

Sustainable Starters

Outreach Activity

Overview: Invite participants to begin thinking about where materials come from through an interactive activity during which participants match technologies with the bio-based starting materials from which they are made.

Goal: By thinking about where do materials come from, participants begin to think “Where could materials come from?”

ChemAttitudes Public Learning Outcomes:

- Increased interest in the field of green chemistry/chemistry
- increased understanding of the relevance of green chemistry/chemistry to their lives

ChemAttitudes Activity Format & Structure

- Interactive
- Simple to do and easy to understand
- Evoke familiar experiences

ChemAttitudes Chemistry Content

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|--|--|
| Chemistry concept | introduction to green chemistry; introduction to chemistry of materials/plastics |
| Connection to everyday life | chemistry of everyday objects |
| Applications and uses of green chemistry/chemistry | making sustainable products and technologies |
| Connections across other STEM topics | life science/earth science - minimizing human impact on the environment; materials science |
| Connections to societal issues | use of renewable vs non-renewable resources |

Invention Education Framework Tenets

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|-------------------------------|--|
| Context | 1c. Age Appropriate and Culturally Competent Application 1e. Larger Educational Ecosystem Context |
| Empathy | 2c. Statement of Work Across Disciplinary Boundaries 2d. Selected Approach(es) to Real World Problem Identification |
| Problem Solving | 3a. Problem Solving 3f. Intellectual Tools and Approaches |
| Continuous Learning | 4d. Self Directed Learning Experiences |
| Iteration | 5f. Celebration of Historical and Modern Inventors |
| Sustainable Innovation | 6c. Understanding Environmental Impact and Planning for Sustainability |

Introduce Activity

ChemAttitudes Facilitation Techniques – Invite Participation by:

- Starting with basics
 - Engaging the whole group
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- Invite participants to look at the space around them and ask, “What are most of the materials around you made from?”
 - Answers will likely include wood and metal (furniture, doors, etc), paper (books, notebooks, etc), plastic (tech devices, most fabrics, school supplies/writing tools, etc)
 - Remark on the importance of plastics in each of our lives and the diversity of plastic products
 - *Optional* – Have participants compare and contrast some of the properties of the plastic materials directly around them/in front of them

ChemAttitudes Facilitation Techniques – Support Exploration by:

- Being flexible and attentive
 - Asking guiding questions
 - Being a good listener
 - Offering positive feedback
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- Ask “What are plastics made from?” and allow students to brainstorm/share/discuss
 - *Optional* - For higher-level groups, may also want to discuss what chemically makes something a plastic/polymer (i.e., long chains of smaller molecules bonded together in a repeating pattern)
 - Guide participants to the concept that most plastics are made from non-renewable materials (like petroleum/fossil fuels)
 - *Optional* - If time there is time, invite student feedback as to why this might be problematic for society in the long-term
 - Introduce concept of green chemistry
 - *Optional* - If there is time, invite participants to share what they think green chemistry is before defining green chemistry for the group
 - Use a definition of green chemistry that makes the most sense for the group
 - EPA definition: Green chemistry is the design of chemical products and processes that reduce and/or eliminate the generation of hazardous substances.
 - Other ways to describe: “pollution prevention at the molecular level,” “designing materials in a way that prevents them from causing harm to people and the environment”
 - Explain that one of the Principles of Green Chemistry encourages scientists to use *renewable feedstocks*, or renewable starting materials. An entire field of chemistry is devoted to *bioplastics*, plastics made from renewable biomass (biomass = materials made from living things, like plants and algae)
 - *Optional* – Ask participants for examples of renewable materials or biomass
 - Tell participants that they’ll be looking at some examples more sustainable materials that scientists have made using renewable resources

Activity

- Activity found at: https://matchthememory.com/sustainable_starters
- Half of the cards show a technology/man-made material. The other half depict renewable resource that was used as a starting material. Match the technology with the starting material from which it is made.
- Each time a correct match is made, there will be a short blurb on the technology and links to videos or articles about the materials.
- There are no limits to the number of times cards may be flipped.

ChemAttitudes Facilitation Techniques – Deepen Understanding by:

- Asking discussion questions
 - Making connections
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- Debrief together once all participants have completed the activity
 - What was surprising to you?
 - What was interesting to you?
 - Which, if any, were you familiar with?
 - Which do you think you would be able to use?
 - What other types of bio-based materials do you know about/have you used?
 - Why might a bio-based material be more desirable/sustainable than one made from a non-renewable resource?

Matching Game Key

| Sustainable Starter | Product | Resources |
|--------------------------|------------------------------------|--|
| Tapioca starch | Biodegradable plastic bag | Read how tapioca is being used to make bags in Bali! |
| Virus | Environmentally friendly batteries | Viruses were able to be optimized and then used to grow environmentally friendly batteries. Learn more here |
| Mycelium | Faux-leather | Mycelium (root-like) structures in mushrooms are used form a leather replacement that can be used in various forms, such as in creating handbags. Learn more here |
| Sugar cane | LEGOs | By 2030, Lego has pledged to make its blocks out of sugarcane as a naturally sourced bio material! Watch Here! |
| Crustacean shells | Self-fertilizing plots | Shellworks is creating planters, along with all sorts of things from crustacean Shells. See their process here! |
| Seaweed | Edible straws | Loliwear creates products are both biodegradable and edible, including both cups and straws! Watch here about their edible cups |