- How do we use a spring scale?

    To use a spring scale, first we have to _________________. Then, we
    ________________. After that, we _________________. Finally, we have
    to _________________.

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Lesson 3: Balanced and Unbalanced Forces
7th and 8th Grade – Science

Instructions: Level 5/4
(Teacher’s Original Product)

Something to Think About
Think about what happens during a rocket launch. The rocket is propelled into the air by combustion in the engine creating thrust. How does the creation of thrust move the rocket through the air? Let’s conduct an investigation of Newton’s third law of motion to discover the answer!

- *To every action (force applied) there is an equal and opposite reaction (equal force applied in the opposite direction).*

Materials
- A partner
- 2 Spring scales measured in Newtons
- Chair
- Scientific notebook to record observations
Lesson 3: Balanced and Unbalanced Forces
7th and 8th Grade – Science

Instructions: Level 3
(Modified)

Something to Think About

Think about what happens during a rocket launch. The rocket is propelled into the air by combustion in the engine creating thrust. How does the creation of thrust move the rocket through the air?

Let's conduct an investigation of Newton's third law of motion to discover the answer!

- To every action (force applied) there is an equal and opposite reaction (equal force applied in the opposite direction).

Materials
- A partner
- 2 Spring scales (measured in Newtons)
- Chair
- Scientific notebook (to record observations)
Lesson 3: Balanced and Unbalanced Forces
7th and 8th Grade – Science

Instructions: Level 2
(Modified)

**Something to Think About**

Think about what happens during a rocket launch.

The rocket is propelled (pushed) into the air by combustion (burning something) in the engine creating thrust (a sudden push).

How does the creation of thrust move the rocket through the air?

Let’s conduct an investigation of Newton’s third law of motion to discover the answer!

- To every action (force applied) there is an equal and opposite reaction (equal force applied in the opposite direction).

**Materials**

- A partner
- 2 Spring scales
- Chair
- Notebook to record observations
Lesson 3: Balanced and Unbalanced Forces
7th and 8th Grade – Science

Instructions: Level 1
(Modified)

Something to Think About

Think about what happens during a rocket launch.

The rocket is propelled (pushed) into the air by combustion (burning something) in the engine creating thrust (a sudden push).

How does the creation of thrust move the rocket through the air?
Let’s conduct an investigation of Newton’s third law of motion to discover the answer!

- To every action (force applied) there is an equal and opposite reaction (equal force applied in the opposite direction).

Materials

<table>
<thead>
<tr>
<th>2 spring scales</th>
<th>A partner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notebook</td>
<td>Chair</td>
</tr>
</tbody>
</table>
Investigation

1. Each person should hold a spring scale. Hook the scales together with the s-hooks at the end. One group member will hold still while the other member pulls on the first member using the spring scale. You should observe that the scale the first member holds measures the force exerted on that person. The scale the second member holds measures the force exerted on that person. Try to stay still long enough to record the force readings on your scale.

Record the force exerted on each scale in Newtons.

Scale 1: _______ N
Scale 2: _______ N

Which one is larger? The force on the person doing the pulling or the person being pulled on? Or, are the forces the same?


2. Now hook one of the scales to some non-movable object. Attach the other spring scale to the first with the s-hooks. Pull on the immovable object and look at the force readings on the spring scales. The spring scale attached to the object measures the force exerted on the object. The spring scale you hold measures the force exerted on you.

Record the force exerted on each scale in Newtons.

Scale 1: _______ N
Scale 2: _______ N

Which one is larger? The reading on the scale attached to the immovable object or the reading on the scale you pull with? Or, are they the same?
3. Based on your observations above, would you say that an object that is not moving can exert a force? Why or why not?

__________________________
__________________________
__________________________

If you answer yes, can you give another example of an object that is not moving, but that exerts a force on another object?

__________________________
__________________________
__________________________

4. Have each group member hold a spring scale again. Hook the scales together with the s-hooks. Pull on one another and move as you do this. Try to look at the force readings on each of the two scales often. The scale you hold measures the force exerted on you by the other person. The scale your group member holds measures the forces exerted on them by you. When, if ever, do the scale readings appear to be different from one another?

__________________________
__________________________
__________________________

5. What conclusions can you make from your observations?

__________________________
__________________________
__________________________

__________________________
Investigation

1. Each group member should hold 1 spring scale.
   Hook the scales together with the s-hooks at the end.
   One group member will hold STILL while the other member pulls on the first member using the spring scale.
   You should observe that the scale the first member holds measures the force exerted on that person.
   The scale the second member holds measures the force exerted on that person.
   Try to stay STILL long enough to record the force readings on your scale.
   Record the force exerted on each scale in NEWTONS (N).

   Scale 1: ___________ N
   Scale 2: ___________ N

   Which one is larger? The force on the person doing the pulling or the person being pulled on? Or, are the forces the =same=?

