Sarah Bepler
TE804 Spring 2010

Instructional Approach
For
Changes in Motion

Sarah Bepler

Learning Goals

Students will understand that:

- Forces cause objects to slow down, speed up, change direction, stop or start. (GLCE Companion Document)
- Gravity is the force that pulls objects to the earth. (GLCE Companion Document)
- In space, different forces are in effect than they are on Earth. Objects are not pulled towards the ground and once and object has had a force applied, its motion continues on until another force is applied.
- The position and motion of objects can be changed by pushing or pulling. The size of the change is related to the strength of the push or pull. (National Science Education Standards)

Calendar Day	Activity No.	Activity Label	Activity Description	Activity strategic function
2/18/10	1	Identifying forces: Gravity	Students are given a ball of paper; toss it in the air, and record observations. I will stand on a ladder, and drop a pencil, book, and piece of paper from the top of the ladder. Students record the direction in which the objects fall.	Explore Phenomena For Patterns: Identifying Forces
2/18/10	2	Discussion: What is gravity?	Hold a discussion about the students' observations. Guide the students to draw connections between gravity and their own observations of all objects falling to the ground.	Students Explain Patterns: Gravity Discussion
2/19/10	3	Changes of Motion	Students interact with ball-n-jacks, a wind-up toy, and paper airplane and record observations. Since they have recently learned about gravity, they will write in their journal the ways in which gravity has an effect on their experience with these materials.	Explore Phenomena For Patterns: Changes of Motion
		Science Talk	Divide students into groups of five. Allow	Students Explain

2/19/10	4		them to discuss their observations and draw connections between gravity and these materials. Walk around the room and listen to students as they form explanations. Use this information as an informal assessment of student's knowledge.	Patterns: Gravity Science Talk
2/22/10	5	Making Predictions	As a class, generate ideas of what it would be like to have these same previous experiences in space. What would be the same? What would be different? Does the motion change? Why? Brainstorm a list of ideas to revisit after viewing the video.	Establish A Question: Making Predictions
2/23/10	6	Pursuing a question: How do objects move in space?	Based on student predictions, hold a discussion with the students about what they want to know. Focus the discussion around the question: "How is motion different in space than it is on Earth? Why?" Although students will begin to attempt to answer this question, post it on the board so that students revisit the idea throughout the film *Toys in Space*.	Establish A Question: Motion in Space Elicit Students' Initial Ideas: Motion in Space
2/23/10	7	Observation: Video of objects in space	Students will watch a movie entitled *Toys in Space*. Using the same objects that the students recently observed, astronauts use in space. Students will record in their journals the motion of the objects in space.	Explore Phenomena For Patterns: View *Toys in Space*.
2/24/10	8	Sharing, Comparing, and Contrasting	Students discuss with a partner, the similarities and differences between the ways in which the objects moved on Earth, compared to their motion in space. The students will begin to make connections between the lack of gravity in space, and the motion of the objects.	Students Explain Patterns: Motion in Space and on Earth Discussion
2/25/10	9	Observing motion through creation of a "science mobile"	Students will construct a science mobile with a partner. After they have put together the science mobile, they will share their observations with another set of partners. Record observations individually in science journal focusing on the motion of the object, and the forces in effect that allow the science mobile to move.	Explore Phenomena For Patterns: Observing Motion in a Science Mobile Explore Ideas About Patterns: Creating a Science Mobile
2/25/10	10	Group Discussion: Patterns about Motion	As a class, discuss the ways in which the science mobile moved and identify the forces at work. Student will present their ideas to the class with their partner and	Explore Ideas About Patterns: Discussing Patterns about

			other students in their group.	Motion
2/26/10	11	Newton's First Law: The Washer Experiment	Each student will have a washer on a piece of paper laid across the top of a cup. Students will observe the motion as it sits still. Students will then "flick" the piece of paper and observe the motion of the washer. Students will record observations (through pictures and writing) in their Science Journals of the washer at rest, and the washer in motion.	Explore Phenomena For Patterns: The Washer Experiment
2/26/10	12	Science Talk	Students will be separated into groups of four. Together they will discuss the motion of an object based on the force acting upon it. Students will answer the following questions: "Did the washer have forces acting on it before I flicked it with my hand? How did the force of my hand affect the motion of the washer? Why?"	Explore Ideas About Patterns: Washer Experiment Science Talk
3/1/10	13	Generating Ideas: Laws of Motion	Roll objects along the floor and allow them to come to a stop on their own. Brainstorm ideas, as a class, explaining why the objects may come to a stop.	Compare Student & Scientific Ideas: Brainstorming Possible Explanations
3/2/10	14	The effect of forces on a marble run.	Students work in groups of four to construct "u-shaped" tracks. They will place a marble at one end of the track and let go. Students will record the motion of the marble (speed, direction, etc.) in their student journals through pictures. Students will begin to identify patterns after the multiple experiences of and observation of the marble.	Explore Phenomena For Patterns: The Effect of Forces on a Marble Run
3/3/10	15	Predicting based on previous experience.	Construct an "L-shaped" track as a class. Ask the students: "How high would I have to drop this marble to get it to reach the same height after being pulled downwards by gravity?" (Never, the marble would simply continue on until it stopped moving entirely) Students will draw on the previous experience with the "u-shaped" track to better understand the role of gravity in the experiment. They will then use this knowledge to form conclusions about how gravity will ultimately pull the marble downwards.	Students Explain Patterns: Making Predictions
		Science Talk	As a class, we will hold a Science Talk	Compare

3/3/10	16		about gravity. Based on our previous experiences, allow the students to consider the ways in which gravity is important to our lives, and the direction of the force. I will provide the actual definition of gravity, and a class, we will compare our findings and observations to the standard definition.	Student & Scientific Ideas: Gravity Science Talk

Daily Lesson Plan

Teacher: Sarah Bepler   Date submitted: April 18th, 2010   Lesson date: March 19th, 2010

Overall lesson topic/title: What Goes Up, Must Come Down

Learning goals:

P.FM.03.22- Identify the force that pulls objects towards the Earth.

P.FM.03.35- Describe how a push or a pull is a force.

S.IP.03.11- Make purposeful observations of the natural world using the appropriate senses.

S.IA.03.12- Share ideas about science through purposeful conversation in collaborative groups.

S.RS.03.11- Demonstrate scientific concepts through various illustrations, performances, models, exhibits, and activities.

Rationale: *(What function(s) of the Inquiry and Application Instructional Model do the activities fulfill?)*

Explore Phenomena For Patterns: Identifying Force- Students will observe the effects of gravity using a variety of materials. Based on these observations, students will begin to identify patterns between the laws of gravity and their experiences.

Students Explain Patterns: Gravity Discussion- Students will take part in a Science Talk with their classmates to share their observations and identified patterns. The students will begin to formulate explanations based on these patterns, and will incorporate personal experience into the discussion. Students may question and comment on other's scientific ideas, and beliefs may alter during the course of discussion.

