GRADE 10 SCIENCE: Physics—Egg-citing Egg Drop

Summary of Learning Opportunity		
This egg drop activity is a fun introductory and then summative task for Science 10 Physics. In groups of two to three, students design, build and test their egg drop containers to protect an egg from being damaged from a five metre drop. Students conduct the official drops and collect key data such as the time of descent and the mass of the container plus egg. At the end of the unit, I hand back the egg drop lab for students to complete calculations, analyze and interpret their data for energy transformation, conservation of energy, kinetic energy and potential energy. Students use their data to compete for the title of Slowest Egg Drop.		
Science 10	**Learning Standards**	• Collaboratively and individually plan, select and use appropriate investigation methods, including field work and lab experiments, to collect reliable data (qualitative and quantitative) • Use knowledge of scientific concepts to draw conclusions that are consistent with evidence • Communicate scientific ideas, claims, information and perhaps a suggested course of action, for a specific purpose and audience, constructing evidence-based arguments and using appropriate scientific language, conventions and representations • Law of conservation of energy, potential and kinetic energy, transformation of energy

Numeracy Connections	Instruction and Assessment	Competencies Developed, Practiced, and/or Assessed
	1. Students are introduced to the egg drop challenge during the first week of classes as a fun community building activity. In groups, students design, build, test and revise prototypes. They use materials from their home recycling bins to use for their egg drop container. On the final testing day, students video and time their drops, collecting important data for later use.	Collaboratively and individually, plan, select and use appropriate investigation methods, including field work and lab experiments, to collect reliable data (qualitative and quantitative)
NUMERACY: Interprets—Understands the real-world problem	2. We then progress through the Physics unit, learning about conservation of energy, kinetic energy, potential energy and energy transformations. We practice identifying energy transformations, learn how to calculate potential and kinetic energy and analyze different real-world scenarios to determine how the energy will be transformed as objects change their vertical position, speed up and slow down.	

NUMERACY: Solves—Solves the mathematical problem

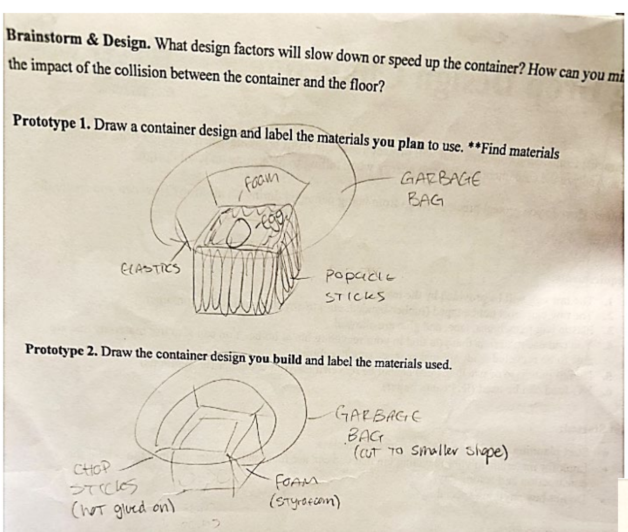
NUMERACY: Communicates—Represents processes and solution

3. At the end of the Physics unit, students go back to make calculations and analyze and interpret their egg drop data. This, along with a few other in-class experiments, becomes a part of their overall lab assessment. I created an assessment rubric using language from the Science curricular competencies and content learning standards and Numeracy proficiency descriptors.

Use knowledge of scientific concepts to draw conclusions that are consistent with evidence

Communicate scientific ideas, claims, information and, perhaps, a suggested course of action for a specific purpose and audience, constructing evidence-based arguments and using appropriate scientific language, conventions and representations

Demonstration of Student Learning, Teacher Assessment and Reflection


Brainstorm & Design. What design factors will slow down or speed up the container? How can you mi[nimize] the impact of the collision between the container and the floor?

Prototype 1. Draw a container design and label the materials you plan to use. **Find materials

Prototype 2. Draw the container design you build and label the materials used.