2. Now hook one of the scales to some non-movable object.
   Attach the other spring scale to the first with the s-hooks.
   Pull on the immovable object and look at the force readings on the spring scales.
   The spring scale attached to the object measures the force exerted on the object.
   The spring scale you hold measures the force exerted on you.
   Record the force exerted on each scale in NEWTONS (N).

   Scale 1: ___________ N
   Scale 2: ___________ N

   Which one is larger? The reading on the scale attached to the immovable object or the reading on the scale you pull with? Or, are they the =same=?
Lesson 3: Balanced and Unbalanced Forces
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3. Based on your observations above, would you say that an object that is not moving can exert a force? Why or why not?

If you answer YES, can you give another example another example of an object that is not moving, but that exerts a force on another object?

4. Have each group member hold a spring scale again.
   Hook the scales together with the s-hooks.
   Pull on one another and move as you do this.
   Try to look at the force readings on each of the two scales often.
   The scale you hold measures the force exerted on you by the other person.
   The scale your group member holds measures the forces exerted on them by you.
   When, if ever, do the scale readings appear to be DIFFERENT from one another?

5. What conclusions can you make from your observations?
Lesson 3: Balanced and Unbalanced Forces
7th and 8th Grade – Science

Investigation: Level 3
(Modified)

Investigation

1. Each group member should hold 1 spring scale.
Hook the scales together with the hooks at the end of each scale. One group member will NOT MOVE while the other member pulls on their own spring scale.
You should notice that the scale the first member holds measures the force exerted on that person. (What they are doing to their partner)
The scale the second member holds measures the force exerted on that person. (What they are doing to their partner)
Try to NOT MOVE long enough to record the force readings on your scale in your notebook. Record the force exerted on each scale in NEWTONS (N).

Scale 1: ___________ N (write the number on the first scale here)
Scale 2: ___________ N (write the number on the other scale here)

Which one is larger? The force on the person doing the pulling or the person being pulled on? Or, are the forces the =same=?

⇒ Example: The force on ________ is ________ because _____________.


2. Now hook one of the scales to some non-movable object (a chair). Attach the other spring scale to the first with the hooks. Pull on the immovable object (chair) and look at the force readings on the spring scales.
The spring scale attached to the chair measures the force exerted on the chair.
The spring scale you hold measures the force exerted on you. Record the force exerted on each scale in NEWTONS (N).

Scale 1: ___________ N (write the number on your scale here)
Scale 2: ___________ N (write the number on your scale here)

Which one is larger? The reading on the scale attached to the immovable object (chair) or the reading on the scale you pull with? Or, are they the =same=?

⇒ Example: The reading on the scale ___________ is ________ because ____________.
3. Based on your notes ▲▲▲▲ above, would you say that an object that is not moving can exert a force? (Can the chair use force?) Why or why not?

→ Example: An object that is not moving _______ exert force.
   We know this because ________________.

If you answer YES ☑, can you give another example another example of an object that is not moving, but that exerts a force on another object?

→ Example: An example of an object that is not moving but exerts a force on another object is ________________.

4. Have each group member hold a spring scale again.
   Hook the scales together with the hooks at the end of the scale.
   Pull on each scale and move in a circle as you do this.
   Try to look at the force readings on each of the two scales many times.
   The scale you hold measures the force exerted on you by the other person.
   The scale your group member holds measures the forces exerted on them by you.
   When, if ever, do the scale readings appear to be DIFFERENT? from one another?

→ Example: The scale readings ______ appear different from one another.
   This happens when ____________________.

5. What conclusions can you make from your observations (notes) ▲▲? 

→ Example: From our observations, we can conclude that ____________________.
Lesson 3: Balanced and Unbalanced Forces
7th and 8th Grade – Science

Investigation
1. Each group member should hold 1 spring scale.
   Hook the scales together with the hooks at the end of each scale.
   One group member will NOT MOVE while the other member pulls on the other spring scale.
   You should observe that the scale the first member holds measures the force exerted on that person.
   The scale the second member holds measures the force exerted on that person.
   Try to NOT MOVE long enough to record the force readings on your scale.
   Record the force exerted on each scale in NEWTONS (N).
   **Note, something should look very similar.

   Scale 1: __________ N (write the number on the first scale here)
   Scale 2: __________ N (write the number on the other scale here)

   Which one is larger? The force on the person doing the pulling or the person being pulled on? Or, are the forces the =same=?

   ➔ Example: The force on the person doing the pulling is larger because it exerts a higher number of N than the force on the person being pulled on.

2. Now hook one of the scales to some non-movable object (the chair).
   Attach the other spring scale to the first with the hooks.
   Pull on the chair and look at the force readings on the spring scales.
   The spring scale attached to the chair measures the force exerted on the object.
   The spring scale you hold measures the force exerted on you.
   Record the force exerted on each scale in NEWTONS (N).