Materials & supplies needed:

- Scrap Paper (21 Pieces)
- Student Page (From Activity Journal)
- Tennis Ball
- Pencils and Crayons (Writing and Drawing Observations)

Procedures and approximate time allocated for each event	***Academic, Social, and Linguistic Support***

• ***<u>Introduction to the Lesson</u>*** *(10 minutes)*	
Review the concept of force with the students."Yesterday we spent a lot of time talking about friction, and looking at different examples of how the force of friction affects motion. What is a force?" Remind the students that forces change motion. Have students discuss with a partner. Ask a volunteer: "How does friction change the motion of an object?" Students should be able to explain that friction is a force that slows down the motion of an object and eventually, brings the object to a stop. Roll a tennis ball along the floor. Allow the ball to continue to slow down as it rolls, and ultimately comes to a stop.	*For ELL students, include pictures to help them better understand the force of friction. By using pictures centered on activities previously completed, this will help to trigger their memories and motivate them to share.*
I will then stand up with the tennis ball, and hold the ball in my hand. Once all students have their eyes on the ball, I will remove my hand and allow the ball to fall to the floor. Hold a discussion with the students about the motion of the ball. "In this activity, we will be exploring a different force that affects the motion of objects, called gravity." Hold a discussion with the students to informally pre-assess their knowledge of gravity. Record all ideas discussed on the Easel.	*A few of my students may refuse to participate because they are too shy or lack the confidence to share ideas aloud. I have included a partner share to ensure that all students are participating, all ideas are shared, and the students remain on task. I will walk around the room at this point, to listen in on discussions.*
Ask the students to generate a list of ways that we, as a class, could find out more about gravity. List all ideas on the Easel.	*If the students have difficulty remembering what was discussed in previous lessons, have them look through their activity journals for a gentle reminder.*
• ***<u>OUTLINE of activities during the lesson</u>***	
Making Observations and Predicting (15 Minutes)	
Students will begin this activity sitting at the rug. Divide the class into groups of two students each (Draw sticks to determine who is partnered with whom). Once each student is sitting with their partner, give each group a piece of scrap paper. Tell the students: "One of you will be the observer and recorder, while the other person will be the ball handler. It is up to you to decide who does what, however, you will both get the opportunity to take part in each role."	*Some of my students tend to worry when they do not know exactly how an experiment will turn out. They may refuse to predict because they want to know exactly what will happen, or will become upset because they have not learned about the topic yet. For this reason, I will explain to the students that there is no right or wrong ideas in predicting, and they are not being graded based on their predictions. I will also tell them that I expect all students to participate and if they refuse, I will ask these students to write their predictions down so that I can make sure that all students*
Explain to the students that they are responsible for finding as many ways as possible to move the paper ball. The observer and recorder will observe the motion (slow, fast, upwards, downwards, left, right, etc.) and recording the information in his activity journal.	
As the students complete this activity, walk around the room and probe student's thinking by asking the following questions:	
-"How have you moved the paper ball this far? What were your	

observations? Is that what you predicted would happen? Did the ball stop moving? Why do you think this happened?"

-"What are some other ways that you could move the ball? What do you think would happen if you moved it that way?"

-"What do you think would happen if you tossed the paper ball into the air? How would this be different than throwing it across the room? How would the motion change?"

Class Discussion (10 Minutes)

Have students return to the carpet for a discussion of observations. Ask each team to demonstrate and explain one way they moved the ball. This will ensure that all students are given an equal opportunity to participate in discussion.

Ask the class: "What eventually happened to all of the balls no matter how they were moved?" (All of the balls fell to the floor and stopped moving) Together, talk about how the student's push was the force that started the motion of the paper ball, and the forces that changed the motion were friction and gravity.

Discuss the term gravity. "Gravity is a force that pulls an object toward another object." Explain that the students cannot see gravity, but we have evidence of it everywhere. Brainstorm a class definition of the term gravity. Once the students have created their own definition, allow them to compare and contrast that definition with their Student Journal definition.

Feeling the Force of Gravity (5 Minutes)

Students return to their seats, and stand next to their desks for equal spacing. Each student will then raise his arms straight out to the side. Ask them: "Can you feel the force of gravity pulling down on your arms? Do not put your arms down, please hold them up for as long as you possibly can." The students' arms will eventually begin to lower towards the ground. "Can anyone describe the way that their arms feel now?" Look for responses such as: "Gravity is pulling my arms down, but my muscles are pulling my arms up!" All students may then lower their arms if they have not done so already.

Making Observations: Tennis Ball (10 Minutes)

Place a tennis ball on the table at the front of the room. Pose the question: "Are forces acting on this ball?" Have students record their predictions in their Science Journals. "Why isn't the ball floating in the air?" Have volunteers share their responses aloud

are taking part in the activity.

Many of my students are ELL. For these students, I will do a large amount of modeling so that they can better understand my teaching. In addition, as a class we will be constructing a word wall for our science terms. As we discuss different concepts, we will list words and their definitions so that these students can use it at a reference whenever necessary.

In the past, I have found that group work is extremely beneficial to my students. It is helpful for them to share their ideas with a partner, and also, forces them to practice their social skills. A few of my students try to sit back and watch others when we have group discussions, but by breaking the class into smaller groups, each student will be responsible for sharing his ideas with others. Discussion is vital to the learning process, and therefore, I want every student to express their thoughts aloud.

with the class. "The force of gravity is pulling down on the ball and the table is pushing up on the ball with an equal force. The ball does not move because the forces are the same." As a group, identify objects in the room that have two equal forces acting on it, and therefore not moving. • ***<u>Closing summary for the lesson</u>*** *(15 minutes)* *Ask the students to return to the rug for the closing summary. Ask the following questions:* *-"Why don't we fall up instead of down when we jump off of a diving board?" (Gravity pulls us downwards)* *-"How does gravity slow our movement down when we hike up a hill?" (Gravity pulls us downwards while we are trying to hike up the hill)* *-"What are some animals on Earth whose movement is affected by gravity? (All animals including birds, dogs, cats, etc.)* *At this point in the lesson, it is my hope that I will hear from all students. Since we are having a discussion, some students may refuse to share aloud. If too many students refuse to share, give each student the opportunity to respond in a journal entry.*	*Some of my students may refuse to share their thoughts in a class discussion format. I plan to record this discussion to better understand who is able to explain and apply these concepts. In addition, if I notice that many students are sitting silently, I will ask all students to write their ideas down as a journal entry. I will also draw pictures and model the questions for my ELL students, and pair them up with another student for further assistance if necessary.*
Basis for assessment *For an informal individual assessment, students will respond to the following journal entry question:* *"What would it be like without any gravity? Choose a favorite activity. Draw and write a story that tells what it would be like without any gravity."* *Since this is an individual assessment, it will allow me to better understand which students need additional support and activities to understand the concept of gravity. I will look for responses that discuss gravity as a force that pulls us towards the Earth, and specific examples from their own lives that demonstrate personal connections to the concepts.* *Based on the student responses, I will devote additional time to exploring phenomena and identifying patterns concerning gravity. If the students have a strong grasp on the concept, we will begin to discuss the differences between the motion of objects on Earth, and the motion of objects in space in the following lesson.*	***Academic, Social, and Linguistic Support during assessment*** *Before the students begin to respond in their journals, I will first ask if anyone has any questions. I will verbally explain the question as well, to ensure that everyone understands the purpose of the question.* *For my ELL students, I will pull them aside to further discuss the question. For students who cannot write in English yet, I will have them answer the question verbally and record their answer.*

	It is important that all students complete this assessment individually. This will allow me to determine who needs additional help with the concepts, and who has a strong understanding. This information will tell me if I should spend extra time on certain concepts, or if the students are ready to continue ahead in their learning.

Daily Lesson Plan

Teacher: Sarah Bepler Date submitted: April 18th, 2010 Lesson date: March 29th, 2010

Overall lesson topic/title: Newton's First Law

Learning goals:

P.FM.03.36- Relate a change in motion of an object to the force that caused the change of motion.

P.FM.03.37- Demonstrate how the change in motion of an object is related to the strength of the force acting upon the object and to the weight of the object.

P.FM.03.38- Demonstrate when an object does not move in response to a force, it is because another force is acting on it.

