**Life-Cycle Assessment GROUP Worksheets Answer Key**

**~Environmental Impact of Cupcakes~**

**Stage 1: Wet Ingredients**

**Inventory Analysis**

Each component used to make a cupcake has its own life cycle of production, use and waste. You will collect the values for the energy used and greenhouse gases (GHG) emitted during the *production phase* of each ingredient. From the ingredient cards, gather the data of each item needed to make cupcakes for your assigned stage. The information you gather should be enough to make **12** cupcakes.

**Data Collection and Calculations**

|  |  |
| --- | --- |
| **You need:** | **Calculate This:** |
| **Item** | **Amount** | **Unit** | **Energy Used** | **Unit** | **GHG emissions** | **Unit** |
| Egg | 2 | egg | 4000 | kJ | 600 | g CO2e |
| Milk | 120 | ml | 600 | kJ | 144 | g CO2e |
| Butter | 120 | ml | 3960 | kJ | 480 | g CO2e |
| Vanilla | 2.5 | ml | 10 | kJ | 10 | g CO2e |
| **TOTAL** | **8,570** | **kJ** | **1,234** | **g CO2e** |

Use the space below to calculate the energy used and GHG emissions for each ingredient.

*Example*: 1 egg needs 2000 kJ energy and you need 2 eggs: Energy used = 2 x 2000 kJ = 4000 kJ

Egg: $2 eggs ×\frac{2000 kJ}{1 egg}=4000 kJ$ $2 eggs ×\frac{300 g CO\_{2e}}{1 egg}=600 g CO\_{2e}$

Milk: $120 ml ×\frac{50 kJ}{10 ml}=600 kJ$ $120 ml ×\frac{12 g CO\_{2e}}{10 ml}=144 g CO\_{2e}$

Butter: $120 ml ×\frac{330 kJ}{10 ml}=3960 kJ$ $120 ml ×\frac{40 g CO\_{2e}}{10 ml}=480 g CO\_{2e}$

Vanilla: $2.5 ml ×\frac{4 kJ}{1 ml}=10 kJ$ $2.5 ml ×\frac{4 g CO\_{2e}}{10 ml}=10 g CO\_{2e}$

**Total energy:** 4000 kJ + 600 kJ + 3960 kJ + 10 kJ = 8,570 kJ

**Total emissions:** 600 g CO2e + 144 g CO2e + 480 g CO2e + 10 g CO2e = 1,234 g CO2e

**Stage 2: Dry Ingredients**

**Inventory Analysis**

Each component used to make a cupcake has its own life cycle of production, use and waste. You will collect the values for the energy used and greenhouse gases (GHG) emitted during the *production phase* of each ingredient. From the ingredient cards, gather the data of each item needed to make cupcakes for your assigned stage. The information you gather should be enough to make **12** cupcakes.

**Data Collection and Calculations**

|  |  |
| --- | --- |
| **You need:** | **Calculate This:** |
| **Item** | **Amount** | **Unit** | **Energy Used** | **Unit** | **GHG emissions** | **Unit** |
| Flour | 210 | g | 231 | kJ | 231 | g CO2e |
| Sugar | 230 | g | 2300 | kJ | 207 | g CO2e |
| Baking powder | 6 | g | 45 | kJ | 4.5 | g CO2e |
| **Total** | **2,576** | **kJ** | **442.5** | **g CO2e** |

Use this space to calculate the energy used and GHG emissions for each item.

*Example*: 1 egg needs 2000 kJ energy and you need 2 eggs: Energy used = 2 x 2000 kJ = 4000 kJ

Flour: $210 g×\frac{11 kJ}{10 g}= 231 kJ$ $210 g ×\frac{11 g CO\_{2e}}{10 g}=231 g CO\_{2e}$

Sugar: $230 g ×\frac{100 kJ}{10 g}=2300 kJ$ $230 g×\frac{9 g CO\_{2e}}{10 g}= 207 g CO\_{2e}$

Baking powder: $6 g×\frac{7.5 kJ}{1 g}= 45 kJ$ $6 g×\frac{0.75 g CO\_{2e}}{1 g}=45 g CO\_{2e}$

**Total energy:** 231 kJ + 2300 kJ + 45 kJ = 2576 kJ

**Total emissions:** 231 g CO2e + 207 g CO2e + 4.5 g CO2e = 442.5 g CO2e

**Stage 3: Baking Materials**

**Inventory Analysis**

Each component used to make a cupcake has its own life cycle of production, use and waste. You will collect the values for the energy used and greenhouse gases (GHG) emitted during the *production phase* of each ingredient. From the ingredient cards, gather the data of each item needed to make cupcakes for your assigned stage. The information you gather should be enough to make **12** cupcakes.

**Data Collection and Calculations**

|  |  |
| --- | --- |
| **You need:** | **Calculate This:** |
| **Item** | **Amount** | **Unit** | **Energy Used** | **Unit** | **GHG emissions** | **Unit** |
| Paper liner | 12 | liner | 240 | kJ | 12 | g CO2e |
| Metal cupcake tray | 1 | tray | 2600 | kJ | 2200 | g CO2e |
| Metal mixing bowl | 1 | bowl | 1100 | kJ | 1000 | g CO2e |
| **Total** | **3,940** | **kJ** | **3,212** | **g CO2e** |

Use this space to calculate the energy used and GHG emissions for each item.