   Scale 1: __________ N (write the number on your scale here)
   Scale 2: __________ N (write the number on your scale here)

   Which one is larger? The reading on the scale attached to the chair or the reading on the scale you pull with? Or, are they the =same=?

   ➔ Example: The reading on the scale you pull with is larger because it exerts a higher number of N than the reading on the scale attached to the immovable object.
3. Based on your notes 🔅🪔🪔🔺leftrightarrow, above, would you say that an object that is not moving can exert a force? (Can the chair exert force?) Why or why not?

→ Example: An object that is not moving can exert force.
   We know this because it did exert force N on the scale.

If you answer YES ☺️, can you give another example another example of an object that is not moving, but that exerts a force on another object?

→ Example: An example of an object that is not moving but exerts a force on another object is gravity on the people on planet Earth.

4. Have each group member hold a spring scale again.
Hook the scales together with the hooks.
Pull on one scale and move in a circle as you do this.
Try to look at the force readings on each of the two scales many times.
The scale you hold measures the force exerted on you by the other person.
The scale your group member holds measures the forces exerted on them by you.
When, if ever, do the scale readings appear to be DIFFERENT, not the same from one another?

→ Example: The scale readings do appear different from one another.
   This happens when we pull the scales and move at the same time.
5. What **conclusions** can you make from your observations (notes)?

→ Example: **From our observations, we can conclude that** an object that is not moving can exert force. **We also can conclude that movement affects the amount of force exerted**.
Lesson 3: Balanced and Unbalanced Forces
7th and 8th Grade – Science

Investigation
1. Each person should hold a spring scale.

Hook the scales together with the hooks at the end of each scale.

One group member will NOT MOVE while the other member pulls on the other spring scale.

You should notice that the scale the first member holds measures the force exerted on that person.

The scale the second member holds measures the force exerted on that person.

Try to NOT MOVE long enough to see the force readings on your scale.

Write down the force reading on each scale in NEWTONS (N).
**Note: something will look very similar.

Scale 1: _______ N (write the number from the first scale here)
Scale 2: _______ N (write the number from the other scale here)

Which one is larger? The force on the person doing the pulling or the person being pulled on? Or, are the forces the =same=?
Lesson 3: Balanced and Unbalanced Forces
7th and 8th Grade – Science

Example: The force on the person doing the pulling is larger because it exerts a higher number of N than the force on the person being pulled on.

The force on __________ is __________ because __________

2. Now hook one of the scales to some non-movable object (the chair).

Attach the other spring scale to the first with the hooks.

Pull on the chair and look at the force readings on the spring scales. The spring scale attached to the chair measures the force applied to the chair.

The spring scale you hold measures the force applied on you.
Lesson 3: Balanced and Unbalanced Forces
7th and 8th Grade – Science

Record the force exerted (applied) on each scale in NEWTONS (N).

Scale 1: __________ N (write the number on your scale here)

Scale 2: __________ N (write the number on your scale here)

Which one is larger? The reading on the scale attached to the chair or the reading on the scale you pull with? Or, are they the same?

⇒ Example: The reading on the scale you pull with is larger because it exerts a higher number of N than the reading on the scale attached to the immovable object.

The reading on the scale is __________ because __________

3. Based on your notes above, would you say that an object that is not moving (like the chair) can exert (apply) a force? Why or why not?

Can ◀ Cannot

⇒ Example: An object that is not moving can exert force. We know this because it did exert force N on the scale.

An object that is not moving __________ exert force.

We know this because __________
If you answer **YES**, can you give another example another example of an object that is **not moving**, but that **exerts a force** on another object?

![Chair Image]

Can

**Example:** An example of an object that is not moving but exerts a force on another object is **gravity on the people on planet Earth**.

An example of an object that is not moving but **exerts force** on another object is

---

4. Have each group member hold a **spring scale** again. Hook the **scales** together with the **hooks**.

Pull on one scale and **move in a circle** as you do this.

![Circle Image]

Try to look at the **force** (numbers) on each of the two scales many times. The **scale** you hold measures the **force applied** on you by the other person.

**Other Member**

The scale your group member holds measures the **forces applied** on them by you.

**You**

When, if ever, do the scale readings appear to be **DIFFERENT, not the same** from one another?

![Apple Images]

The same OR Different
Example: The scale readings do appear different from one another.
This happens when we pull the scales and move at the same time.

The scale readings appear different from one another.
This happens when

5. What conclusions can you make from your observations (notes)?

Example: From our observations, we can conclude that an object that is not moving can exert force. We also can conclude that movement affects the amount of force exerted.

From our observations, we can conclude that
Lesson 3: Balanced and Unbalanced Forces
7th and 8th Grade – Science

Extension

1. Now that you have seen that there is always an opposite reaction, let’s think about what happens when forces are balanced and unbalanced. Place a chair in the middle of the floor. What forces are acting on the chair?

