Sample Information

Subject	Science
Strand/Topic	Energy experimental investigation
Task	Identify how the energy efficiency of a bouncing ball changes when different balls or surfaces are used
Year/Class	8X Date 18/11/2021

Teacher Name   Kerenza/Lenore

Overall grade   A   B   **C**   D   E

Summary justification

The student's work shows a high level of investigative skills, particularly in the methodology and processe collecting and representing data. Application of scientific understanding and using data in explanations a for development.

Strengths of the performance

The rationale and background information indicate good science understanding of different forms of energy related to bouncing balls. The student has identified that energy transformations occur during the bouncing of the balls, and that there's a change in energy between potential forms and kinetic forms. They've provided a definition about energy efficiency in terms of how much available energy there is within the system and that this decreases over time due to friction and transformation into thermal energy.

The student has identified some variables in the variable table, which corresponds with the C standard.

An investigable question has been written in terms of the independent and dependent variables. A precise prediction has been provided that is related to the question with some justification for that prediction. This corresponds with the A standard.

The student has identified some risks associated with their behaviour in conducting the experiment and in the use of materials, and how to manage those risks. This shows an ability to analyse the methodology. The student has collected consistent data sets and accurately calculated their energy efficiency which aligns with the A standard. Conventions of graphing with titles, axis labels, scale and representation in columns have been followed.

In the analysis and explanation of the data, a relationship between the two variables has been discussed in terms of the impact on energy efficiency related to the physical properties of the ball (size, materials) which shows some science understanding. In the evaluation, a major source of human error to accurately measure rebound height is identified. The student has suggested using a slow-motion camera to make more accurate measurements. This shows good understanding about the impact of methodology on the accuracy of collected data.

Cognitive Commentary

Areas for improvement

The independent and the dependent variables have not been expressed in terms of what is changing and what is being measured. For example, the independent variable is the type of ball, but the student has listed the balls being used and in other places referred to the material of the ball. All physical properties of the balls (not just material) are not able to be controlled and will therefore have an impact. In the dependent variable, the student has discussed the percentage energy efficiency (what is calculated) rather than rebound height (what is being measured). Two controlled variables have been identified but not discussed in the methodology in relation to how these variables are controlled to reduce their impact on the quality of the collected data. For example, whether a ruler is being used to ensure a consistent measurement.

The response could also be enhanced by discussion of the use of trials, increasing the number of trials and calculating averages as scientific ways of reducing the impact of anomalous data or outliers, and improving the reliability of the data.

The explanations and conclusions need to demonstrate linkage between the scientific understanding of energy transformation and the relationships in the data, for example, in this investigation the student needs to connect their discussion of energy efficiency, the physical properties of the balls and rebound height. The relationship seen in the data between the independent variable (ball type) and the dependent variable (rebound height) can be explained by the physical properties (e.g., material, structure of the ball); the physical properties will either increase or decrease the percentage of transformation that occurs within the system which determines the increase or decrease in rebound height.

Next steps for teaching

Focus will be on developing skills to write an explanation, linking the student's good understanding of science with their data. This will include identifying dependent and independent variables and using these when drawing conclusions about the experiment. Support will be provided by reframing questions in the analysis, conclusion and evaluation sections to scaffold the type of response required, enabling the student to think logically through those steps and make connections to form the explanation. These questions would be similar to those provided at the beginning of the task.

Online simulations where students isolate, control and manipulate variables will be used to model scientific investigation of topics like energy efficiency in transformations between potential energy and kinetic energy. Simulations provide a visual of what is happening within a system, which will support skills to write good scientific explanations.

Finally, to develop literacy demands within science, we will work on deconstructing and reconstructing responses to identify the important language features and technical vocabulary and structures. This will support the crafting of strong, scientific explanations that incorporate the collected data and justifications, drawing on relevant scientific theory and principles.

SCIENCE DEPARTMENT
Year 8 Assignment Task Sheet

Name	
Form	
Subject Teacher	
Head of Department	
Unit	Energy
Assessment Type	Experimental investigation
Task	Record of investigations

Rationale (Background information)

When you drop a tennis ball onto a surface it does not bounce back to its original height.

In your own words:

1. Identify the different forms of energy involved in bouncing a ball.
2. Explain energy transfers or transformations that occur (include an energy transformation flow diagram for a bouncing ball).
3. Describe what energy efficiency is.
4. Identify factors that could affect the rebound height of a bouncing ball and why there could be a change in percentage energy efficiency.

