

Who Says So? A Jigsaw on Sources, Origins and Impacts of Four Materials

Learning target: I can work with a team to gather information from several sources about where a synthetic material comes from and how it affects people and the environment, judge which sources are credible and which claims are supported, and defend our ratings.

Collaborative investigation

About 50 min

Jigsaw

MS-PS1-3 · assesses

collaboration

reading

discussion

Name _____

Date _____

Period _____

Directions

Work in home groups of four. Step 1 (expert round, 12 minutes): each member takes one expert set of three cards (Set A: cards 1-3, polyester; Set B: cards 4-6, corn ethanol; Set C: cards 7-9, sucralose; Set D: cards 10-12, PLA). Read your cards, then meet with the other students holding the same set and agree on three things: the natural resource and chemical process behind your material, one benefit and one cost, and which of your three cards is most and least credible and why. Step 2 (home round, 20 minutes): return to your home group, teach your material in two minutes, and complete the group record together. Step 3 (defense, 8 minutes): present your least-credible ratings to a neighboring group, who will challenge one. Step 4 (individual, 10 minutes): answer Part C alone.

You will need: Twelve cards per group, cut from the card sheet, Group record table, Pencils

Twelve source cards (sources labeled 'fictional' were written for this activity; all other cards state documented facts)

1 Card 1 (Set A): Encyclopedia entry, 'Polyester'

Polyester fabric is made from PET, a polymer first produced in England in 1941. Two small molecules obtained from petroleum are reacted and joined into long chains, which are melted and drawn into fibers. Polyester resists wrinkles and absorbs little water, so it dries quickly. It is the most widely produced clothing fiber in the world. Like other petroleum-based plastics it does not rot, and washing it releases tiny fibers into wastewater. Written by staff editors; sources listed at the end of the entry.

2 Card 2 (Set A): Clothing company web page (fictional)

EcoSoft Performance Tees are made of pure polyester, so no trees, no cotton fields and no animals are touched. That makes them the natural choice for the planet. Our fabric is engineered in a lab from scratch, with no raw materials wasted. Feels like nothing, lasts forever. Buy three, get one free.

3 Card 3 (Set A): Government agency report on waste

In 2018, about 17 million tons of textiles (clothing, sheets, towels, carpet) were thrown away in the United States. About 15 percent was collected for recycling; roughly 11 million tons went to landfills. Synthetic fibers such as polyester and nylon do not break down in a landfill on any useful timescale. The agency publishes these figures every few years and explains how it measured them.

4 Card 4 (Set B): Energy agency explainer, 'Ethanol'

Fuel ethanol in the United States is made mostly from corn. The starch in the kernels is broken into glucose, yeast ferment the glucose into ethanol and carbon dioxide, and the ethanol is distilled off and blended into gasoline. Nearly all gasoline sold in the country contains up to 10 percent ethanol (E10). A liter of ethanol carries about two thirds of the energy of a liter of gasoline. The leftover grain from ethanol plants is sold as livestock feed. Data tables and methods are posted with the explainer.

5 Card 5 (Set B): Fuel company billboard (fictional)

CORN POWER. 100 percent renewable. Zero pollution. Grown right here, so it never runs out and never hurts anyone. Fill up with Corn Power and drive clean, forever.

6 Card 6 (Set B): Agricultural economics summary of two studies

A 1995 federal agriculture study estimated that corn ethanol returned about 1.24 units of energy for every unit of fossil energy used to grow the corn and run the plant, and that the balance had recently turned positive. A 2016 university analysis found that the net energy gain had grown substantially by 2008 as farming and distilling became more efficient. Critics point out that corn for fuel uses farmland, fertilizer and water, and competes with corn for food and feed. The summary names both studies and says the result depends on the methods used.

7 Card 7 (Set C): Food regulator fact sheet, 'High-intensity sweeteners'

Sucralose was approved for use in food in 1998 after the agency reviewed more than 100 safety studies. It is made from sugar (sucrose) by a chemical process that replaces three oxygen-hydrogen groups with chlorine atoms. It is about 600 times sweeter than sugar, is not digested for energy, and generally does not raise blood sugar. The sheet lists the approved sweeteners and the year each was approved.

8 Card 8 (Set C): Social media post (fictional), 2,300 shares

WAKE UP. Sucralose is FAKE sugar made with CHLORINE, the same stuff they put in swimming pools. You are basically eating bleach. Natural sugar never hurt anybody. Share before they delete this!!!

