Lab 2: Isotope Simulation — Average Atomic Mass (Beans)

Name: ___________________________ Partner(s): ___________________________

Date: _____________ Period: _____

Purpose:

Model isotopes and calculate a weighted average atomic mass.

Standards: *HS-PS1-8*

Materials & Equipment:

• Mixed beans (2–3 types/colors); cups/weigh boats; calculator

• Electronic balance (±0.01 g)

Procedure:

1. Obtain a mixed sample (~80–120 beans). Separate piles by isotope (bean type).
2. For each isotope, count beans and measure total mass to 0.01 g; record in table.
3. Compute average mass per bean for each isotope.
4. Compute fractional abundance for each isotope (count/total).
5. Calculate weighted average atomic mass: Σ[(avg mass) × (fractional abundance)].
6. Repeat with a second sample or swap with another group; compare results.

Data & Calculations:

Isotope	Count	Total Mass (g)	Avg Mass (g/bean)	Fractional Abundance	Weighted Term
A					
B					
C (if used)					
Totals					

Analysis Questions:

1. Compare your result to another group's. What accounts for small differences?
2. Why is the periodic table atomic mass rarely a whole number?
3. If isotope B's abundance increases, predict the direction of change in the average atomic mass and justify.

Conclusion (CER):

1. **Claim**: State your class's best estimate of the sample's average atomic mass and whether your group's value is consistent.

2. **Evidence**: Cite your counts, masses, and the weighted-average calculation.

3. **Reasoning**: Explain how isotopes and fractional abundance produce a non-integer atomic mass.

4. **Error/Improvement**: Identify likely sources of variability (e.g., sampling, mass resolution) and propose improvements.

Lab 2: Isotope Simulation — Average Atomic Mass (Beans) — Rubric

*Weights: Only **Analysis & Explanations (×2)** and **Conclusion (×2)** are doubled.*

Criterion	1	2	3	4	5
Preparation & Technique	Disorganized; mishandles materials; frequent fixes required.	Partial setup; inconsistent technique; some inaccurate measurements.	Adequate setup; follows directions; measurements mostly accurate.	Careful technique; minimizes error; repeats for reliability.	Meticulous, efficient technique; optimizes for precision and reliability.
Data & Calculations	Incomplete or incorrect; key values missing.	Basic data recorded; several calculation errors.	Complete data; minor calculation errors only.	Complete and well-labeled; calculations shown step-by-step.	Exemplary accuracy; clear work; checks/justifies assumptions.
Analysis & Explanations (×2)	Little/no interpretation; misapplies concepts.	Basic interpretation; limited connection to model; generic statements.	Correct interpretation with support from data.	Strong interpretation; connects to natural abundance and variability.	Insightful analysis; limitations articulated; compares models/data effectively.
Conclusion (×2)	No/weak claim; unsupported.	Vague claim; minimal support.	Clear claim with some support from calculations.	Well-supported claim; references specific numbers.	Compelling claim; integrates calculations, uncertainty, and model limits.
Clarity & Mechanics	Disorganized; frequent grammar/format issues impede understanding.	Partly organized; several errors; hard to follow at times.	Generally clear; minor errors; readable structure.	Well organized; concise; almost no errors; visuals/tables support text.	Polished, professional scientific writing; precise vocabulary; flawless formatting.