__________________________________________________________________________

__________________________________________________________________________

2. Have one partner gently push the chair a short distance over the floor. What force caused the chair to move over the floor?

__________________________________________________________________________

__________________________________________________________________________

3. Now repeat step 2, but this time, have your partner push back against you so that it doesn’t move. The chair is not moving, but are there any forces acting on the chair?

__________________________________________________________________________

__________________________________________________________________________

4. Now, what conclusions can you make about the forces on the chair when the chair moves? What conclusions can you make about the forces on the chair when the chair is not moving?

__________________________________________________________________________

__________________________________________________________________________

Draw the forces acting the chair when it is not moving and when it is moving.

Not moving

Moving
Lesson 3: Balanced and Unbalanced Forces
7th and 8th Grade – Science

5. Think back to the rocket, how does the thrust propel the rocket into the air? Use what you have learned about Newton’s third law of motion to explain this.

6. **Challenge:** Is there anything that you can do (with the scales hooked together) that produces different forces on the two interacting objects? Explain.
Lesson 3: Balanced and Unbalanced Forces
7th and 8th Grade – Science

Extension

1. Now that you have seen that there is always an opposite reaction, let’s think about what happens when forces are balanced and unbalanced.

Place a chair in the middle of the floor. What forces are acting on the chair?

2. Have one partner gently push the chair a short distance over the floor.

What force caused the chair to move over the floor?

3. Now repeat step 2, but this time, have your partner push back against you so that it doesn’t move.

The chair is NOT MOVING, but are there any forces acting on the chair?

4. Now, what conclusions can you make about the forces on the chair when the chair moves?

What conclusions can you make about the forces on the chair when the chair is NOT MOVING?
Lesson 3: Balanced and Unbalanced Forces
7th and 8th Grade – Science

Draw the *forces acting* the chair when it is **NOT moving** and when it **IS moving**.

- NOT moving
- IS moving

5. Think back to the rocket, how does the *thrust* propel \( \uparrow \) the rocket into the air?

Use what you have learned about *Newton’s third law of motion* to explain this.
6. **Challenge:** Is there anything that you can do (with the scales hooked together) that produces **different forces** on the **two interacting objects**? Explain.
Lesson 3: Balanced and Unbalanced Forces
7th and 8th Grade – Science

Extension

1. Now that you have seen that there is always an opposite reaction, let’s think about what happens when forces are balanced (equal) and unbalanced (not equal).

Place a chair on the floor. What forces are acting on the chair?

⇒ Example: The forces acting on the chair is/are _____________________.


2. Have one partner gently push the chair a short distance across the floor.

What force made the chair to move across the floor?

⇒ Example: The force that caused (made) the chair to move across the floor is _____.


3. Now repeat step 2, but this time, have your partner push back against you so that it doesn’t move. (both of you push on the chair)

The chair is NOT MOVING, but are there any forces acting on the chair?

⇒ Example: The chair is not moving, but there _____ (some/any) forces acting on the chair. (If you said yes ☑) The forces moving on the chair is/are _________.


4. Now, what conclusions can you make about the forces on the chair when the chair moves? What conclusions can you make about the forces on the chair when the chair is not moving?

Example: When the chair moves, we can conclude that __________. When the chair does not move, we can conclude that ____.

Draw the forces acting the chair when it is not moving and when it is moving.
5. Think back to the rocket, how does the thrust propel (push up) the rocket into the air?

Use what you have learned about Newton’s third law of motion to explain this.

→ Example: Using what I’ve learned about Newton’s third law of motion, the thrust propels the rocket into the air because ________________.

________________________________________
________________________________________
________________________________________
________________________________________

6. Challenge: Is there anything that you can do (with the scales hooked together) that creates different forces on the two objects hooked together? Explain.

→ Example: There ______ (something/anything) that we can do that produces different forces on the two interacting objects. (If you said yes 😊) What we can do is ________________.

________________________________________
________________________________________
________________________________________
________________________________________
________________________________________
Lesson 3: Balanced and Unbalanced Forces
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Extension

1. Now that you have seen that there is always an opposite reaction, let’s think about what happens when forces are balanced (equal) and unbalanced (not equal).

Place a chair on the floor. What forces are acting on the chair?

⇒ Example: The forces acting on the chair is/are gravity.

2. Have one partner gently push the chair a short distance across the floor.

What force caused the chair to MOVE across the floor?

⇒ Example: The force that caused the chair to move across the floor is friction.

3. Now repeat step 2 ⬆️, but this time, have your partner push back against you so that it DOESN’T MOVE. (both of you push on the chair at the same time)

The chair is NOT MOVING, but are there any forces acting on the chair?