*Example*: 1 egg needs 2000 kJ energy and you need 2 eggs: Energy used = 2 x 2000 kJ = 4000 kJ

Paper liner: $12 liners×\frac{20 kJ}{1 liner}= 240 kJ$ $12 liners×\frac{1 g CO\_{2e}}{1 liner}=12 g CO\_{2e}$

**Total energy:** 240 kJ + 2600 kJ + 1100 kJ = 3940 kJ

**Total emissions:** 12 g CO2e + 2200 g CO2e + 1000 g CO2e = 3212 g CO2e

**Stage 4: Oven Baking**

**Inventory Analysis**

Each component used to make a cupcake has its own life cycle of production, use and waste. You will collect the values for the energy used and greenhouse gases (GHG) emitted during the *production phase* of each ingredient. From the ingredient cards, gather the data of each item needed to make cupcakes for your assigned stage. The information you gather should be enough to make **12** cupcakes.

**Data Collection and Calculations**

|  |  |
| --- | --- |
| **You need:** | **Calculate This:** |
| **Item** | **Amount** | **Unit** | **Energy Used** | **Unit** | **GHG emissions** | **Unit** |
| Electricity (177°C) | 20 | minute | 2400 | kJ | 360 | g CO2e |

Use this space to calculate the energy used and GHG emissions for each item.

*Example*: 1 egg needs 2000 kJ energy and you need 2 eggs: Energy used = 2 x 2000 kJ = 4000 kJ

Electricity: $20 minutes×\frac{7200 kJ}{60 minutes}= 2400 kJ$ $20 minutes×\frac{1080 g CO\_{2e}}{60 minutes}=360 g CO\_{2e}$

**Stage 5: Frosting**

**Inventory Analysis**

Each component used to make a cupcake has its own life cycle of production, use and waste. You will collect the values for the energy used and greenhouse gases (GHG) emitted during the *production phase* of each ingredient. From the ingredient cards, gather the data of each item needed to make cupcakes for your assigned stage. The information you gather should be enough to make **12** cupcakes.

**Data Collection and Calculations**

|  |  |
| --- | --- |
| **You need:** | **Calculate This:** |
| **Item** | **Amount** | **Unit** | **Energy Used** | **Unit** | **GHG emissions** | **Unit** |
| Sugar | 800 | g | 8000 | kJ | 720 | g CO2e |
| Milk | 5 | ml | 25 | kJ | 6 | g CO2e |
| Butter | 240 | ml | 7920 | kJ | 960 | g CO2e |
| Vanilla | 5 | ml | 20 | kJ | 20 | g CO2e |
| **Total** | **15,965** | **kJ** | **1,706** | **g CO2e** |

Use this space to calculate the energy used and GHG emissions for each item.

*Example*: 1 egg needs 2000 kJ energy and you need 2 eggs: Energy used = 2 x 2000 kJ = 4000 kJ

Sugar: $800 g ×\frac{100 kJ}{10 g}=8000 kJ$ $800 g×\frac{9 g CO\_{2e}}{10 g}=720 g CO\_{2e}$

Milk: $5 ml ×\frac{50 kJ}{10 ml}=25 kJ$ $5 ml ×\frac{12 g CO\_{2e}}{10 ml}=6 g CO\_{2e}$

Butter: $240 ml ×\frac{330 kJ}{10 ml}=7920 kJ$ $240 ml ×\frac{40 g CO\_{2e}}{10 ml}=960 g CO\_{2e}$

Vanilla: $5 ml ×\frac{4 kJ}{1 ml}=20 kJ$ $5 ml ×\frac{4 g CO\_{2e}}{10 ml}=20 g CO\_{2e}$

**Total energy:** 8000 kJ + 25 kJ + 7920 kJ + 20 kJ = 15,965 kJ

**Total emissions:** 720 g CO2e + 6 g CO2e + 960 g CO2e + 20 g CO2e = 1706 g CO2e

**Stage 6: Disposal**

**Inventory Analysis**

Each component used to make a cupcake has its own life cycle of production, use and waste. You will collect the values for the energy used and greenhouse gases (GHG) emitted during the *production phase* of each ingredient. From the ingredient cards, gather the data of each item needed to make cupcakes for your assigned stage. The information you gather should be enough to make **12** cupcakes.

**Data Collection and Calculations**

|  |  |
| --- | --- |
| **You need:** | **Calculate This:** |
| **Item** | **Amount** | **Unit** | **Energy Used** | **Unit** | **GHG emissions** | **Unit** |
| Landfill paper liner | 12 | liner | 600 | kJ | 18 | g CO2e |
| Compost paper liner | 12 | liner | 600 | kJ | -48 | g CO2e |

Use this space to calculate the energy used and GHG emissions for each item.

*Example*: 1 egg needs 2000 kJ energy and you need 2 eggs: Energy used = 2 x 2000 kJ = 4000 kJ

**Landfill:** $12 liners×\frac{50 kJ}{1 liner}= 600 kJ$ $12 liners×\frac{1.5 g CO\_{2e}}{1 liner}=18 g CO\_{2e}$

**Compost:** $12 liners×\frac{50 kJ}{1 liner}= 600 kJ$ $12 liners×\frac{-4 g CO\_{2e}}{1 liner}=-48 g CO\_{2e}$