TA COLLECTION:

Symbol:	Before:	Observation/Calculation (include units)
m	Total Mass – egg & container (convert to kg by dividing the amount in grams by 1000)	Egg = 53.89g = 0.05389 C and E = 119.38g = $\boxed{0.11938}$
h	Height that the object will fall	5.3 m

Symbol:	During:	Observation/Calculation (include units)
t	Time of Descent (seconds)	2.81 s
	Describe how the container fell? Impact?	IT FELL SLOW AND SWAYED AROUND BEFORE SOFTLY HITTING THE GROUND AND TIPPING OVER. THE EGG SURVIVED

5. Use your egg drop lab to complete the following questions.
   a. Did your egg survive or break?
      survived
   b. How long did it take for your egg to drop to the ground?
      2.81 s (seconds)
   c. What was the initial potential energy of your egg + container?
      6.2 J (0.11938 kg · 9.81 m/s² · 5.2 m) (mgh)
   d. What was the estimated final kinetic energy of your egg + container?
      0.849 J $\left(\frac{0.11938 \times 3.772^2}{2}\right)\left(\frac{mv^2}{2}\right)$
   e. How much energy was 'lost' when the egg fell (show your work)?
      $PE_i - KE_f$ = Energy lost   6.2 − 0.849 = 5.351 J
      5.351 J was lost when the egg fell
   f. Where did this energy go?
      It was lost to thermal energy

Instructions:	Calculations (Show your work)
Calculate the initial potential energy (in Joules) of the container just before it was released. $g = 9.81\ m/s^2$ $E_{pi} = mgh$	mgh = 0.11938 · 9.81 · 5.3 = $\boxed{6.2 J}$
What is the final Potential Energy of the container when it hits the floor? Where h = 0. $E_{pf} = mgh$	mgh = 0.17324 · 9.81 · 0 = $\boxed{0 J}$
Calculate the speed it was traveling when it hit the floor $v_f = 2(d/t)$	$V = 2\left(\frac{5.3}{2.81}\right) = \boxed{3.772\ m/s}$
Calculate the final kinetic energy of the container the moment before it hit the ground (use the "v" above) $E_{kf} = \frac{mv^2}{2}$	$E_{kf} = \frac{mv^2}{2} = \frac{0.11938 kg \cdot 3.772^2}{2}$ $\boxed{= 0.849 J}$
What is the initial kinetic energy of the container (before it starts to fall)? Where v = 0 m/s. $E_{ki} = \frac{mv^2}{2}$	$E_{kf} = \frac{mv^2}{2} = \frac{0.11938 \cdot 0^2}{2}$ $\boxed{= 0 J}$

Sample student's design, data collection calculations, and data analysis.

2. Did all the potential energy get converted into kinetic energy right before the container hit the ground? Where did the rest of the potential energy go?

NOT all the potencial energy got converted into kinetic energy. The rest of the potential energy got lost to thermal energy

3. What would have happened if all the potential energy was converted into kinetic energy? Explain your thinking.

It would of fallen faster and more directly instead of slowing and swaying in the air.

4. What was the effect of wind resistance on your container?

It caused our container to slow down and sway in the air

5. What was the most effective part of your design? What was the weakest part of your design? How would you improve your design if you did the project again?

Best part = parachute because it caused our design to fall slower and in the end saving our egg

Worst part = Body because it swayed the most in the design and the lid was not very stable

improvements = make a better fit a smaller box.

6. What real world applications does this project have?

When rockets come back down from space they use physics the slow the descent to ensure a safe landing. Think of the rocket as the container, the parachute is same just different size/shape, and think of the people as the egg

Teacher's Observations and Assessment

The student was able to use knowledge of scientific concepts to draw conclusions that are consistent with evidence. In question 5, they described specific ways to improve their investigation methods and the quality of data. They connected their in-class learning to a real-world situation in question 6.

Attempts to communicate a basic understanding of the concepts covered in this unit	Conveys a simple (or basic) understanding of the scientific concepts covered in this unit	Uses correct units. Able to represent and analyze a relationship using graphs and equations	Clearly and thoroughly communicates scientific ideas Constructs evidence-based arguments by showing calculations Describes specific ways to improve their investigation methods

Teacher's assessment rubric (above)

Teacher's Reflection

This was a fun way for students to practice and demonstrate cross-curricular Numeracy critical thinking and communication skills. For my Science 10 course this year, I wanted to focus specifically on "understanding real-world scenarios" in my Physics unit.

While we frequently examine real-world examples, it's easy to get caught up in the math. Students often excel at the calculations but struggle to apply them to word problems or real-life scenarios. By keeping the emphasis on real-world problems central to my unit, I helped students connect more deeply with the concepts, enhancing their problem-solving skills. When asked to reflect on their learning, students demonstrated a solid understanding of all the concepts introduced.

Real-world scenarios allow students to better connect to the material they are learning about. It is more relevant and understandable for students if they can image or picture what is happening in a context that is familiar. If they can reflect on their own experiences, analyzing them with their new understanding of the science concepts, it helps students make sense of the world around them and transfer these understandings to new scenarios.