⇒ Example: The chair is not moving, but there are some/any forces acting on the chair. (If you said yes 😊) The forces moving on the chair is/are gravity.
4. Now, what **conclusions** can you make about the **forces** on the chair when the chair **MOVES**?
   What **conclusions** can you make about the **forces** on the chair when the chair is **NOT MOVING**?

→ **Example:** When the chair moves, we can conclude that the **force friction** is working on the chair.
   When the chair does not move, we can conclude that the **force gravity** is working on the chair.

Draw the **forces acting** the chair when it is **NOT moving** and when it **IS moving**.

← **Use arrows to demonstrate how your forces are working.** →
Lesson 3: Balanced and Unbalanced Forces
7th and 8th Grade – Science

5. Think back to the rocket, how does the thrust propel (pushed up) the rocket into the air?

Use what you have learned about Newton's third law of motion to explain this.

**HINT:** To every action (force applied) there is an equal and opposite reaction (equal force applied in the opposite direction).

➔ Example: Using what I’ve learned about Newton’s third law of motion, the thrust propels the rocket into the air because forces were pushing the rocket into the air using pressure and balanced amounts of force.

6. **Challenge:** Is there anything that you can do (with the scales hooked together) that produces different forces on the two objects connected together? Explain.

➔ Example: There is (something/anything) that we can do that produces different forces on the two interacting objects. *(If you said yes 🎉)* What we can do is move around while exerting force on the other object.
Extension

1. Now that you have seen that there is always an \( \textit{\textbf{opposite reaction}} \), let’s think about what happens when \textit{forces} are \textit{balanced} (equal) and \textit{unbalanced} (unequal).

\[
\begin{array}{c}
\text{VS.} \\
\text{Place a chair on the floor. What \textit{forces are acting} on the chair?}
\end{array}
\]

\( \Rightarrow \) \textbf{Example: The forces acting on the chair is/are} \textit{gravity}.

\[
\begin{array}{c}
\text{\textbf{Example: The forces acting on the chair is/are} gravity.}
\end{array}
\]

2. Have one partner \textit{gently push} the chair a short distance across the floor.

\[\Rightarrow \text{\textbf{Example: The force that caused the chair to move across the floor is friction.}}\]
3. Now repeat step 2 🗣, but this time, have your partner push back against you so that it DOESN’T MOVE. (both of you push on the chair at the same time)

The chair is NOT MOVING, but are there any forces acting on the chair?

→ Example: The chair is not moving, but there are some/any forces acting on the chair. (If you said yes ☺️) The forces moving on the chair is/are gravity.

4. Now, what conclusions can you make about the forces on the chair when the chair MOVES → → →?
What conclusions can you make about the forces on the chair when the chair is NOT MOVING X X X?

→ Example: When the chair moves, we can conclude that the force friction is working on the chair.
When the chair does not move, we can conclude that the force gravity is working on the chair.
Lesson 3: Balanced and Unbalanced Forces
7th and 8th Grade – Science

Draw the forces acting the chair when it is NOT moving and when it IS moving.

Use arrows to demonstrate how your forces are working.

NOT moving

IS moving

5. Think back to the rocket, how does the thrust (heat and fire) propel (push up) the rocket into the air?

Use what you have learned about Newton’s third law of motion to explain this.

- To every action (force applied) there is an equal and opposite reaction (equal force applied in the opposite direction).
Lesson 3: Balanced and Unbalanced Forces
7th and 8th Grade – Science

➔ Example: Using what I've learned about Newton’s third law of motion, the thrust propels the rocket into the air because forces were pushing the rocket into the air using pressure and balanced amounts of force.

6. Challenge: Is there anything that you can do (with the scales hooked together) that produces different forces on the two interacting objects? Explain.

➔ Example: There is (something/anything) that we can do that produces different forces on the two interacting objects. (If you said yes ☑) What we can do is move around while exerting force on the other object.
Lesson Three: Reflective Narrative

The biggest modifications that were made to this unit to help make the content more comprehensible for English language learner students were the changes to the text in the Investigation and Expansion handouts. The vocabulary of the pieces of text, first and foremost, is very overwhelming to an English language learner. Most of the content is academic language, which is a higher level that requires more language skills than an ELL will already possess coming into the classroom. A lot of visuals were added to level 1 to help the student make a connection between the picture and the content word. In all the levels 4-1, I added different **bolded**, underlined, *italicized*, colored, or **highlighted** text to help the students make connections. For example, in Investigations: Level 4 I highlight sentences using yellow and gray backgrounds. This modification allows the students to make the connection between what they should see happening to the scale student 1 may be holding (yellow highlight) and what should be happening to the scale attached to the immovable object or student 2 (gray highlight). Another modification made to the text was changing a bit of the language used. As mentioned about, a lot of the text is very high level and not known by lower level EL students. Without taking away from the content the students need to receive, I added different definitions, changed some wording, reduced the amount of text for lower levels, and level 1 added pictures to make a connection to the vocabulary word or concept at hand. Doing these 2 modifications, as well as spacing out the steps line by line, rather than in paragraph form, makes the readability of the content a bit easier, and makes the language more comprehensible to all levels of EL students in the classroom.
Checklists
# Appendix A: Grammar and Functions Checklist

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Appendix A: Sheltered ELL Strategies Checklist

Write the page numbers and any other identifying features to identify those parts of your lessons that employ the following strategies.

