**Part 1** of the project introduces students to the 12 Principles of Green Chemistry and to the concept of lifecycle analysis. It is divided into two lessons and will take between 12 and 14 days. After completing introductory activities and researching the lilfecycle of a product/artifact of their choice, students will present their own findings and connect the lifecycle of their chosen artifact to the 12 Principles of Green Chemistry. The lesson is written so that the final product is a poster presentation; however, you might consider alternative methods to present to the greater community – for example, a public service announcement, a science fair-style presentation with poster boards, etc.

**Teacher Information/Extra Resources:**

* Beyond Benign website: <https://www.beyondbenign.org/lessons/lifecycle-sustainability-analysis/>
* William McDonough Cradle to Cradle Design TED Talk <https://www.ted.com/talks/william_mcdonough_on_cradle_to_cradle_design>

**\*This lesson has been written with activities itemized by in-class days; however, the teacher may choose to assign some of the activities to be conducted at home.**

**Lesson 1: Introduction to Green Chemistry**

**Day 1**: Use the BLOSSOMS Green Chemistry video and suggested activities within the video. After completing the video, ask students to brainstorm properties of glue to test homemade glue vs. a store-bought glue. Properties of glue could include, but are not limited to, viscosity, spreadability, and stickiness. Then students will conduct their glue tests.

**Day 2-3:** Begin the lesson by having students complete their glue tests and record observations. Then students will complete the 12 Principles Match-Up activity (see document 3, which includes teacher notes and answer key). After completing the match-up activity, students will have scaffolded a better understanding of the 12 Principles. Have them go back and think about the two versions of glue they tested and analyze them based on the 12 Principles. For example, after doing the glue tests, students might realize that even though the homemade glue was greener in many respects, it might not have met principle 4 (designing safer chemicals) if it was not as effective as the store-bought glue.

Optional intermediate activity: If you would like to give your students more time to generate ideas about the sources and impact of consumer waste, you could show the document 12 slides to help students imagine the problems with those materials (perhaps even utilizing a [jigsaw](https://www.cultofpedagogy.com/jigsaw-teaching-strategy/) method to have student groups take on a single material to analyze--or even to break down what materials are involved in a single product). This, then, could inform the Principles of Green Chemistry in a way that would give immediacy and concreteness to the concepts as students are exposed to the formal/official language. To the same end, this kind of approach could inform the process of students choosing products for their analysis/experimentation.

**Lesson 2: Introduction to and Applications of Lifecycle Analysis**

**Day 4:** Engage students by prompting them to think about the ethical issues surrounding pollution. Use the 60 Minutes video clip on “Wisdom” the bird:

<https://www.youtube.com/watch?v=02RyxA1mC5s>

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Ask students to create a list of questions as they watch the clip. Have students get into pairs or small groups to share their list of questions (for several minutes). Show the Intro to Lifecycle Analysis slideshow. The slideshow includes teacher notes and suggestions for transitions between slides. Please note that teachers should be careful explaining the difference between closed and open loop lifecycles, as students often confuse recycling a product with closing the loop. Recycling does not mean that the product has a closed loop lifecycle UNLESS it becomes the exact same thing again. Also, note that the optional Part 2 of the project includes a review of the lifecycles of polystyrene and Ecovative that are described in the slideshow. If you are not planning to do part 2, it is suggested that you show students the TED talk by Eben Bayer, founder of Ecovative, that is found in the part 2 lesson plan.

**Day 5**: Students will select a commercial product to research (see document 5, which includes project instructions, final product requirements, and teacher notes). Once again, be sure that students do not confuse recycling with a closed loop lifecycle. Students should submit their ideas to the teacher, who will either approve the idea or ask the student to choose a different product/artifact to resubmit. For example, you may want each student or pair to research a unique artifact, so any duplicates would have to be resubmitted.

**Day 6-8:** Students will research their chosen product/artifact and take notes in their journal. The journal may be typed or handwritten at the teacher’s discretion, but regardless of format, students must record all the information they think they will need for their final products. Depending on the age and level of your students, you may want to allocate fewer or more than three days for research. At the conclusion of the research phase, students should turn in their journals to demonstrate the completion of their research.

**Expectations for journal assessment:**

* + - Include the date for each day of research
    - Include either printed journal articles used during the research or a summary of articles
    - Works Cited
    - All questions from the project assignment handout should be addressed completely

**Day 9**: Students will prepare a draft of their poster or alternative final product. As they are planning their final product, make sure they are following the format described on the poster instructions handout. Students should turn in their draft at the end of the day.

**Day 10-11**: Students will put together their posters or final alternative product. Remind them that they also need to attach a properly-formatted works cited page for the sources they accessed (this may be glued to the back of the poster).

**Day 12-14:** Students will present their findings and evaluate others’ work. Teachers may choose to require formal presentations, in which each student/group presents their poster or final alternative product to the whole class while their classmates fill out the evaluation forms. This technique will likely take two-three days, depending on the size of the class. Another technique that works well is to do a poster session, in which students set up their posters around the classroom or a larger space (library, gym, etc). During the poster session, individual students/groups are interviewed by the teacher, and each student is responsible for completing the evaluation forms by the end of class, as handling the presentations this way should only take one day.

* + - Expectations for poster/presentations
    - All questions on poster assignment have been addressed completely and poster follows format described on poster assignment handout
    - Presentation techniques are appropriate for student age, i.e. Professional dress, speaking clearly, no gum chewing, able to answer questions about the project, etc.

**Options for additional people to invite to the presentations:**

* + - Other classes
    - Parents
    - Outside community groups