



SS - And the Award Goes To...

Background: The Presidential Green Chemistry Challenge Awards are given every year to people, companies, and institutions of higher learning who innovate using green chemistry methods. Go to <http://www.epa.gov/greenchemistry/presgcc.html> for more information regarding these awards. This lesson plan is designed to alert students to the way that people who work in the sciences are using the 12 Principles of Green Chemistry to invent new products and to make already existing products better.

Goal: Students will learn about different green chemistry technologies.

Objectives: Students will...

- Learn about different green chemistry technologies.
- Work in teams.
- Determine how products can be made better by using the 12 Principles of Green Chemistry.

Materials (for a class of 32):

- 3 fly swatters
- Copies of the game answers (included in lesson materials)

Time Required: 45–60 minute class period

Standards Met: LA3, LA4, LA5, LA6

Green Chemistry Principles Addressed: 1–12

Procedure:

PREP

- Make two copies of each of the game answer sheets.
- The 'game board' should be displayed on the wall so students can see it from a distance away.

IN CLASS

- Have three students come to the front of the room and give each of them a fly swatter.
- Have them face so that their backs are towards the game board.
- Explain to students that they will be hearing a problem that has been solved through the use of one the Principles of Green Chemistry.
- The solution to the problem is indicated on two of the answer sheets on the game board behind them.
- Explain to the students that after reading the problem you will tell them by saying "go" to turn around and, as quickly as possible, swat the solution to the problem. Indicate to them that there are only two solutions to the problem and that one student will be eliminated from the competition each time.

- Students will remain in the game as long as they are one of the two students to swat the solution.
- The winning student will be the one that participates in the most rounds.
- Tell the students that these are all examples of technologies developed by companies who have won green chemistry awards.
- Read the problems from the And the Award Goes To... Problem/Statement Teacher Sheet

Assessment:

- Participation in the activity



And the Award Goes To... Problem/Statement Teacher Sheet

1. **PROBLEM: Many labels on glass bottles use a direct ink transfer process that includes the use of heavy metals such as lead, cadmium, and chromium, which stay in the environment after they are discarded.**

ANSWER: A direct silk screen process that uses radiation curable ink and exposure to UV light is being used to stick environmentally friendly ink onto glass containers.

2. **PROBLEM: Sticky substances produce spots and holes in paper when we try to recycle them, making the product of poor quality.**

ANSWER: A new enzyme makes it possible to recycle paper that has substances on it and allows the process to be more efficient while maintaining the quality of the product.

3. **PROBLEM: People control the spread of termites around buildings by surrounding them with insecticide that is potentially bad for the environment.**

ANSWER: A solution that attracts the termites is now used in a much smaller area when the bugs are gathered, and the insecticides can be used in much smaller quantities and areas.

4. **PROBLEM: The cleaning agent in certain shampoos that helps the water to blend with it is not totally biodegradable.**

Answer: An ingredient has been developed that is biodegradable and still cleans hair well and mixes well with water.

5. **PROBLEM: Farmers need to grow as many crops as they can while not losing what they have grown to pests, disease, and weather. In the past they have only had the option to use chemicals that can change the plant and can hurt animal and human life.**

Answer: A naturally-occurring protein has been developed that triggers a plant's natural defense system and stimulates plant growth without being harmful.

6. **PROBLEM: The value of crops destroyed by insects exceeds 10s of billions of dollars each year.**

Answers: A new biodegradable insecticide has been developed that disrupts the insects' growing process, causing them to stop feeding and therefore to die.

- 7. PROBLEM: Many synthetic fibers in clothes are petroleum-based and therefore non-renewable.**

ANSWER: A material made from resources that is annually renewable can be used to create a fabric that is just as good and that can be easily recycled and composted.

- 8. PROBLEM: The standard process for developing photographic films involved the use of several chemicals that are toxic to the environment.**

ANSWER: A heat-sensitive film that can be activated by a laser involves the use of no toxic chemistry.

- 9. PROBLEM: Anti-inflammatory pain killers such as ibuprofen typically create 60% waste from all the ingredients used to produce them.**

ANSWER: A pain killer can now be made by the use of a catalyst that produces only 20% of waste from its ingredients.

- 10. PROBLEM: Production of the anti-depression drug Zoloft® involved a three-step process that used excessive amounts of solvents and raw materials.**

ANSWER: A new, single-step process in the production of a drug which helps people feel better has eliminated waste, reduced the use of solvents, and maximized the use of key chemicals.

A direct silk screen process that uses radiation curable ink and exposure to UV light is being used to stick environmentally friendly ink onto glass containers.

A new enzyme makes it possible to recycle paper that has substances on it and allows the process to be more efficient while maintaining the quality of the product.

A solution that attracts the termites is now used in a much smaller area when the bugs are gathered, and the insecticides can be used in much smaller quantities and areas.

An ingredient has been developed that is biodegradable and still cleans hair well and mixes well with water.

A naturally-occurring protein
has been developed that
triggers a plant's natural
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A new biodegradable insecticide has been developed that disrupts the insects' growing process, causing them to stop feeding and therefore to die.

A material made from resources that is annually renewable can be used to create a fabric that is just as good and that can be easily recycled and composted.

A heat-sensitive film that can be activated by a laser involves the use of no toxic chemistry.

A pain killer can now be made
by the use of a catalyst that
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A new, single-step process in the production of a drug which helps people feel better has eliminated waste, reduced the use of solvents, and maximized the use of key chemicals.