Rationale: *(What function(s) of the Inquiry and Application Instructional Model do the activities fulfill?)*

Explore Phenomena For Patterns: The Washer Experiment- Students will observe an object at rest to better understand Newton's First Law of Motion which states: "An object at rest remains at rest unless acted on by another force." Students will then have the opportunity to flick a card with a washer on top of it (all on top of a cup) to create a force. The students will then realize that the motion of their hand was the motion that moved the object.

Exploring Ideas About Patterns: Washer Experiment Science Talk- Through careful observation, the students will work together in a Science Talk, to discuss the reasoning behind the movement of the washer. Together, they will begin to understand that objects at rest remain at rest, unless acted on by another force.

Materials & supplies needed:

- Student Page (From Activity Journal)
- 12 washers
- 12 index cards
- 12 plastic cups (9 oz)
- 1 cotton ball

- 1 jumping frog
- 1 wind-up toy
- 1 tennis ball
- Pencils and Crayons (Writing and Drawing Observations)

Procedures and approximate time allocated for each event	***Academic, Social, and Linguistic Support***
• ***<u>Introduction to the Lesson</u>*** *(10 minutes)*	
Review the different terms listed on the "Motion Chart" that was created in the previous lesson. As a class, discuss the terms and their meanings to allow for questions, and introduce the terms to any students who may have been absent on the previous day. It is important that the students are able to identify and define these terms, because they will be asked to use them in their future writing of observations.	*There are many ELL students in my classroom, and reviewing the terms will not only help them through constant exposure, but this will also give them the opportunity to ask questions.*
Next, roll the tennis ball across the floor so that it bumps into a wall. Once the ball comes to a stop, ask the students: "Why does the ball start rolling?" [I pushed it with my hand] "Why does the ball stop rolling?" [At this point, look for any responses that include the term friction, or a relative explanation] *If the students insist that the wall is the reason that the ball stopped rolling, roll the ball again in an area in which it will not bump into another object. The ball will eventually come to a stop on its own due to gravity. Ask students for possible reasons as to why the ball may have stopped moving.* *Introduce the phrase "laws of science" to the students. Explain that the law of gravity states that objects fall down or objects are pulled toward Earth. Then, tell the students that they are going to learn about laws of motion that scientists use to describe motion.*	*It is vital that all of my students participate in this group activity. It I notice, at this point, that many of my students are refusing to participate, I will ask everyone to write their ideas down on paper. I will also enforce the rule that whoever has the "talking stick" is the only person that may speak out. Otherwise, the same students are constantly sharing their ideas and others are overshadowed. Also, many of my students may worry if they have not heard the phrase "laws of science." If this situation occurs, calm the students by telling them it is okay if they have not heard the phrase used, and that they will better understand by the end of the lesson.*
• ***<u>OUTLINE of activities during the lesson</u>*** ***Explore Phenomena for Patterns (20 Minutes)***	
Students will begin this portion of the lesson sitting at the rug. Divide students into groups of two by pulling sticks. Distribute one washer and one index card to each group. The students will then place the washer on the index card so that it is in front of both of the students. For the next thirty seconds, the students will focus their eyes on the washer and observe the washer for evidence of any motion and then record their observations. Tell the students to only record information related to motion.	*Instead of having my students move to different parts of the room during the first part of this activity, I will ask them to remain on the carpet. My students lose a lot of instructional time during transitions, so I try to minimize it*

At this point, the students will be looking for a law or statement that applies to the motion of the washer. Once the students have recorded their observations, they will return to the carpet to share their results with the class. I expect many students to explain that their washer did not move at all. *Relate the current student observations to those made in the previous lesson.* *-Place a cotton ball, jumping frog, wind-up toy, and tennis ball on the table at the rug so that everyone can see. Ask the students if the objects are moving. Then, ask: "What forces are acting on the items at rest?" [Gravity, friction, the force of the table, etc.]* *-Review the concept of gravity with the students. "The force of gravity is pushing down on the items and the table is pushing up on the items. The forces are equal so the objects do not move."* *-Ask the students: "What are the forces that are acting on the washer at rest on the index card? What would be needed to make the washer move?" Record student's ideas on the easel.* *"Do we have enough information to make a science law about objects at rest?" [Yes] Allow students the opportunity to share their ideas in a science talk. Once the students have exhausted their list, write Newton's First Law of Motion on the easel: "An object at rest remains at rest unless acted on by another force."* *Call on volunteers to explain Newton's laws in their own terms. "How does this law relate to the washer? How is this law useful in describing motion?"* ***Exploring Ideas About Patterns: The Washer Experiment (20 minutes)*** *Distribute one plastic cup to each group. Show the students how to place the card on the cup and the washer on top of the card. Tell the students that sometimes things move in ways that we do not expect, but if we think of Newton's Law, we can better understand why objects move in that way.* *Give the following set of instructions to the groups:* *1. Hold the cup with one hand.* *2. Flick the side of the card with the other hand.* *3. Discuss and record observations with your partner.* *4. Repeat the activity by switching roles.* *5. Take turns repeating the activity using different amounts of force.* *Allow the students to work independently with their partners. As the students make observations, circulate around the room and ask the following questions:*	*as much as possible.* *For my ELL students, I will do a great deal of modeling during the Science Talk. It is important that they understand what is being discussed, and this is possible through concrete materials. I will also have these students sitting with a student who speaks English as a first language, to provide additional assistance.* *Since so many of my students are reserved during classroom discussions, I will explain to them ahead of time that my expectation is that everyone participates in the Science Talk. Generally, the students seem to make the most connections during these talks, because they can speak openly with their peers. I want to give every student the opportunity to share and this can only be done by voicing expectations ahead of time.* *To help my students, I will first model this experiment. The students must see an example of the card being flicked to fully understand the directions. I will also explain that if they really concentrate, they too will be able to complete the experiment. By telling the students this first, they will all try their hardest to be successful.*

-*"Can you explain what you have observed so far?"* -*"What do you notice when the force is applied to the card?"* -*"How does this relate to Newton's First Law?"* -*"What forces were acting on the card? The washer?"* -*"Why didn't the washer move with the card?"* • ***<u>Closing summary for the lesson</u>*** *(15 minutes)* *Ask the students to return to the rug for the closing summary. As a class, discuss the observations of each student. Ask a volunteer to demonstrate the forces that were acting on the cup, index card, and washer. [Look for answers that include: flicking on the card applied a force in a direction and the card moved. The washer did not move in the direction of the card because the force was only applied to the card. The washer dropped into the cup because the force of gravity pulled it into the cup after the card no longer pushed up on the washer.]* *At this point in the lesson, I will ask that each student share their observations with the group. Although some of my students are a bit shy when speaking in front of a group, it is important that they become comfortable and have the opportunity to share their ideas with their classmates.*	*It is very possible that a few of my students will refuse to participate during discussion. If this occurs, I will ask these students to write down their observations so that I may share them with the class. The purpose of this activity is for every student's voice to be heard, and this is impossible if some students refuse to speak. Therefore, either way, all observations will be shared.*
Basis for assessment *For an informal individual assessment, the students will individually record their observations and form a conclusion based on the activity. The journal page will read:* *1. "Draw a picture of the cup, index card, and washer before you flicked the card."* *2. "Draw a picture of the cup, index card, and washer after you flicked on the card."* *3. "What happened to the card and the washer?"* *This assessment will be completed individually. Therefore, I can better determine what students know, and what misconceptions they may have. If the students are having difficulty answering the questions or show glaring areas of concern, I will re-address Newton's Law in the following lesson. It is vital that the students understand the importance of this law, and how it relates to this experience to better understand the world around them.*	***Academic, Social, and Linguistic Support during assessment*** *Before the students begin to respond in their journals, I will first ask if anyone has any questions. I will also read the question aloud, to avoid any vocabulary confusion.* *If necessary, I will allow my ELL students to complete this by verbally explaining their answers to me. I will record their ideas as well, so that I may return to them at a later time for assessment purposes.* *It is important that all students complete this assessment individually. This will allow me to determine who needs*

	additional help with the concepts, and who has a strong understanding. This information will tell me if I should spend extra time on certain concepts, or if the students are ready to continue ahead in their learning.

