Lesson Designer Name	Maggie Wentworth	School Grade Course	Bay District Schools 6th Grade Science	Lesson Title	Elastic Energy System 3 Day Lesson

PRE-PLANNING

BIG IDEA	FLORIDA BENCHMARKS
Energy Transfer and Transformations	SC.6.P.11.1: Explore the Law of Conservation of Energy by differentiating between potential and kinetic energy. Identify situations where kinetic energy is transformed into potential energy and vice versa. Cognitive Complexity: Level 2: Basic Application of Skills & Concepts LACC.68.RST.1.3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. Cognitive Complexity: Level 2: Basic Application of Skills & Concepts I Date Adopted or Revised: 12/10 Belongs to: Key Ideas and Details LACC.68.WHST.1.2: Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information into broader categories as appropriate to achieving purpose; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension. Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples. Use appropriate and varied transitions to create cohesion and clarify the relationships among ideas and concepts. Use precise language and domain-specific vocabulary to inform about or explain the topic. Establish and maintain a formal style and objective tone. Provide a concluding statement or section that follows from and supports the information or explanation presented. Cognitive Complexity: Level 3: Strategic Thinking & Complex Reasoning I Date Adopted or Revised: 12/10 Belongs to: Text Types and Purposes MACC.6.SP.2.4: Display numerical data in plots on a number line, including dot plots, histograms, and box plots. Cognitive Complexity: Level 2: Basic Application of Skills & Concepts I Date Adopted or Revised: 12/10 Belongs to: Summarize and describe distributions.

ESSENTIAL QUESTION

What relationship does potential energy have to kinetic energy?

ENDURING UNDERSTANDING

The Law of Conservation of Energy: Energy is conserved as it transfers from one object to another and from one form to another. The amount of potential energy determines the available energy that can convert to kinetic energy. By increasing or decreasing the amount of potential energy, kinetic energy can be changed. Other variables can cause changes in motion as well.

PRIOR KNOWLEDGE

Energy is the ability to do work or cause change. Motion is the evidence of kinetic energy. Kinetic energy is energy of motion, while potential energy is stored energy.

The law of conservation of energy states that energy cannot be created nor destroyed.

Energy can be transformed into a new form.

Potential energy can be transformed into kinetic energy and kinetic energy can be transformed into potential energy.

Gravitational potential energy can transfer to kinetic energy.

SKILL/KNOWLEDGE ACQUISITION

Students will be able to predict kinetic energy changes resulting from decreased or increased potential energy.

Students will describe how energy changes form but is not lost.

Students will be able to identify variables in an elastic energy system.

Students will be able to design an elastic energy system that controls projectile motion.

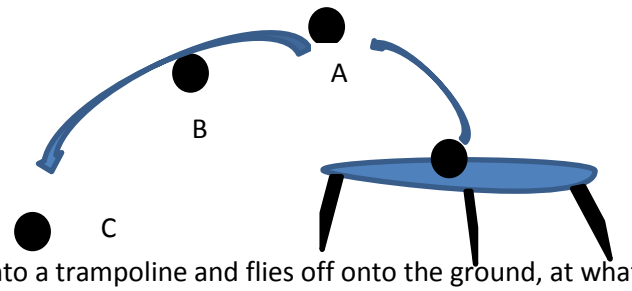
MISCONCEPTION(S)

Elastic energy cannot be transformed into motion energy (AAAS Project 2061, n.d.)

Energy can be created (Kruger, 1990; Lovrude, 2004; Papadouris et al., 2008)

Springs or other elastic objects have the same amount of elastic energy regardless of how much they are stretched or compressed (AAAS Project 2061, n.d.)

Summative Assessment Target Question

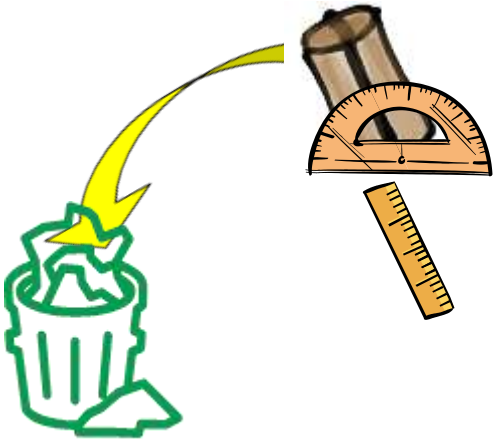


If a bowling ball is dropped onto a trampoline and flies off onto the ground, at what point has all the potential energy been converted to kinetic energy?

a. At the top.