9 Card 9 (Set C): History of science article

Saccharin, the first synthetic sweetener, was discovered in 1879 by a chemist working at a university laboratory in Baltimore. It became widely used during the First World War, when sugar was scarce and rationed and many people switched to saccharin; when sugar supplies returned after 1918, most people went back to sugar. Table salt, sodium chloride, has contained chlorine atoms for as long as people have eaten it, and so has sucralose since 1976; a chlorine atom bonded inside a compound behaves nothing like chlorine gas. The article cites letters, patents and newspapers from the period.

10 Card 10 (Set D): University extension bulletin, 'Bioplastics'

PLA is made from corn starch: the starch is broken into glucose, microbes ferment the glucose into lactic acid, and the lactic acid units are joined into long chains. PLA readily breaks down only in a commercial composting facility that keeps it hot (about 58 °C), moist and aerated; the industrial standard is 90 percent of its carbon converted to carbon dioxide within 180 days. It does not biodegrade in a landfill, a backyard pile or the ocean, and it should not go in recycling bins because it contaminates PET. Bio-based plastics are not necessarily biodegradable, and some petroleum-based plastics are. Written by university faculty with a reference list.

11 Card 11 (Set D): Cup maker's flyer (fictional)

Planet-Perfect cups are made from plants, so they are 100 percent biodegradable. Toss them anywhere and they vanish in 30 days. Finally, a cup with zero environmental cost. Ask your school to switch today.

12 Card 12 (Set D): Government agency figures on plastic waste

In 2018 about 9 percent of the plastic waste generated in the United States was recycled; about 76 percent went to landfills and most of the rest was burned for energy. For PET bottles and jars alone the recycling rate was higher, about 29 percent. The agency notes that what is accepted for recycling varies by community, so an item marked recyclable is not always recycled. Tables and methods are published with the figures.

Part A: Expert round (one set per person)

1. Your expert set: _____. For each of your three cards, write who produced it, what they wanted from the reader (to inform, to sell, to persuade), and whether it gives evidence or a way to check its claims. Then rank your three cards from most to least credible.

Part B: Home group task

1. Each expert teaches the group their material in two minutes: the natural resource, the chemical process, one benefit for people, one cost to people or the environment, and the most and least credible card.
2. Fill one row of the group record for each material. Use only facts from credible cards; if a fact appears only on a fictional advertisement or post, do not record it as a fact.

- For each material, write the least credible card's number and the three signs that made you distrust it (for example: no author or evidence, trying to sell something, a claim that a credible card contradicts, vague words such as 'zero' or 'forever').
- Find one claim on an untrustworthy card that is nevertheless partly true, and one claim on a credible card that surprised you. Be ready to explain both.
- Prepare a one-minute defense of your least-credible ratings. Every member must be able to give it and to answer a challenge with a card number.

Group record (fill in)

Material	Natural resource	Chemical process (who or what does it)	One benefit	One cost	Most credible card and why	Least credible card and the three signs
Polyester						
Corn ethanol						
Sucralose						
PLA						

- Group answer: Which card does your group rate least credible of all twelve, and what three signs told you? Which claim on that card is nevertheless partly true?

- Group answer: Write the strongest challenge the neighboring group made to one of your ratings, and how you answered it using a card number.

Part C: Individual accountability (complete alone)

- Choose a material you were NOT the expert on. Trace it from natural resource to product, naming the chemical process, and name the card you learned it from.

5. Card 8 says sucralose contains chlorine 'the same stuff they put in swimming pools.' Using Card 7 and Card 9, explain what is true in that sentence and what is wrong with the conclusion drawn from it.

6. Card 6 reports two studies that reached different numbers about ethanol's energy balance. Does disagreement between studies make the card less credible or more credible? Explain, and say what a reader should conclude from the card.

7. Write a four-line checklist your group could use on any new source about a material. Each line must be a question with a yes-or-no answer. Then apply your checklist to Card 11 and to Card 10 and show the results.

Three questions for any source

If credibility feels like a guess, ask three questions of each card: Who made it, and do they say? What do they gain if you believe it? Can you check it, because it gives numbers, methods, dates or references? A card with a named maker, nothing to sell and a way to check is usually credible; a card with no maker, something to sell and only big words usually is not. Being credible is not the same as being right, and a seller can say true things; that is why the group record asks for the partly true claim too.

The thirteenth card

Write a thirteenth card about a material of your choice from the chapter (paclitaxel, synthetic rubber, Blue No. 1, nylon) in the voice of a credible source: name the producer, give at least two checkable facts that are actually true (verify them in the chapter or a reference), and include one honest cost. Then write a fourteenth card in the voice of a seller that uses only true statements but still leaves a misleading impression. Trade with a partner and see whether they can tell which is which and explain how the honest-but-misleading card works.