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Original Lessons
General Information:

Avery Rourke  
Dr. Verplaetse  
TSL 518  
Spring 2016

Unit Information:

Lesson # 1-4  
Title of Unit: Balanced and Unbalanced Forces  
Grade: 7-8 Science  
Target Group: Mainstream Class with Integrated ELL Students

Reading Materials:

www.ck12.org  
(Attached pages for brief reading)

Lesson Resource:

This lesson was created and adapted by a middle school science teacher in New Haven, CT (Suzanne Botta-Sullivan).  
http://newhavenscience.org/81unit.htm  
http://www.nextgenscience.org/next-generation-science-standards

Goals of the Unit:

I want my students to know the difference between balanced and unbalanced forces.  
I want my students to know how to develop, propose, and carry out an investigation.  
I want my students to know how to apply Newton’s Law to their investigations.
Newton’s First Law

Jean Brainard, Ph.D.
To access a customizable version of this book, as well as other interactive content, visit www.ck12.org

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Newton’s First Law

- Use skateboarding to explain Newton’s first law of motion.

There’s no doubt from Corey’s face that he loves skateboarding! Corey and his friends visit Newton’s Skate Park every chance they get. They may not know it, but while they’re having fun on their skateboards, they’re actually applying science concepts such as forces and motion.

**Starting and Stopping**

Did you ever ride a skateboard? Even if you didn’t, you probably know that to start a skateboard rolling over a level surface, you need to push off with one foot against the ground. That’s what Corey’s friend Nina is doing in this picture 1.1.

Do you know how to stop a skateboard once it starts rolling? Look how Nina’s friend Laura does it in the Figure 1.2. She steps down on the back of the skateboard so it scrapes on the pavement. This creates friction, which stops the skateboard.

Even if Laura didn’t try to stop the skateboard, it would stop sooner or later. That’s because there’s also friction between the wheels and the pavement. Friction is a force that counters all kinds of motion. It occurs whenever two surfaces come into contact.
Video Break

Laura learned how to use forces to start and stop her skateboard by watching the videos below. Watch the video to see how the forces are applied. You can pick up some skateboarding tips at the same time!

Starting: http://www.youtube.com/watch?v=OpZIVjbMAOU

Stopping: http://www.youtube.com/watch?v=6fuOwhx91zM
Laws of the Park: Newton's First Law

If you understand how a skateboard starts and stops, then you already know something about Newton's first law of motion. This law was developed by English scientist Isaac Newton around 1700. Newton was one of the greatest scientists of all time. He developed three laws of motion and the law of gravity, among many other contributions.

Newton's first law of motion states that an object at rest will remain at rest and an object in motion will stay in motion unless it is acted on by an unbalanced force. Without an unbalanced force, a moving object will not only keep moving, but its speed and direction will also remain the same. Newton's first law of motion is often called the law of inertia because inertia is the tendency of an object to resist a change in its motion. If an object is already at rest, inertia will keep it at rest. If an object is already in motion, inertia will keep it moving.

Do You Get It?

Q: How does Nina use Newton's first law to start her skateboard rolling?
A: The skateboard won't move unless Nina pushes off from the pavement with one foot. The force she applies when she pushes off is stronger than the force of friction that opposes the skateboard's motion. As a result, the force on the skateboard is unbalanced, and the skateboard moves forward.

Q: How does Nina use Newton's first law to stop her skateboard?
A: Once the skateboard starts moving, it would keep moving at the same speed and in the same direction if not for another unbalanced force. That force is friction between the skateboard and the pavement. The force of friction is unbalanced because Nina is no longer pushing with her foot to keep the skateboard moving. That's why the skateboard stops.

Changing Direction

Corey's friend Jerod likes to skate on the flat banks at Newton's Skate Park. That's Jerod in the Figure 1.3. As he reaches the top of a bank, he turns his skateboard to go back down. To change direction, he presses down with his heels on one edge of the skateboard. This causes the skateboard to turn in the opposite direction.

Video Break

Can you turn a skateboard like Jerod? To see how to apply forces to change the direction of a skateboard, watch this video:

http://www.youtube.com/watch?v=iOnlcEk50CM
Do You Get It?

Q: How does Jerod use Newton’s first law of motion to change the direction of his skateboard?

A: Pressing down on just one side of a skateboard creates an unbalanced force. The unbalanced force causes the skateboard to turn toward the other side. In the picture, Jerod is pressing down with his heels, so the skateboard turns toward his toes.