Daily Lesson Plan

Teacher: Sarah Bepler Date submitted: April 18th, 2010 Lesson date: March 22nd, 2010

Overall lesson topic/title: Objects in Motion

Learning goals:

P.FM.03.41- Describe the motion of objects in terms of path and direction.

P.FM.03.42- Identify changes in motion (change direction, speed up, slow down).

S.IP.03.11- Make purposeful observations of the natural world using the appropriate senses.

S.IP.03.16- Construct simple charts and graphs from data and observations.

S.IA.03.11- Summarize information from charts and graphs to answer scientific questions.

S.RS.03.15- Use evidence when communicating scientific ideas.

Rationale: *(What function(s) of the Inquiry and Application Instructional Model do the activities fulfill?)*

Explore Phenomena For Patterns: Identifying Motion- Students will observe the cause of motion and direction of motion using a jumping frog and cotton ball. Based on these observations, students will then compare and contrast the motion of the two objects.

Students Explain Patterns: Motion Discussion- As a class, students will share their findings with their peers. They will discuss what force was needed to move each object, and how far each object traveled depending on the force exerted. Students will each share their group's findings, and as a class, formulate conclusions.

Materials & supplies needed:

- 22 coffee stirrers
- 6 cotton balls (One for each group)
- 6 measuring tapes (One for each group)
- 6 jumping frogs (One for each group)
- Masking tape
- Student journal entry (From Activity Journal)

Procedures and approximate time allocated for each event	***Academic, Social, and Linguistic Support***
• ***<u>Introduction to the Lesson</u>*** *(5 minutes)*	
Begin the lesson by reviewing directional terms with the students. The previous lesson focused on directional words with regards to motion. I will begin this lesson by meeting with the students on the rug, and revisiting the word chart from the previous day. This way, the directional words will be fresh in their minds as they make their own observations in today's activities.	*For ELL students, include pictures to help them better understand the motion of objects. This will help the students remember what activities they took part in on the previous day, which will motivate them to participate in review.*
• ***<u>OUTLINE of activities during the lesson</u>***	
Making Observations and Predicting (15 Minutes)	
While sitting at the rug, show the students the cotton ball and the jumping frog. Ask a student volunteer to describe the properties of the cotton ball (soft, round, white, solid, etc.). Then, ask a different volunteer to describe the jumping frog (hard, solid, green, frog shaped, etc.). Tell the students that they are going to use the cotton ball and the jumping frog to describe and compare motion of objects and record their observations and data.	*As the objects are described, take a moment to define each of the words used. It is important that all of the students understand the properties of the objects before comparing and contrasting their motion.*
Ask the class to brainstorm different ways that the objects might move. "Will they move on their own? Do we need to move them?" Finally, ask for ideas of what data can be collected through observing the movement of the cotton ball (distance, direction, type of motion). Show the students how to make the jumping frog move and ask for ideas of what data and observations can be collected through observing the movement of the jumping frog (distance, direction, type of motion, etc.).	*Some of my students may refuse to participate because they are too shy. For these students, I will ask them to write their ideas down on paper so that they still have the opportunity to share their thoughts.*
Comparing and Contrasting Motion (20 Minutes)	
Divide the students into groups of four by drawing sticks. Distribute straws, jumping frogs, cotton balls, tape measures, and masking tape to the groups. Read the directions aloud to the class that is found in the Student Activity Journal.	*I have purposely scheduled science during a time in which multiple M.S.U. service learning students are available. I will place an M.S.U. student with each group to ensure that the students remain on task.*
As students work in groups, circulate around the room and observe the students. To check student progress, ask the following: *-"Can you explain what you have observed and recorded so far?"* *-"How did you decide to collect and organize your data and observations?"*	*In the past, I have found that group work is extremely beneficial to my students. It is helpful for them to share their*

-*"Can you think of another procedure that might work?"* -*"What do you notice when you blow through the stir straw to make the cotton ball move? Did everyone's cotton ball travel the same distance? How do you know?"* -*"What motion words can you use to describe the motion of the cotton ball?"* -*"What could you do differently to make the cotton ball go farther? The jumping frog?"* *While the students are collecting data, assist the groups with their data organization as needed.* ***Student Assessment (10 Minutes)*** *Once the students have finished collecting data, they will return to their desks. Each student will be responsible for using their data to write a journal entry about what conclusions they formed from the experiment. It is crucial that students work independently, to better determine what students know.*	*ideas with a partner, and also, forces them to practice their social skills. A few of my students try to sit back and watch others when we have group discussions, but by breaking the class into smaller groups, each student will be responsible for sharing his ideas with others. Discussion is vital to the learning process, and therefore, I want every student to express their thoughts aloud.*
• ***<u>Closing summary for the lesson</u> (15 minutes)*** *Ask the students to return to the rug for the closing summary. Ask the following questions:* -*"Was everyone able to get the cotton ball and jumping frog to move?"* -*"What evidence do you have that tells you the objects moved?"* -*"What started the object's motion? What stopped it?"* -*"Does anyone have a conclusion that they would like to share with the class?"* *At this point in the lesson, it is my hope that I will hear from all students. Some students may refuse to speak aloud in fear that their answer is incorrect. This is why I chose to have all students write in their journals before meeting at the rug. Either the students can volunteer to share their ideas, or I can read it for them. Either way, every student's ideas will be heard during discussion.*	*Many of my students are ELL. For these students, I will do a large amount of modeling so that they can better understand my teaching. In addition, as a class we will be constructing a word wall for our science terms. As we discuss different concepts, we will list words and their definitions so that these students can use it at a reference whenever necessary.* *Although some of my students may refuse to participate, I will be requiring everyone to speak at least once during this time. While I certainly do not want to make my students uncomfortable, it is vital that everyone shares their own ideas and opinions during discussion. Otherwise, the same students will speak out while others sit back quietly.*
Basis for assessment	***Academic, Social, and***

As an informal assessment, I will be using the journal entries that the students wrote after collecting their data. This will help me to determine whether or not the students were able to use their collected data to form conclusions, and better understand student thinking. I will also record the discussion portion of the lesson so that I may refer to it at a later time. Some students may begin to change their beliefs during the class discussion, and by videotaping the discussion I can identify additional misconceptions and have shifts in thinking documented. *Based on the student responses, I will devote additional time to identifying the motion of objects. If the students appear to have a strong grasp on the concepts presented, I will begin to transition into the following lesson. If the students need additional help, I will provide supplemental materials and experiences to help students better make sense of this phenomena.*	***Linguistic Support during assessment*** *Before the students begin writing their journal entries, I will ask if there are any questions. I will also make sure that it is quiet so that all students have the opportunity to work free from distractions.* *For my ELL students, I will pull them aside to further discuss the question. For students who cannot write in English yet, I will have them answer the question verbally and record their answer.* *It is important that all students complete this assessment individually. This will allow me to determine who needs additional help with the concepts, and who has a strong understanding. This information will tell me if I should spend extra time on certain concepts, or if the students are ready to continue ahead in their learning.*

TE 804:Pre-Assessment Analysis

<u>Reiteration of Primary Learning Goals</u>

Students will know that:

- Forces are pushes and pulls.
- Friction and gravity are forces.
- Forces start, stop, and change the motion of objects.
- Friction and gravity affect our lives.
- A force is necessary to change the motion of an object.

Students will be able to:

- Describe motion where there is no gravity.

