Group member names: _____ Date: _____

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 CO_{2e}
Milk	120	ml	600	kJ	144	g CO_{2e}
Butter	120	ml	3960	kJ	480	g CO_{2e}
Vanilla	2.5	ml	10	kJ	10	g CO_{2e}
		TOTAL	**8,570**	**kJ**	**1,234**	**g CO_{2e}**

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: $2\ eggs\ \times \frac{2000\ kJ}{1\ egg} = 4000\ kJ$ $2\ eggs\ \times \frac{300\ g\ CO_{2e}}{1\ egg} = 600\ g\ CO_{2e}$

Milk: $120\ ml\ \times \frac{50\ kJ}{10\ ml} = 600\ kJ$ $120\ ml\ \times \frac{12\ g\ CO_{2e}}{10\ ml} = 144\ g\ CO_{2e}$

Butter: $120\ ml\ \times \frac{330\ kJ}{10\ ml} = 3960\ kJ$ $120\ ml\ \times \frac{40\ g\ CO_{2e}}{10\ ml} = 480\ g\ CO_{2e}$

Vanilla: $2.5\ ml\ \times \frac{4\ kJ}{1\ ml} = 10\ kJ$ $2.5\ ml\ \times \frac{4\ g\ CO_{2e}}{10\ ml} = 10\ g\ CO_{2e}$

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

Total emissions: 600 g CO_{2e} + 144 g CO_{2e} + 480 g CO_{2e} + 10 g CO_{2e} = 1,234 g CO_{2e}

Group member names: _____ Date: _____

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 CO_{2e}
Sugar	230	g	2300	kJ	207	g CO_{2e}
Baking powder	6	g	45	kJ	4.5	g CO_{2e}
		Total	**2,576**	**kJ**	**442.5**	**g CO_{2e}**

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: $210 \; g \times \frac{11 \; kJ}{10 \; g} = \; 231 \; kJ$ $210 \; g \; \times \frac{11 \; g \; CO_{2e}}{10 \; g} = 231 \; g \; CO_{2e}$

Sugar: $230 \; g \; \times \frac{100 \; kJ}{10 \; g} = 2300 \; kJ$ $230 \; g \times \frac{9 \; g \; CO_{2e}}{10 \; g} = \; 207 \; g \; CO_{2e}$

Baking powder: $6 \; g \times \frac{7.5 \; kJ}{1 \; g} = \; 45 \; kJ$ $6 \; g \times \frac{0.75 \; g \; CO_{2e}}{1 \; g} = 45 \; g \; CO_{2e}$

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

Total emissions: 231 g CO_{2e} + 207 g CO_{2e} + 4.5 g CO_{2e} = 442.5 g CO_{2e}

Group member names: _____ Date: _____

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 CO$_{2e}$
Metal cupcake tray	1	tray	2600	kJ	2200	g CO$_{2e}$
Metal mixing bowl	1	bowl	1100	kJ	1000	g CO$_{2e}$
		Total	3,940	kJ	3,212	g CO$_{2e}$

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: $12 \ liners \times \frac{20 \ kJ}{1 \ liner} = \ 240 \ kJ$ $12 \ liners \times \frac{1 \ g \ CO_{2e}}{1 \ liner} = 12 \ g \ CO_{2e}$

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

Total emissions: 12 g CO$_{2e}$ + 2200 g CO$_{2e}$ + 1000 g CO$_{2e}$ = 3212 g CO$_{2e}$

Group member names: _____ Date: _____

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 CO_{2e}

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: $20\ minutes \times \dfrac{7200\ kJ}{60\ minutes} = 2400\ kJ$ $20\ minutes \times \dfrac{1080\ g\ CO_{2e}}{60\ minutes} = 360\ g\ CO_{2e}$

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 CO_{2e}
Milk	5	ml	25	kJ	6	g CO_{2e}
Butter	240	ml	7920	kJ	960	g CO_{2e}
Vanilla	5	ml	20	kJ	20	g CO_{2e}
		Total	**15,965**	**kJ**	**1,706**	**g CO_{2e}**

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: $800 \ g \ \times \frac{100 \ kJ}{10 \ g} = 8000 \ kJ$ $800 \ g \times \frac{9 \ g \ CO_{2e}}{10 \ g} = 720 \ g \ CO_{2e}$

Milk: $5 \ ml \ \times \frac{50 \ kJ}{10 \ ml} = 25 \ kJ$ $5 \ ml \ \times \frac{12 \ g \ CO_{2e}}{10 \ ml} = 6 \ g \ CO_{2e}$

Butter: $240 \ ml \ \times \frac{330 \ kJ}{10 \ ml} = 7920 \ kJ$ $240 \ ml \ \times \frac{40 \ g \ CO_{2e}}{10 \ ml} = 960 \ g \ CO_{2e}$

Vanilla: $5 \ ml \ \times \frac{4 \ kJ}{1 \ ml} = 20 \ kJ$ $5 \ ml \ \times \frac{4 \ g \ CO_{2e}}{10 \ ml} = 20 \ g \ CO_{2e}$

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

Total emissions: 720 g CO_{2e} + 6 g CO_{2e} + 960 g CO_{2e} + 20 g CO_{2e} = 1706 g CO_{2e}

Group member names: _____ Date: _____

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 CO_{2e}
Compost paper liner	12	liner	600	kJ	-48	g CO_{2e}

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: $12 \; liners \times \dfrac{50 \; kJ}{1 \; liner} = \; 600 \; kJ$ $12 \; liners \times \dfrac{1.5 \; g \; CO_{2e}}{1 \; liner} = 18 \; g \; CO_{2e}$

Compost: $12 \; liners \times \dfrac{50 \; kJ}{1 \; liner} = \; 600 \; kJ$ $12 \; liners \times \dfrac{-4 \; g \; CO_{2e}}{1 \; liner} = -48 \; g \; CO_{2e}$