Summary

- Newton’s first law of motion states that an object at rest will remain at rest and an object in motion will remain in motion unless it is acted on by an unbalanced force.
- Using unbalanced forces to control the motion of a skateboard demonstrates Newton’s first law of motion.

Explore More

Do you think you understand Newton’s first law? Go to the URL below to find out. Review Newton’s law and watch what happens to the skateboarder in the animation. Then answer the questions at the bottom of the Web page.

http://teachertech.rice.edu/Participants/louiere/Newton/law1.html

Review

1. State Newton’s first law of motion.
2. You don’t need to push off with a foot against the ground to start a skateboard rolling down a bank. Does this violate Newton’s first law of motion? Why or why not?

3. Nina ran into a rough patch of pavement, but she thought she could ride right over it. Instead, the skateboard stopped suddenly and Nina ended up on the ground (see Figure 1.4). Explain what happened.

4. Now that you know about Newton’s first law of motion, how might you use it to ride a skateboard more safely?

References

1. Image copyright DenisNata, 2013. Skateboarder pushing off the ground. Used under license from Shutterstock.com
2. Image copyright DenisNata, 2013. Moving skateboarder. Used under license from Shutterstock.com
3. Image copyright Nikola Blic, 2013. Skateboarder changing direction. Used under license from Shutterstock.com
4. Image copyright DenisNata, 2013. Practice problem to help students understand Newton’s first law of motion. Used under license from Shutterstock.com
This lesson is takes place mid year and assumes that a classroom culture has been built around working through frustration, classroom discourse, and students willingness to have unresolved questions, and ideas that disturb their thinking.

Engage / Engaging phenomena

1. **Day 1 (55 min)** Student challenge

*SW: Investigate balanced & unbalanced forces.

*SW: develop a model demonstrating balanced/ unbalanced forces

W.U. Balance toy maker

* (1) Craft stick

* (2) washers - * the washers are used as weights can other material can be used in lieu of washers

* (1) Pipe cleaner

Introduce task /challenge:

Using the materials the students need to craft a toy that where the very end of the craft stick will balance on the very tip of a finger. They can arrange the pipe cleaner and washers how ever they need to to get the craft stick to balance.

Restrictions: They may not attach any part to their finger. It must be freely perched on the finger, the craft stick must be all the way out (like a diving board.)

Demonstrate the position of the craft stick but do not show them a picture of the completed task. They generally think it’s impossible, remind them, you’d only give them an achievable task. *Sometimes (depending on the group, and point in the year I like to mention to them, they will likely start to feel a level of frustration and that it is really normal and when they feel the frustration begin to well up to take a couple of deep breaths, remind themselves they have struggled before and successfully overcome challenges, e.g. video game levels, sports maneuvers, dance steps, hand movement with an instrument. They will be successful and today they will engage with productive struggle. This is a classroom cultural aspect that needs to be targeted many times for students to trust in the process.

Finally, let them know they are going to be discussing their finding later so pay attention to the changes that make your model successful.

*This image is for the teacher for clarity. Note, when balanced well, you can touch even less of the craft stick. Also this is one way to set it up to make it balance. There are many iterations that will work.*
Before releasing the students to work (in groups of 3 or fewer) have the students tell each other what they are going to do when they are released. If needed model, "when she says go we are gonna..."

After a (approximately 30 seconds) ask, does anyone have any questions? If none, release them to work.

**Guidelines for Modeling**

- Address a question about something in the real world
- Include entities (sometimes invisible or hypothetical) and rules for how they interact
- Must be consistent with the evidence we have and make predictions about future observations
- Are revisable
- Are public

As students are working, continue to walk around the room encouraging students to persist through their frustrations. There will be a point where groups start to get close to success. Remember to push them to get the craft stick on to the tip of their finger, like a diving board. They’ll want to claim success before they cross the finish line, encourage them, they are almost there. You will on occasion get a student who solves it very quickly.

Once students achieve balance, let them have their moment. Pass out large chart paper. Have students create on paper a model of their balance toy. The “model” (an NGSS Science and Engineering Practice) is an illustration of their creation, all its parts, and other components, seen and unseen. At this point very few students will include gravity or forces.

As they are drawing, ask them how did you get it to balance, what is going on? In your model in addition to the objects include

- all the parts in the system
- causes
- effects
- things you manipulated.

Close:
Something you learned, something you liked, a question you have.

For tomorrow be prepared to discuss your findings.
SW: Investigate balanced & unbalanced forces.

SW: Draw conclusions about forces
SW: Develop a model and propose explanations / describe phenomena

Warm up: Look back at your drawing from day 1.

Discuss with your table: What was the goal?

How did you achieve the goal?

Draw out, how did you get it to balance, what is going on?

* causes
* effects
* manipulations

Add any last touches to model. Have students hand the (drawn) model close to each other on a board / wall. Have the students form a semi-circle around the wall with the models.