- Identify sources of friction in everyday situations.
- Build a toy and explain how it moves.
- Communicate and present findings of observations and investigations.

Adapted from the Battle Creek Area Mathematics & Science Center: Changes in Motion, for third grade.

Student Conceptions
Task label: Friction
Task Description: Students each roll a tennis ball across the floor. They will observe the motion of the ball to determine whether the ball slows down or speeds up. Depending on their answer, they will then identify the reasoning as to why the motion changed. To support ELL students, model the process before allowing them the opportunity to try it themselves. In addition, students who cannot write in English can verbalize their explanation as I record the response.
Rationale: Students will draw conclusions based on personal observations. This will identify their conceptions and any misconceptions that they may have about friction and its effect on motion. By using an object that the students are familiar with, it will become clear to me whether or not they have been introduced to the concept of friction.

Example of student responses:
Student #1 Response: "The ball keeps speeding up until it just stops. It stops because it just can't keep going forever. The ball is not that heavy but it is just heavy enough to make it stop moving."

Interpretation #1: Student #1 realizes that the tennis ball cannot continue to roll on forever. Once he elaborated on his explanation however, it is clear that he does not understand why the ball would stop moving. Although he is somewhat correct in that the weight of the ball creates a downward force, he is unable to connect it to the force of friction.

Student #2 Response: "It speeds up for a little bit and then it slows down. It happened because of the wall. If the wall wasn't there, it would probably keep going on forever because nothing would stop it."

Interpretation #2: Student #2's tennis ball stopped moving because it hit a nearby wall. Although I was pleased that she continued to question how the motion of the ball would have changed had the wall not been a factor, it is evident that she does not grasp the effect of friction. She believes that the ball would otherwise travel forever. Student #2 does recognize that a force is needed to stop the ball (in her case, it is the wall), but she apparently does not consider friction to be a force that would stop the ball. She either has not been introduced to this concept, or only believes that a physical object could stop the ball's movement.

Student #3 Response: "The ball really just slows down because of gravity. Gravity is pushing the ball into the ground, so it is hard for the ball to keep going. It kept going in a straight line."

Interpretation #3: Although Student #3 has been previously exposed to the concept of gravity; she is having difficulty explaining how gravity is affecting the motion of the ball. She realizes that gravity pushes the ball downwards toward the Earth, and that this is making it difficult for the ball to continue moving. Student #3 is partially correct in that gravity is a force; however, she is unable to connect it to the concept of friction.

Student #4 Response: "The ball keeps slowing down until it stops. I think that it stops because gravity makes the ball heavier, so it can't move as fast. Or because the ball is not smooth that is why it stops. "

Interpretation #4: Student #4 was the only student in my class who commented on the surface of the tennis ball. He recognized that the floor rubbing against the tennis ball might be a reason as to why the tennis ball slows down. Although he also believed gravity to be a factor, I am hopeful that with scaffolding, this student will be able to draw connections and form conclusions regarding friction.

Name:________________________________

Roll a ball across the floor. Does it continue moving forever, or does it eventually stop? Why?

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Task label: Gravity

Task Description: The students are each given a marble, in which they toss into the air (not above their heads) and observe the motion of the object. Students will realize that every person's marble eventually falls to the floor, even though they threw it upwards in the air. For ELL students, explain the term "direction" and help them by verbally explaining the question. I included a picture portion specifically for these students who have difficulty writing in English. Once again, allow them the opportunity to verbalize their response if writing in English has not been mastered.
Rationale: The students must recognize gravity as a force that affects our life on Earth. Gravity is a force that pushes objects downward on Earth, and every marble that is tossed into the air will eventually fall to the ground. The students will recognize this pattern, and even if they are unable to articulate the reasoning for the direction change, it is my hope that they will have at least heard the term "gravity" used and are able to begin thinking about the concept. This task will help to identify any misconceptions that the students may have about the concept as well.

Example of student responses:
Student #1 Response: "It moves down to the ground because it is kind of heavy and can't go up forever! I don't know why though."

Interpretation #1: This particular response demonstrates a lack of knowledge regarding gravity. This student believes the marble fell because of its own weight. Even though he recognizes that the marble will not float upwards forever, he is unable to explain why this is.

Student #2 Response: "The marble didn't come straight down. It rolled away after it hit my desk."

Interpretation #2: Student #2 did not make a connection between gravity and the marble falling downwards. Instead, he focused on what happened after the marble fell back towards the Earth. Based on this explanation, it is unclear to me whether or not he is familiar with the concept of gravity.

Student #3 Response: "The marble came down because of gravity. Gravity keeps us on the ground."

Interpretation #3: Student #3 recognized that the marble fell downwards because of gravity. She did not explain how gravity affected the motion, but she was the only student in the class who used the term in conjunction with her explanation. She understands that gravity brings objects downward and with enough hands-on experiences and discussion, she will better understand the force of gravity.

Student #4 Response: "The marble went up really high. The higher I threw it, the harder it fell down I think."

Interpretation #4: Student #4 was able to make a connection between the height of the object, and the speed at which it traveled downwards. Although he did not choose to use a stopwatch to guide his claims, he appears to have found a relationship between height and speed. This student did not, however, use the term gravity and therefore I am unsure as to whether or not he has a basic understanding of this concept.

Name:_______________________________

Toss the marble on your desk into the air. Does the marble continue to move upwards, or does it come back down to the ground? Why does the marble move this way? Draw a picture below of the direction the marble traveled, and include any force that may be acting on the marble.

because this is what many of my lessons are focused on. Although the students clearly do not, for the most part, understand the concept of friction, I am confident that with the appropriate activities and classroom discussions, I will be able to scaffold student thinking and the students will ultimately be able to not only define these terms in their own words, but also, apply the concepts to their lives as well.

Funds of Knowledge Focus Areas

Through this pre-assessment, I realized that not one of my students was able to identify friction as the force that ultimately stops the tennis ball from rolling forever. Even though they may have heard of this term at some point in their lives, they were unable to draw a connection between this experience and the concept of friction. Therefore, in this unit, I will devote much of my focus to not only explaining this term, but also, providing the students with multiple everyday experiences surrounding this topic. It is vital that the students not only recognize friction as a science term, but as a force that affects their lives daily. Only once the students are able to make these personal connections will they begin to understand the importance of friction in their lives.

Many of my students have heard of the term gravity, however, they are unable to define it properly. A few of my students identify gravity as what brings objects down to the ground; however, they do not understand its effect on their lives. In this unit, I will focus on gravity on Earth and in space, so that the students can better appreciate this force. It is difficult for the students to identify gravity as a force because they are used its effects, and claim that they do not feel anything pushing down on them. By showing a video of objects in space as well, the students can begin to compare and contrast their lives on Earth compared to living in space. Identifying gravity as a force will also help the students to better understand friction as two forces rubbing against one another.

My students have multiple strengths that will help them to understand and apply these concepts to their lives. These students truly enjoy sharing information and experiences with one another. Instead of asking each student to provide their own examples for every concept, I am allowing the students to build on each other's experiences. It is important that the students can talk through their ideas, question one another, and provide explanations when necessary. These students also have spent a lot of time drawing connections from personal experiences. This alone leads me to believe that with the right activities, the students will be able to identify these forces on their own, and only at the end of a particular lesson will I provide them with the scientific definition.

Small Group Talk Guiding Questions

There are numerous small group talk guiding questions that I used throughout my pre-assessment. After the students completed their questions individually, I held an informal group discussion which included the following questions:

1. "A few of you stated that that tennis ball would roll on forever if an object did not stop it. Why do you think this is so?"
2. "Has anyone ever heard the word 'friction'? If so, how was it used?"
3. "Can anyone explain why the marble that you tossed into the air fell to the ground?"
4. "What is gravity? Can anyone use an example of gravity in their everyday lives?"

