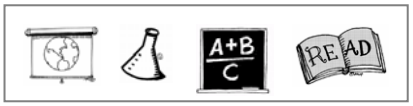


S - Selecting for Sustainability

Background: After completing the production and packaging of your crayons in the previous activities, it is now time to rate your product using the Principles of Green Chemistry. You will determine this rating by using the Selecting for Sustainability Decision Grid Rating Sheet. The criteria that you will use to make your ratings have been predetermined and are related to the concepts associated with the 12 principles of Green Chemistry.

Goal: The students will determine the sustainability of their product in relation to the 12 Principles of Green Chemistry.

Objectives: Students will…

- Rate their products by using green chemistry criteria.
- Plot their rating on a sustainability grid.

Materials (for a class of 32):

- 32 copies of Selecting for Sustainability Student Sheet
- 32 copies of Selecting for Sustainability Decision Grid Rating Sheet
- 32 copies of Selecting for Sustainability Judge's Score Sheet
- Data from previous activities on product testing/design
- Any information gathered from other resource materials (Internet, etc.)
- Rulers
- Colored makers or pencils

Time Required: 45–60 minute class period

Standards Met: C5, E1, E2, E3, E4, E5, E7, E19, G5, S1, S2, S7, M1, M3, M6, M8, M11, M13, M14, LA3, LA7, LA8

Green Chemistry Principles Addressed: 1–12

Procedure:

IN CLASS

- Place the students into their company groups.
- Have each company get out all of the information that they have compiled about their products.
- Allow each company to read over the criteria that are given for each of the "three Es" of sustainability.
- Explain to them that these criteria are based on the 12 Principles of Green Chemistry.
- Have each company decide a rating for each of the three criterion in all "three E" categories, supporting this rating with information or data gathered from their activities or other outside resources.
- Have each company determine an average for each "E" category.
- Tell the students that they should fill in (color) their Sustainability Grids on their Selecting for Sustainability Student Sheet using these averages.

- Using the rulers provided, have each student calculate the area (Area=1/2 base x height) that has been filled in on the grid. This is the Sustainability Factor of their product.
- Each company should appoint a spokesperson (captain) to report the results from their Sustainability Grid to the other companies in the class. Allow some time for questions from the other companies.

Follow-Up:

- Students may want to experiment with other options at home to see if they can improve their product.

Assessment:

- Completion of the Selecting for Sustainability Decision Grid Rating Sheet
- Calculation of the Sustainability Factor of their product
- Reporting their results

Selecting for Sustainability Student Sheet

Name: _____ Date: _____

Directions: Complete the tables and Sustainability Grid for the product your company has created. Make sure that you give supporting data (from previous activities or your research) for each of your ratings.

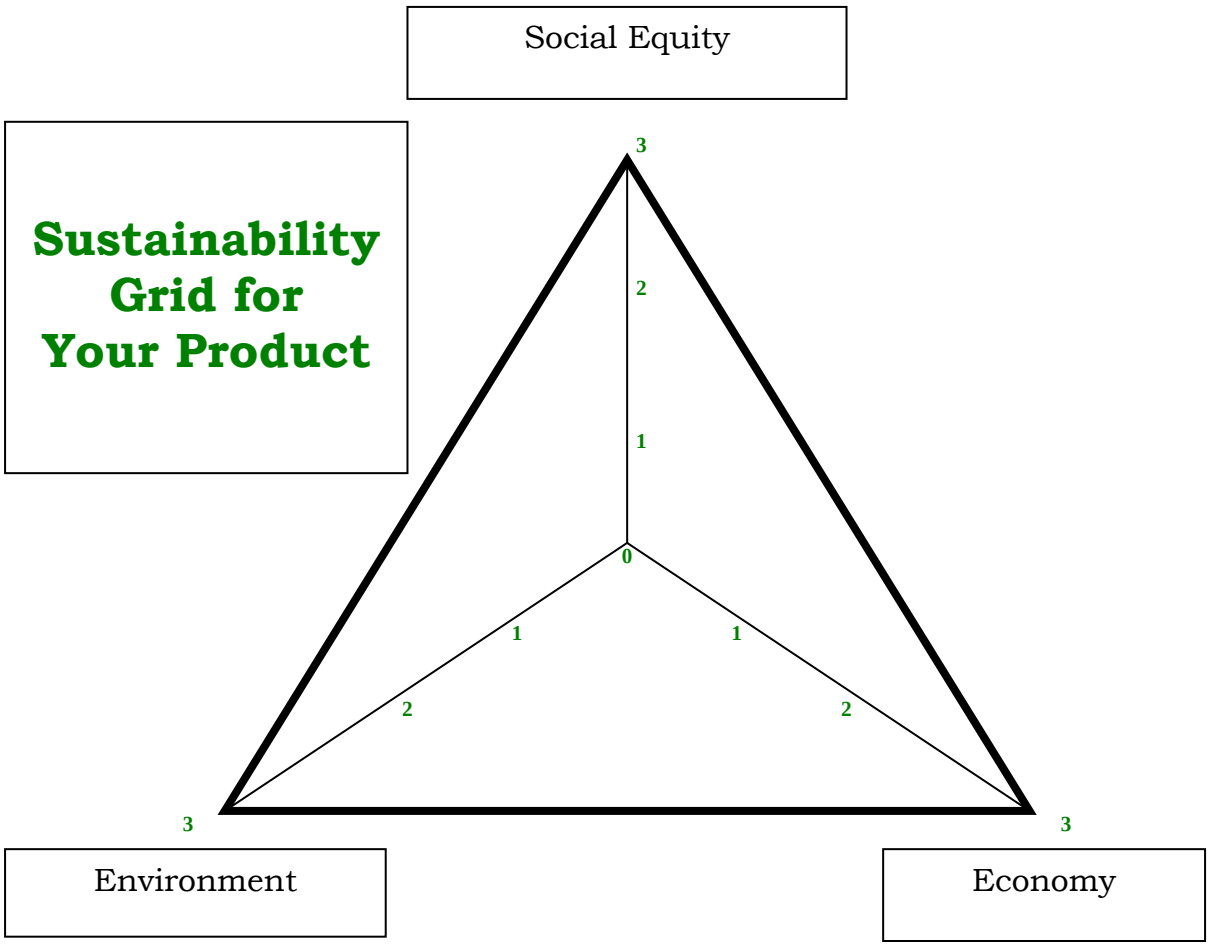
Rating Scale:

3 – Meets all or nearly all of the criterion
2 – Meets most of the criterion
1 – Meets some of the criterion
0 – Meets none or almost none of the criterion

Selecting for Sustainability
Decision Grid Rating Sheet

Social Impact	**Supporting Data**	**Ratings**
Maintains efficacy (maximizes product's performance)		
Minimizes negative effects on health (limits production or use of toxic and/or hazardous materials)		
Strives for safety (monitors each step in production process focusing on the elimination of potentially dangerous reactions or exposures)		
Average		
Environmental Impact	**Supporting Data**	**Ratings**
Minimizes the production of wastes		
Promotes the use of renewable resources		
Aims to produce a product that, at the end of its function, breaks down into innocuous degradation products		
Average		
Economic Impact	**Supporting Data**	**Ratings**
Minimizes energy requirements		

Aims to minimize the steps and time of production through use of catalysts		
Strives to maximize the incorporation of all materials used in the production process into the final product (atom economy)		
Average		



Selecting for Sustainability
Judges Score Sheet

Directions: Please check the boxes below that apply to this company's crayons, and add the rating scores to find their total score.

Company Name: _____

Group Average Company Total Score: _____

3 P O I N T S E A C H	☐ Made large reduction in waste ☐ Received a 0 for EPA Threshold Limit Value Rating ☐ Used no paraffin to make crayons ☐ A small child could eat an entire box of crayons and never get sick ☐ Received a 1–2 transferability rating ☐ Least-expensive crayon in the room ☐ Crayons are easy to grasp and ergonomically pleasing ☐ Crayons write smoothly and do not crumble ☐ Outstanding color options in the package ☐ Packaging and crayon are exceptionally aesthetically pleasing ☐ Received a safety rating of 1–2
2 P O I N T S E A C H	☐ Made some reduction in waste ☐ Received a 1 for EPA Threshold Limit Value Rating ☐ Used combination of paraffin and soy to make crayons ☐ A small child could eat an entire box of crayons and just be slightly ill ☐ Received a 3–5 transferability rating ☐ Moderately priced compared to the other crayons in the room ☐ Crayons are somewhat easy to grasp and ergonomically pleasing ☐ Crayons fragment somewhat, but still produce a pleasing line ☐ Moderate color options in the package ☐ Packaging and crayon are somewhat aesthetically pleasing ☐ Received a safety rating of 3–5
1 P O I N T E A C H	☐ Made no reduction in waste ☐ Received more than 1 for EPA Threshold Limit Value Rating ☐ Used only paraffin to make crayons ☐ If a small child ate any crayons, he or she would have to be rushed to the emergency room ☐ Received a transferability rating of greater than 5 ☐ Most-expensive crayons in the room ☐ Crayons are difficult to grasp and not ergonomically pleasing ☐ Crayons crumble and produce a sloppy line ☐ Poor color options in the package ☐ Packaging and crayon are not aesthetically pleasing ☐ Received a safety rating of greater than 5

To determine your average score, please complete the following steps:

1. List the number of 3s, 2s, and 1s you got. (Each time you checked a box in the 3 category, write a 3 down in your list, etc.)
2. Add all of the numbers in your list (you should have twelve numbers).
3. Divide your total number by 12.

What's your score? Circle your score below.

1.0 – 1.6 = Poor adherence to the Principles of Green Chemistry
1.7 – 2.3 = Good adherence to the Principles of Green Chemistry
2.3 – 3.0 = Excellent adherence to the Principles of Green Chemistry