Review discussion guidelines

* teacher note, a class discussion like this can be the best part of teaching, it can also be a mess. Be sure your class has practice in class discussion routines (track the speaker, respond to what was said, etc.) Wait-time, wait-time, wait-time. It WILL start out painfully slow, know that, relax and allow room for the process to unfold. Do not save the kids from silence, someone else will feel the need to fill the space, let them.

Add: Be prepared to feel disturbed and un-resolved.
Go through guidelines, have students give concrete examples of what respectful looks like, what it sounds like. What does connecting to each others’ ideas sound like. What does it mean to feel unresolved?

Begin the discussion by having them list out all the items in the system. Chart their responses (you’ll need this paper later.)

Once they have a comprehensive list, begin asking them more probative questions? Why does the craft stick stay balanced, what else is going on the model that we can not see? (Take notes)

Would it work if you moved the washers....
Do you see any commonalities among the models? Differences?
Are there rules you can create that explain what’s going on and can those rule also explain this phenomena

Create space for students to agree with something that someone else has said, even if it’s redundant, just so as everyone speaks

As your approaching the end of your time. Ask the students, what they next need to know in order to better, and more fully explain what’s going on with the craft stick model?

They (hopefully) will have said, they need to understand more about forces, or gravity, they may have even
mentioned Newton’s law.

Have them take their model back and add one thing, or rule based on the class discussion.
Day 3: Balanced Forces Investigation: Attached to email

Based on your questions and ideas, I have for you another investigation.

Review the use of spring scales (calibration.) A science program covering forces should have access to spring scales.

Below is a guided learning packet (students should work in pairs, maybe 3s, in groups of 4, someone will be note have a role.)

*In the packet below, there is no correct number, except the pairs of numbers should always be the same as each other, e.g.

5 Newtons
5 Newtons

I generally don’t tell the students much, except that.

The tool is a spring scale. It measures force (we’ll get to a definition later)
Force is measured in Newtons, abbreviated as N
Remind them to calibrate with every measurement

**Something to Think About**
Think about what happens during a rocket launch. The rocket is propelled into the air by combustion in the engine creating thrust. How does the creation of thrust move the rocket through the air? Let's conduct an investigation of Newton's third law of motion to discover the answer!

- *To every action (force applied) there is an equal and opposite reaction (equal force applied in the opposite direction).*

**Materials**
- A partner
- 2 Spring scales measured in Newtons
- Chair
- Scientific notebook to record observations

**Investigation**
1. Each person should hold a spring scale. Hook the scales together with the s-hooks at the end. One group member will hold still while the other member pulls on the first member using the spring scale. You should observe that the scale the first member holds measures the force exerted on that person. The scale the second member holds measures the force exerted on that person. Try to stay still long enough to record the force readings on your scale.

Record the force exerted on each scale in Newtons.

Scale 1: __________ N

Scale 2: __________ N

Which one is larger? The force on the person doing the pulling or the person being pulled on? Or, are the forces the same?
2. Now hook one of the scales to some non-movable object. Attach the other spring scale to the first with the s-hooks. Pull on the immovable object and look at the force readings on the spring scales. The spring scale attached to the object measures the force exerted on the object. The spring scale you hold measures the force exerted on you.

Record the force exerted on each scale in Newtons.

Scale 1: _________ N
Scale 2: _________ N

Which one is larger? The reading on the scale attached to the immovable object or the reading on the scale you pull with? Or, are they the same?

3. Based on your observations above, would you say that an object that is not moving can exert a force? Why or why not?

If you answer yes, can you give another example of an object that is not moving, but that exerts a force on another object?

4. Have each group member hold a spring scale again. Hook the scales together with the s-hooks. Pull on one another and move as you do this. Try to look at the force readings on each of the two scales often. The scale you hold measures the force exerted on you by the other person. The scale your group member holds measures the forces exerted on them by you. When, if ever, do the scale readings appear to be different from one another?

5. What conclusions can you make from your observations?
Extension

1. Now that you have seen that there is always an opposite reaction, let’s think about what happens when forces are balanced and unbalanced. Place a chair in the middle of the floor. What forces are acting on the chair?

2. Have one partner gently push the chair a short distance over the floor. What force caused the chair to move over the floor?

3. Now repeat step 2, but this time, have your partner push back against you so that it doesn’t move. The chair is not moving, but are there any forces acting on the chair?

4. Now, what conclusions can you make about the forces on the chair when the chair moves? What conclusions can you make about the forces on the chair when the chair is not moving?

Draw the forces acting the chair when it is not moving and when it is moving.
5. Think back to the rocket, how does the thrust propel the rocket into the air? Use what you have learned about Newton’s third law of motion to explain this.

6. **Challenge:** Is there anything that you can do (with the scales hooked together) that produces different forces on the two interacting objects? Explain.