Summary of Small Group Talk & Observations of Students

I wanted to hold a group discussion with my students, because many of the answers on their pre-assessments were either unclear or not completed. I found myself left wondering what all the students knew because my information was limited to what they chose to write down. As I asked question one, only one student raised her hand. She said: "The ball would roll forever because nothing stops it. I mean, if something got in the way, then yeah, it would stop, but if it was out in the desert of something, it would never stop." I found this statement to be very telling, because this student (and possibly others) did not believe that the tennis ball would ever stop rolling. After no other student attempted to correct her, I asked the second question. One student said: "Yeah, friction, is like, when you rub your hands together." Another student added on to that comment and said: "Oh yeah! Like when you're cold, you can warm your hands up by rubbing them together." These students realized that there was a force at work with friction, however, were not able to articulate it well.

As I asked my group questions regarding gravity, I was astonished to see a great divide in prior knowledge. One student stated: "Gravity makes everything fall to the ground. That is why the marble came back down. In space, there is no gravity, and the marble would float on forever, really." Before assuming that all students were familiar with this term, I asked an ELL student to explain his conceptions of gravity. This student claimed: "Gravity helps you to fly in the air. Like, on an airplane." These two examples alone left me feeling unsure as to how I wanted to approach this concept.

Interpretations and Implications for your Teaching

As mentioned, the pre-assessment that I administered left me feeling cautious of how I wanted to teach the concepts of friction and gravity. Some students had some knowledge of the concepts, others had simply heard the terms, and some students had multiple misconceptions. For my unit, I made the decision to have the students take part in inquiry-based learning. I didn't want the students who understood the concepts to be bored, and I also didn't want to move too quickly for students who had never been introduced to the concepts. Therefore, I based all instruction on activities. Every student took part in the same activities, identified patterns, and then, as a class, we worked together to understand the underlying scientific concepts. Students who understood friction and gravity well were able to explain the terms to their classmates, in a way that was fairly easy for them to understand. Therefore, the advanced students were challenged by the need to explain, and the lower-achieving students were able to receive information in a variety of ways through multiple mediums. All of my students benefited from this type of learning, and not one student complained that they were bored or knew all of the information. Since the learning was centered on these experiences, the detail in each interpretation and explanation varied.

Special Needs

In my classroom, many of my students are ELL. A large majority of my students have never heard a lot of the terms that I used in my teaching. Therefore, I used a great deal of modeling, word charts, partner explanations, and utilized the assistance of Michigan State University service learning students and ELL teachers when available. These students needed one-on-one attention, and I was able to give this to them through the help of support staff. I made sure to never assume that all of my students had heard a vocabulary term used before, because even if a student was familiar with a concept, he may not have known the proper English term. Finally, I allowed my ELL students the opportunity to verbally answer all questions, so that I could better determine what they knew. I wanted to better understand the thinking of the student, instead of deciphering written English.

I also have one student who has Attention Deficit Disorder. This student is unable to sit for long periods of time, and so I included hands-on activities for this reason. I also planned my science time around times that support staff was available. I then was able to have one educator working with this student at all times to ensure that he remained on task. By utilizing my resources and providing experiences that he would find interesting, I was able to keep this student on track throughout my entire unit.

Post Assessment Analysis

Response Analysis

Gravity Connection

Task Description: Students will define gravity through identifying examples in their own lives. Once the students have listed one example of gravity and how it affects their life on Earth, they will then draw the example and label the direction of the force of gravity using the following symbols: ↑, ↓, ←, →.

Rationale: The students have a wide range of knowledge regarding gravity. From my pre-assessment and class discussions, it became apparent that although many of the students had previously heard the term "gravity," they were unable to define the concept. By completing this assessment task, I was able to determine whether or not the students could define the concept, draw personal connections, and identify the direction of the force of gravity.

- **P.FM.03.22** Identify the force that pulls objects towards the Earth.

Identified Task Features:
- Defining gravity on Earth
- Effect of gravity on Earth
- Example of gravity
- Illustration of gravity example
- Direction of the force of gravity

Friction Observation and Reflection

Task Description: This task required the students to observe a moving toy car. They responded to a writing prompt which questioned whether or not the car sped up or slowed down after being pushed. Once the students identified the speed, they defended their answer through a written explanation. After the students labeled the force at work, they were required to identify another experience in which this force is present in their lives. Finally, students listed the two materials rubbing against one another in the initial example, and identified the force slowing the car down as friction.

Rationale: A large portion of my science unit was centered on friction. I realized though group discussions that the students had a very limited knowledge base regarding friction. Through this assessment, I was not only able to determine whether or not the students could identify friction through a specific experience, but also could better understand any additional misconceptions. By requiring the students to identify, explain, and elaborate on the question presented, I am confident that I understand student thinking in more depth than I would have had I asked them closed questions rather than open-ended questions.

P.FM.03.42 Identify changes in motion (change direction, speed up, slow down).

Identified Task Features:

- The speed of the car continues to slow down.
- Identifying friction as a force that affects motion.
- Defining friction and its connection to the observation.
- Two materials rubbing together created the force of friction (carpet and car wheels).
- Example of friction in everyday life.

Once I identified the task features for my assessment, I realized that I had included ten separate tasks in all. Therefore, I made each task worth ten percent, and created a grading scale for myself to determine the level of student achievement. After reading through the rubric for this assignment, I adapted the example which was listed. Students who received 80% or higher on their assessment were considered to have a solid base of knowledge. Those students who had a total score between 50% and 70% had some understanding of the concepts, however, could use additional experience to help make sense of gravity and friction. Finally, any student receiving less than 40% needed re-teaching. Not one of my students fell into the re-teaching category, and I was so proud of my students for understanding and applying these concepts to daily experiences. Fourteen of my students (2/3) demonstrated a high level of achievement. Although 1/3 of my class belonged to the middle category (seven students), I am confident that with future classroom discussions and experiences, they will ultimately have a strong grasp of these scientific concepts.

Unit: **Changes in Motion** Task: **Gravity Connection**

Student #	**Goal Features**					**# of goal features**
	Defining gravity on Earth	Effect of gravity on Earth	Example of gravity	Illustration of gravity example	Direction of the force of gravity	
1	X	X	X	X	X	5
2	X	X	X	X	X	5
3	X				X	2
4	X	X	X	X	X	5
5		X	X	X	X	4
6	X	X	X	X	X	5
7		X			X	2
8	X	X	X	X	X	5
9	X	X	X	X	X	5
10		X	X	X	X	4
11	X	X	X	X	X	5
12	X		X	X	X	4
13		X	X	X	X	4
14	X	X			X	3
15		X			X	2
16	X		X	X	X	4
17		X	X	X	X	4
18	X	X	X	X	X	5
19	X	X	X	X	X	5
20	X	X			X	3
21	X	X	X	X	X	5
#	15	18	16	16	21	
%	71%	86%	76%	76%	100%	

Unit: **Changes in Motion** Task: **Friction Observation and Reflection**

Student #	**Goal Features**					**# of goal features**
	The speed of the car continues to slow down.	Identifying friction as a force that affects motion.	Defining friction and its connection to the observation.	Two materials rubbing together created the force of friction.	Example of friction in everyday life.	
1	X	X	X	X	X	5
2	X	X	X	X	X	5
3	X	X		X		4
4	X	X	X	X	X	5
5	X	X	X		X	3
6	X	X	X	X	X	5
7	X	X		X		3
8	X	X	X	X	X	5
9	X	X	X	X	X	5
10	X	X	X	X	X	4
11	X	X	X	X	X	5
12	X	X	X	X	X	5
13	X	X				3
14	X	X		X		3
15	X	X	X	X	X	5
16	X	X	X	X	X	4
17	X	X	X	X	X	4
18	X	X	X		X	4
19	X	X	X	X	X	5
20	X	X	X		X	3
21	X	X	X	X	X	5
#	21	21	16	17	15	
%	100%	100%	76%	81%	71%	