	b. In the middle c. At the bottom d. It never has 100% because energy is lost as it goes down. Explain your answer.	
	CONCEPT SKILL: Transfer Question	
	If a ball is dropped from half height as before (instead of from the same height) onto the trampoline, then it will have enough kinetic energy to go: a) the same distance; b) half as far as from the top; c) farther; d) not enough information to determine the distance. Explain your answer.	
	READING INFORMATIONAL TEXT: Day 1: 45 minutes	
	Small group read/discuss and answer comprehension questions. (Peer support for struggling readers.)	
LESSON	**ENGAGE THE STUDENT Day 2: 10 minutes**	**MATERIALS/EQUIPMENT**
	Teacher demonstrates the elastic energy system by shooting the projectile across the room. The teacher asks, what caused the projectile to fly across the room? (energy) What kind of energy is used in this system? (elastic) (If prompting necessary) Was it gravitational potential energy? (no) What kind? What is a word for stretchy? (elastic) When the projectile flies, what kind of energy does it have? (kinetic) Can you make an energy system with elastic potential energy that shoots a projectile across the room?	1. Two full straws 2. One straw piece 3. masking tape 4. toilet paper tube 5. rubber band 6. protractor 7. brad fastener 8. ruler 9. trash cans (See actual picture of setup in attached document) 10. SAFETY GOGGLES
	FORMATIVE ASSESSMENT	**Group discussion questions:**

	Probing questions during Inquiry activity: **(Teacher asks these probing questions while visiting each group Day 2.)**	**(After small group discussion, answers are written in individual journals, Day 3.)**
	1. What can you do if it flies too far? 2. Why does that work? 3. What can you do if it doesn't fly far enough? 4. Why does that work? 5. Is there any way to change the distance it flies without changing the stretch of the rubber band? Explain.	Journals: 1. What created potential energy in this system? 2. When did you observe kinetic energy in this system? 3. How did you increase and decrease kinetic energy in this system? 4. Did the projectile go farther if the rubber band was stretched farther? 5. What variables did you identify? 6. What variables did you change to make your projectile go even farther? 7. How did you adjust variables to make your projectile go less far? 8. How does elastic potential energy affect the projectile motion? a. Draw an example(s) 9. How does angle of launch affect the projectile motion? a. Draw an example(s) 10. Were you able to control the kinetic energy by changing variables? 11. Could you increase distance traveled without increasing

		potential energy? How?
	INQUIRY ACTIVITY Days 2 & 3 30 minutes	**MATERIALS NEEDED**
	PROCEDURE: : What procedure will land the projectile in the can consistently (at least 3 times in a row)? (You have 15 minutes to solve the problem.) 1. Build the launcher (toilet paper tube, rubber band) 2. Build the projectile (2 straws, straw piece, masking tape) 3. Place the can 1 meter from the launch site 4. Place projectile on launcher using a protractor to measure angle 5. Set the launch angle and the stretch distance 6. Test the launcher recording the angle and stretch distance, cm; record the procedure 7. Measure the distance of the projectile; record result: X or ☺;describe observation (too far; not far enough) 8. Revise the procedure and retest 9. Measure the distance of the projectile; record 10. Continue to revise/retest until the projectile hits the can three times in a row. 11. As an exit ticket, write your group's solution to the challenge (the procedure) on an index card 12. Clean up your work space. **Day 3:** Continue the Inquiry Activity (You have 15 minutes) 13. Test the procedure of another group and respond on the card: 14. X Does NOT hit the can; ☺ Hit the can!	 Launcher: Toilet paper tube with rubber band around it .  Projectile: Masking tape around two straws with straw piece between 

	15. After your group's discussion and writing in your journal, share your challenge solution with the class explaining how you reached your designed solution (the procedure).	
	ANALYSIS Day 3: 15 minutes	**MATERIALS NEEDED**
	DATA ANALYSIS: (You have 15 minutes to record and analyze the class data independently in your journal.) Graph the data of the solution for each group in your science journal: INDEPENDENT ANALYSIS: Answer the following questions independently in your journal using the class data. 1. Which group(s) found a solution to the problem? 2. Were all solutions the same? 3. Was any of the potential energy lost during the demonstration? Explain. 4. How would you evaluate to determine the most efficient solution to the problem? Hint: Consider the production of potential energy as a cost factor, such as the cost of fuel in a rocket launch. 5. What relationship does potential energy have to kinetic energy? (Write 4 true statements describing the conclusions you have made.) 6. What further testing would you like to conduct? (Ideas should be stated as student generated testable questions.)	SAMPLE Data Table for scaffolding (see attached Lesson Activity Sheet)
	CONCLUDING ACTIVITY Day 3: 10 minutes	**MATERIALS NEEDED**

CONCLUSION	Volunteers share with class their answers to the Independent Analysis Questions. (This helps scaffold struggling writers, modeling for them how to verbalize their thoughts. How does this apply to the REAL WORLD? Do scientists ever have to control motion of a projectile? (launch of space ships; military missils;)	Journals
	Modifications and Differentiation	
MODIFICATIONS	Struggling students are grouped together for inquiry activity and will answer only group questions 1, 2, 3, 4, 8, & 9; plus they will be given a data table to use; while other groups must answer all group questions and create their own data table. (This encourages participation and not just passive involvement due to lack of confidence by the struggling students.) Advanced students will be grouped together and asked to write a predicted procedure for hitting the trash can if it is moved 1 meter forward, basing this only on their test data without any further testing. Predict the procedure for hitting it if it is moved ½ meter closer.	Condensed Group Questions (1, 2, 3, 4, 8, & 9); Data (Table provided as needed for differentiation.)