I believe that there are multiple forms of energy that take place in this experimen including sound energy, kinetic energy, thermal energy (from the friction), elastic energy and gravitational potential energy. During this experiment I witnessed many energy transformations, including elastic energy → kinetic energy → thermal → sour energy. Energy efficiency is the amount of energy out of 100% that is useful, whereas the left over percentage is wasted energy. There are many factors that may have had an impact on the experiment's results. This includes things like whether the ball was forcefully dropped or just dropped normally. Also things like the material of the ball can have a major affect on the results we have gotten. e.g the golf ball had the hardest material and the highest rebound height.

Consider the materials you have available and the results of your previous bouncing ball experiment.

Original bouncing ball experiment

The original experiment measured the percentage energy efficiency of a ball dropped from different heights.

- Rebound height of a tennis ball was measured from a 30cm, 60cm and 90cm drop.
- Percentage energy efficiency was calculated for each drop height.

Materials available for new experiment

- Different types of balls
- Different surfaces

After choosing your materials, **identify** the variables in your experiment.

Independent	Dependent	Controlled
-Tennis ball. - golf ball. - hand ball.	-percentage of the energy efficiency.	-the height (100cm) - the surface (concrete)

Use your independent and dependent variables to write a question that you will investigate (write your question so that it can have a yes or no answer).

Will the golf ball have a higher rebound then the tennis, or hand ball?

Make a **justified hypothesis** about the results of the experiment. You could use the "If…then…because…" sentence structure to write this hypothesis.

I believe that the golf ball will produce the greatest rebound height, out of the hand ball or tennis ball because if the golf ball is dropped at 100cm, on a concrete surface then it will have the heighest rebound height because it is made of a hard mateirial, is rather light and is made to be hit and to bounce or rebound.

Safety considerations

Identify the risks involved with this experiment and **describe** how you will safely perform the experiment.

- a possible outcome that may occur during this experiment, is smashing a window with the golf ball. This can be avoided if we do the experiment far from any windows around. - someone may get hit by the ball, this is a risk because if anyone is mucking around, we can stop this by not being silly and throwing the ball. - Also making sure of noone getting hit by a ruler, this can be prevented by keeping the ruler by your side, whilst walking.
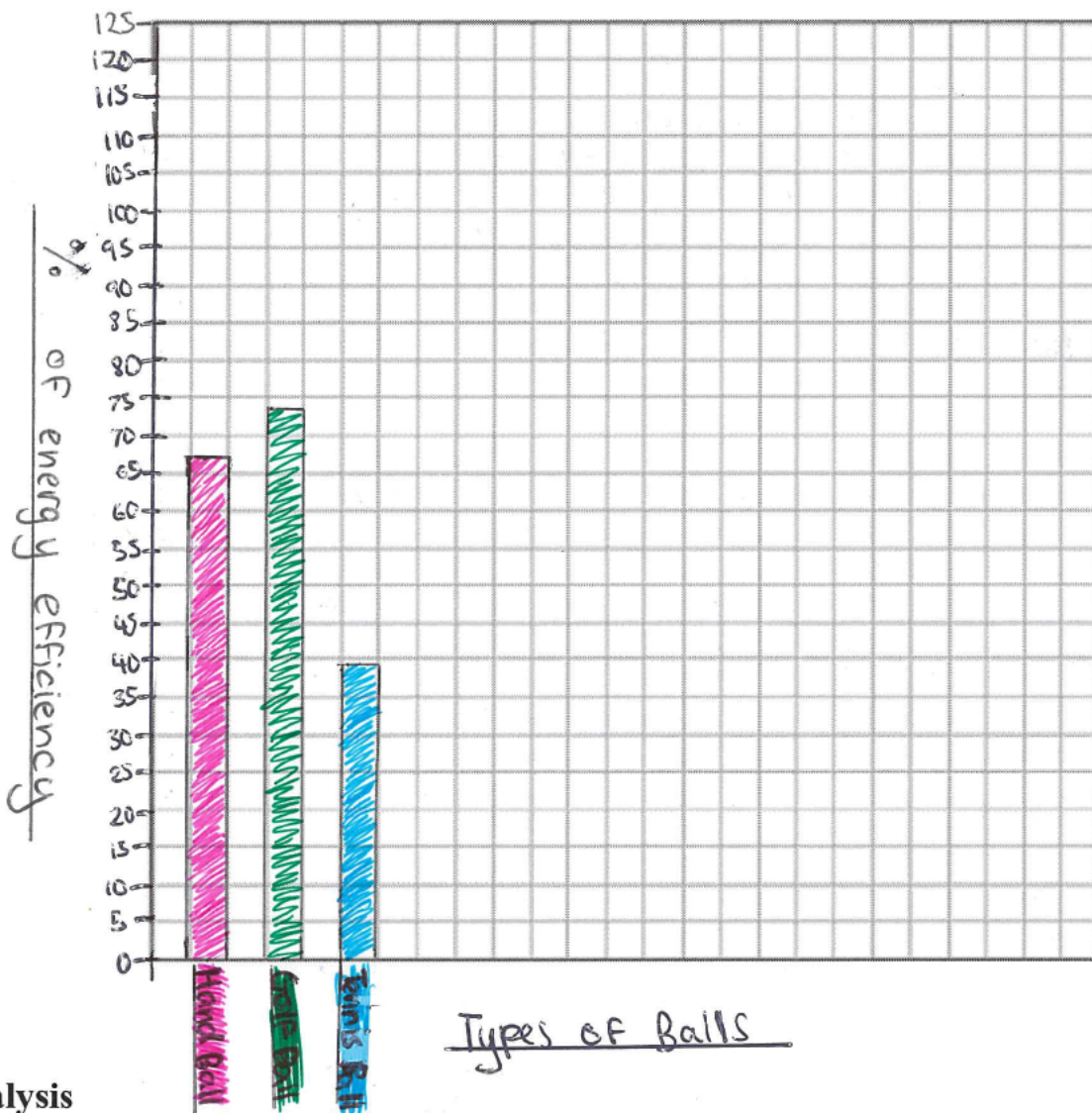
Data