Analysis of Patterns

Once I was able to view student responses in an organized fashion, it became obvious as to which of my goals were met by my students. In relation to the gravity connection task, every student (100%) was able to draw a downwards arrow to represent the direction of the force of gravity on the situation in their illustration. After giving the assessment, I was a bit worried as to whether or not this was a fair task, because had the students drawn an incorrect picture, I assumed that they would not be able to draw a correctly labeled arrow. I did notice, however, that even though a few of my students did not draw pictures demonstrating an understanding of gravity (24%), they still drew an arrow facing downwards towards the ground. I was undecided as to whether or not I should include this as correct if the picture was not, but ultimately I decided that I should consider this to be a separate element. It was not a surprise to me that those students who were able to write down an example would also illustrate the example (76%). Although many of my students were able to identify the importance of gravity on earth (86%), not everyone could define gravity as a concept (71%). These results were surprising in that while the majority of the students could appreciate and apply gravity to given situations, they could not define gravity in writing.

The second task, which was centered on friction, showed clear patterns in student understanding. Looking at student results through a table demonstrated a solid understanding that the car slowed down due to friction (100%). There were quite a few students who were able to identify friction, but did not define the concept (76%). It was interesting to compare this goal to the final goal in which the students were expected to apply the concept to an everyday example.

All but one of the students who were able to define the concept also included an example from their own lives. These tasks were clearly connected because only the students who were able to understand the concept of friction as a whole could apply the information to other situations. Lastly, a large portion of my students identified the two materials rubbing together to create friction (81%). I chose to include this particular element because we spent a great deal of time discussing the cause of friction, and it was important that the students could explain the reasoning for the change in speed.

Reflection

Reflecting on the unit as a whole allowed me to identify what went well, and what areas needed a bit more focus. As mentioned, this unit was centered on changes in motion, with an emphasis on gravity and friction. I constructed a grading scale in which I would consider any student receiving higher than 80% to have a firm grasp on the material. According to this scale, the majority of my students (2/3) were able to define, identify, appreciate, and apply these concepts to their own lives. I would consider this unit to be a success in that each and every one of my students showed great improvement. Not only was this evident in everyday activities and assessments, but it also was clear through student participation. Before teaching this unit, I had many students who refused to participate in classroom discussions. I now have twenty-one students competing for my attention during science discussions! Every student wants to share their ideas, which confirms my belief that the students were successful in understanding these concepts.

The most exciting piece for the students and me was using inquiry-based learning. My students are used to reading information out of textbooks and then taking part in activities. In this unit, I pre-assessed my students, allowed them the opportunity to complete hands-on activities, and then held classroom discussions so that the students could make sense of their data. This experience was extremely difficult for my students at first. The students became so frustrated that they did not know the correct terminology when recording ideas, that two students stopped participating. One student stated: "I can't tell you why this is happening. I don't know the word for it!" He was so concerned with explaining correctly, that it was hindering his ability to record observations. After two lessons, I sat down with my students to explain the reasoning behind my teaching approach. I told them that I wanted them to find patterns and try to formulate their own explanations. This is what scientists do, and I consider each and every one of my students to be scientists. After I explained to the students that it was okay if they did not know everything right away and that we would be helping each other to make sense of the information, the attitudes of everyone shifted dramatically. Suddenly, the students were motivated even more by realizing that every statement did not have to necessarily be correct. If I were to teach this unit again, I would make sure to explain the learning process to my students ahead of time. This would have saved a lot of frustration for my students, and they may have taken even more intellectual risks.

Throughout our course, my colleagues and I have had multiple conversations regarding the different ways to introduce new scientific information to our students. I had struggled with this issue for a long time, and am only now beginning to find my voice. At the start of this course, I argued that students should be responsible for making scientific connections, instead of having a teacher explain scientific concepts to them. The problem with this, however, is that if the students have glaring misconceptions that are never addressed, they may continue to hold these beliefs until they believe them to be fact. Through using the EPE table and I-AIM model, I constructed my own practices. In the beginning stages and hands-on activities, I allow students to state their misconceptions without correcting them. This is a time that I want to hear from all of my students and by correcting them in front of their peers, many students may begin to shut down. After this portion of the lesson, I require the students to take part in hands-on learning. In this stage, the students collect data and identify patterns within the activities. As the students start to explain their patterns, I allow them to once again share their thoughts without correction from myself. On multiple occasions, through group discussions, another peer would begin to question the results of a student if they disagreed with the explanation. Had no other student spoke up at this time, I would have probed the student's thinking by further questioning. While I would hope that the student would ultimately identify the misconception on his own, I would continue to scaffold student thinking until this was identified. I found myself following the I-AIM model closely, even without necessarily recognizing this as a model! I wanted my students to form their own explanations through inquiry-based instruction, and I would consider this type of learning to be the most beneficial for my students.

My assessment provided a large amount of evidence for understanding what the students knew about the concepts presented. While the tasks that I provided did allow me to identify areas of concern, it was the organizational chart that was the most telling. Through looking at a table with the results so organized, it was evident as to which concepts the students had a solid understanding of, and which need more focus. Upon reflection, I would not have used the written example and illustrated example as two separate goals. I chose to incorporate an illustration for my ELL students who have difficulty writing in English. This proved to be one of my greatest challenges because I wanted to identify student conceptions and this was nearly impossible to do if I could not read the writing. The problem with including writing and illustration is that it is technically centered on the same goal but through different mediums. Therefore, I was not surprised to find that only those students who wrote a clear example were also able to illustrate an example. If I were to give this assessment again, I would give the students the opportunity to write or draw an example situation, and would set the goal as connecting information to everyday experiences. This would allow me to more accurately assess what the students know, and I would be able to incorporate an additional piece which would give more information about student understanding.

Overall, I have learned so much more than I could have imagined through the teaching of my science unit. By incorporating discussion with my colleagues, the I-AIM model, and striving for student involvement, I am extremely pleased with the results of my unit. Many of my students had never before heard of these terms, and now, they can appreciate, define, and apply the concepts to their lives. I am grateful for the opportunity to teach through inquiry-based instruction, and plan to teach all future lessons using this format. I will continue to reflect on this experience, and apply what I have learned throughout this unit to my future teaching.

1. Expectations for Student Learning:

Were the lesson goals for students clearly conveyed? Yes No

What evidence supports your observations?

At the beginning of my lesson, I explained the purpose of this particular science experiment to my students. We began by reviewing the previous day's lesson, which included identifying directional words regarding motion. As a class, we began the lesson by listing possible ways that the frog and cotton ball would move across the floor using directional words. Once we had compiled a list, I told the students: "Alright boys and girls, today we will be breaking into small groups so that we can compare the ways in which each of these objects move. Do they slide or roll? How far do they move? How did you get the object the move? Today you will be scientists and record all of your findings. Once you have finished, we will compare the two objects and the way that they moved across the floor." I explained what we would be doing as a class before beginning the experiment so that all students knew what was expected of them. I allowed a short time for any questions to be asked that the students may have had, and then divided the class into small groups by drawing sticks (each stick has a student's name on it).

2. Questioning Strategies:

Were various levels of questioning used?	Yes	No
Was wait time practiced?	Yes	No
Were students engaged in asking questions relevant to the class activities?	Yes	No
Did all of the students have the opportunity to respond to questions?	Yes	No

Please provide examples of your questioning strategies used during this lesson.

