

Life-Cycle Assessment INDIVIDUAL Worksheet **Answer Key**

~Environmental Impact of Cupcakes~

Record all stages (calculated with class answers):

Throw Away Paper Liner (Landfill)				
Stage	Energy Use	Unit	GHG emissions	Unit
Wet ingredients	8570	kJ	1234	g CO _{2e}
Dry ingredients	2576	kJ	442.5	g CO _{2e}
Baking materials	3940	kJ	3212	g CO _{2e}
Oven/baking	2400	kJ	360	g CO _{2e}
Frosting	15965	kJ	1706	g CO _{2e}
Disposal (landfill)	600	kJ	18	g CO _{2e}
Total (12 cupcakes)	A. 34,051	kJ	6,972.5	g CO _{2e}

1 cupcake	B. 2,838	kJ	C. 581	g CO _{2e}
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Impact Analysis

- How much **energy** is needed to produce **12** cupcakes with paper liners disposed in a landfill? (Be sure to include units.)

_____ 34,051 kJ _____

- How much **energy** is needed for **1** cupcake? (*Hint: The answer from "A" is for 12 cupcakes.*)

_____ 2838 kJ _____

- How much **greenhouse gas emissions** are produced from making **1** cupcake with its paper liner disposed in a **landfill**?

_____ 581 g CO_{2e} _____

Record all stages (calculated with class answers):

Compost Paper Liner				
Stage	Energy Use	Unit	GHG emissions	Unit
Wet ingredients	4000	kJ	1234	g CO _{2e}
Dry ingredients	2576	kJ	442.5	g CO _{2e}
Baking materials	3940	kJ	3212	g CO _{2e}
Oven/baking	2400	kJ	360	g CO _{2e}
Frosting	15965	kJ	1706	g CO _{2e}
Disposal (compost)	600	kJ	-48	g CO _{2e}
Total (12 cupcakes)	2,9481	kJ	6,906.5	g CO_{2e}

1 Cupcake	D. 2,457	kJ	E. 576	g CO_{2e}
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4. How much **energy** is needed to produce **1** cupcake if you **compost** the paper liner?

_____ 2457 kJ _____

5. How much **greenhouse gases** are emitted from **1** cupcake if you **compost** your cupcake liner?

_____ 576 g CO_{2e} _____

Improvement Analysis

What could you change in the cupcakes to improve its impact on the environment?

Describe your improvements below. Cite evidence from your calculations to explain your improvements.

(Responses may vary from student to student, but expect them all to reference results from their calculations.)

Example answer: I would compost my paper liner instead of throwing it away in the landfill. Composting a paper liner reduces GHG emissions by 5 g CO_{2e} (581 – 576) for 1 cupcake compared to disposing it in a landfill.

Another response might involve making changes to the recipe. For example: I noticed that the frosting uses the most amount of energy to make compared to all of the other stages. It needs 15,965 kJ of energy, where the second highest stage only needs 4000 kJ of energy. The sugar in the frosting uses the most energy, so if we reduced how much sugar we use or substitute the sugar for a different item that does not use as much energy, the cupcakes would not use as much energy, so the impact on the environment would be reduced.