Independent variable	Rebound Height (cm)			
	Trial 1	Trial 2	Trial 3	Average
1) hand ball	59cm	72cm	73cm	68cm
2) golf ball	72cm	73 cm	74cm	73cm
3) tennis ball	37cm	38cm	43cm	39.3cm

Independent variable	Height dropped (cm)	Height of rebound (cm)	Energy Efficiency (%) = average height of rebound / height dropped x 100 (show working out)
1) hand ball	100cm	68cm	$68 \div 100 = 0.68 \times 100 \approx 68\%.$
2) golf ball	100cm	73cm	$73 \div 100 = 0.73 \times 100 = 73\%.$
3) tannis ball	100cm	39.3cm	$39.3 \div 100 = 0.393 \times 100 = 39.3$

Construct a graph of the recorded data.

1. Plot the independent variable along the horizontal axis (surface, height, type of ball).
2. Plot the energy efficiency percentage along the vertical axis with an appropriate scale.
3. Create a line graph using the recorded data. You should draw three lines on this graph – one line for independent variable (a), one line for independent variable (b) and one line for the control.
4. Ensure your graph has a title.

A bar graph titled "Energy efficiency of the average rebound." The y-axis is labelled "% of energy efficiency" with a scale from 0 to 125. The x-axis is labelled "Types of Balls". Three bars are shown: a pink bar (Hand Ball) at approximately 65, a green bar at approximately 73, and a blue bar (Tennis Ball) at approximately 38.

Analysis

Analyse the data in the tables and graphs (you could use the PQE method). **Describe the relationship** between percentage energy efficiency and the independent variable you tested (Eg. Surface or type of ball).

I believe that the indepent variable that we chose (type of ball) had a huge impact on the energy efficiency. This is because, the balls were each made for different purposes and they all have a different energy efficiencies. Here, you can see on our graph that the golf ball had the highest energy efficieney, I had stated this in my hypothesis and this proves my theory right. An overall trend that is seen in my graph is that the smaller the ball, the higher the energy efficiency. Other than that trend, there was no other patterns seen in this experiment.

Explain why there was a change in percentage energy efficiency between the 3 variables you conducted.

I believe that the change in the percentages of energy efficiency is because of the independent variables that were included in this experiment. This means the things like, the size, shape and materials the different balls were made out of. For e.g (the golf ball had the heighest rebound height and was made out of the hardest material.)

Conclusion

Identify which variable had the greatest energy efficiency. Did this result support your hypothesis? **Justify your conclusion** by referring to your data and the background information.

The variable with the highest energy efficiency was the golf ball, this statement therefore supported my hypothesis because I wrote that the ball which was to produce the highest energy efficiency was going to be the golf ball. Also, the result of which was the highest (the golf ball) was 73% but the hand ball was very close with 68%. I believe that the reason that the golf ball had the heighest rebound height because of the material it was made of.

Evaluation

Identify possible sources of **error or problems** in the experiment. How could these errors or problems affect your results?

During the experiment, there may have been a few errors that changed the results that we had gotten. This includes, maybe one of our group members recorded the results wrong because of how hard it is to see the rebound height on a ruler. A resolution to this could be being more careful with the measuring by using a slow motion camera to see how high the rebound height really was. This will reassure that the results we have gotten were'nt bias.

Suggest improvements to the experiment. **Explain** how the changes would improve the experiment by referring to your previously identified errors/problems above.

A resolution to making the experiment more fair, could be to get a slow motion camera that will re-assure that the Rebound height was not bias and is measured to the right height. Also another resolution or fix to this, could be getting one person to hold the ruler, one person to drap the ball and then one person to measure.