Various levels of questioning were used throughout this lesson. Some of my questions were asked at the very beginning of the lesson. These included: "How do objects move? Does something have to move them, or do they move on their own?" These questions forced students to think about previous experiences. During the lesson and activity, I asked the students numerous questions about what they were experiencing, and what conclusions might be formed because of those experiences. These questions included: "Can you explain what you have observed and recorded so far? How did you decide to collect and organize your data and observations? Can you think of another procedure that might work instead of this one? What do you notice when you blow through the stir straw to make the cotton ball move? Did everyone's cotton ball travel the same distance? How do you know? What motion words can you use to describe the motion of the cotton ball? What could you do differently to make the cotton ball and jumping frog move farther?" Some questions were asked to better understand student thinking, while other questions were asked to push student thinking. During the final discussion, I asked the students: "What conclusions have you formed based on the information that you collected? How was the motion of the objects alike? How was the motion of the objects different?" I made sure to ask questions that required full responses, instead of one word answers. I also asked the students to elaborate when necessary, or clarify when I was unsure of the meaning of their response.

Wait time was practiced throughout our class discussion. The difficulty that I have with many of my students when waiting for a response is that another person tends to simply yell out the answer before the student has an opportunity to respond. Consequentially, although I did provide a great deal of wait time during my lessons, I also explained my own expectations to the students. I told the students: "Please make sure that you are not yelling out your ideas if it is someone else's turn to answer. Only the person with the talking stick may speak out, and anyone who interrupts that person or speaks out of turn will receive a yellow ticket." Although I encourage my students to share their opinions, it has reached a point in which I must hand out yellow tickets (these are considered warnings, and three tickets result in a letter home) in order to have respectful listening practices. The majority of the time I waited roughly twenty or thirty seconds before rephrasing my question.

Students were also engaged in asking questions relevant to the class activities. Fortunately, my students really enjoy science and remain focused on the lessons. They generally do not ask questions that are not related to the goals of my lessons. Some of the questions asked during this lesson were: “How should we define motion? Do you think that the cotton ball will not go as far as the frog because it is kind of heavier? Why does the cotton ball pretty much stay in the same spot even when you blow on it with a straw?” The students were clearly thinking about motion as they asked their questions, and they were allowed to further investigate their questions through inquiry-based activities.

All of the students had the opportunity to respond during discussion. Although it was difficult to motivate everyone to want to participate, everyone had the opportunity. I continued to reiterate throughout the lesson that there was not necessarily one right answer and that I wanted to hear from every student at some point during the discussion. Since I explained my expectations before the lesson, the students all knew what was expected of them and all students were able to contribute to the lesson

How did you respond to student answers? And what kind of feedback did you provide?

During our class discussion, I made sure to never indicate that an answer may have been correct or incorrect. I never once said “that is great, you are correct” or “I am sorry but that is not what I was looking for.” I wanted everyone to feel and know that their opinions are valued, so after each answer, I simply thanked them for their contribution. As I watched my video, I found myself saying: “Thank you for sharing that with us. Does anyone have anything else that they want to add?” This way, I was not correcting student misconceptions and telling them that their responses were correct, but rather, dialogue between the students was encouraged. Once the activities had been completed, we were able to use data collected from each group to form conclusions. This evidence was concrete, and therefore, the students were able to use it to argue and validate their points.

Inquiry-based instruction is a way to promote student thinking and it gives the students the opportunity to formulate their own opinions and conclusions regarding scientific concepts. During the lesson, the feedback that I provided simply encouraged the students to continue investigating and sharing their ideas with their group members and the class as a whole. It was only once the students had defined terms and formed conclusions on their own that I began to add to their ideas. This worked extremely well because even though I was providing the students with information, they had experiences to relate the concepts to, and could better understand the reasoning behind each scientific concept.

3. On-Task Behavior:

Were the students on task? Yes No

What evidence supports these observations? If students were not on task, what changes could be made to this lesson in the future?

Each and every student was on task during this lesson. I attribute a large portion of this success to the fact that I placed an M.S.U. service learning student with each of the groups to ensure that they remained on task. As I moved from group to group, I could see that every student was on task and working hard. Had it been only I in the room, however, I would expect that those students who finished earlier than others may have had a hard time keeping themselves focused. Therefore, even though I did not experience any issues with distractions, in the future I may ask the students to further discuss their conclusions while they wait for the rest of the class to finish collecting data. I ultimately had those students who finished early complete this task, but only because the M.S.U. students were able to provide for a seamless transition.

4. Individual and/or Group Activity (or activities)

Was your activity (or activities) appropriate for the developmental level? Yes No

What evidence supports your observations?

The activity that my students took part in was absolutely appropriate for their developmental level. First, I made sure to model the activity so that each student understood what was expected of them. By doing this, the students were able to ask any questions that they may have had ahead of time. The activity itself was perfect for the developmental level of my class. It was not difficult to physically move the objects. The majority of the lesson was explaining how and why the objects moved. This pushed their thinking, and allowed them to use personal observations to form conclusions.

Did the activity (or activities) support your objectives? Yes No

Please describe how your activity or sequence of activities related to your rationale and learning goals/objectives?

The goals of this particular lesson were to compare and contrast the motion of different objects, and identify changes in direction. In this activity, the students were given two different objects, and asked to observe their motion, identify how to move the objects, and construct a table to compare and contrast the differences of motion. From this activity, they were able to not only compare and contrast the motion of the cotton ball and jumping frog through the use of recorded data, but also use motion words from the previous lesson to describe the changes in motion including speed and direction. All groups were able to collect information and record it successfully and as a group, we were then able to compare and contrast the two sets of information.

5. Student Assessment:

Was assessment embedded in the lesson? Yes No
Did you assess your students after completing the lesson? Yes No

What kinds of feedback were provided to all students (during and after the lesson)?

Student assessment was embedded in this lesson. Although the students collected information as a group, I then required them to individually write a journal entry comparing and contrasting the motion of the two objects. Once the students had used their data to form a conclusion, I asked them to leave their pencils at their desks and to meet me at the rug. This ensured that the students would not be able to change their entries, and they could still use the information to support their arguments during discussion.

I explained to each student that I would be using their journal entry as an assessment. I wanted them to understand that they should take their time writing their entries because it helped me to better understand what they knew. I based my feedback during the lesson on the responses from the students. They shared their thoughts with the class, and I was able to informally assess what they understood, and what misconceptions they had. The conclusions that were shared during this time were accurate, and students used their own evidence to validate their claims. Had a student shared a misconception, I would have used that opportunity to ask for additional help from his peers and modeled the experiment again.

After the lesson, I was able to look through every student's journal to formally assess what they knew. This proved to be a bit difficult, because I didn't know if their beliefs had changed since the class discussion followed the journal assessment. Therefore, I responded to this assessment at the beginning of the following lesson. As we reviewed the lesson, I called on students who had an incorrect journal entry to explain the results from the previous lesson to the class. I then determined that all students had a strong grasp on the material, because those two students successfully explained the scientific concepts related to the lesson, even though their journal entry demonstrated misconceptions.

6. Comment on how your sequence of activities followed your lesson plan. Did you make any modifications as you were teaching this lesson? If so, please explain what they were and why?

Most of my lesson was taught in the way in which I had originally planned. The only difference was the order that I administered my assessment. I had initially planned on having the students complete their journal assessment after our class discussion. As I was teaching the lesson, however, I realized that many of my students would simply copy down the results of their peers rather than look at their own data to form conclusions. I decided to give this assessment right after each group concluded the experiment. We then had a class discussion afterwards. Since they had already completed their journal entry, I could look back at the responses at another time to determine what the students knew, and what beliefs changed throughout the discussion.