

## Unit 5 - Synthetic Materials

Target 1: I can explain what a synthetic material is and where it comes from.

### Natural Materials

A material that is found in nature  
(without having been altered  
chemically by humans.)

#### EXAMPLES:

1. Water
2. Wood
3. Rock
4. Petroleum
5. Air/Wind
6. Plants
7. Animals
8. Cotton
9. Copper
10. Coal

### Synthetic Materials

A material made by using chemical  
processes to alter natural resources.

#### EXAMPLES:

1. Plastic Bag
2. Kevlar
3. Velour
4. Nylon
5. Acrylic
6. Stainless Steel
7. Artificial Turf
8. Vinyl
9. Artificial Leather
10. Disposable Diapers

**BOTH natural and synthetic materials originally come from natural resources.**

**Target 1: I can explain what a synthetic material is and where it comes from.**

**Synthesis:** Production of chemical compounds by reaction from simpler materials.

**Synthesize:** To make; (especially chemically)

Natural Synthesis	Synthesized Material
<p>*Some synthesis happens naturally</p> <p>*Example: Photosynthesis</p> <p>Description: Process by which plants use energy from the sun to make sugar from carbon dioxide and water</p>	<p>*Synthetic materials are made by humans using chemical processes to create new materials</p> <p>*Example: Making Resin</p> <p>Description: Powders are loaded into a machine, heated and then subjected to one or more chemical processes to make a type of plastic called resin.</p>

Target 2: I can give examples of chemical processes that are used to make synthetic materials.

### Creating Synthetic Materials

- There are **MANY** different and complicated processes used to make synthetic materials
- When people create synthetic materials, one or more chemical processes are used. These processes involve the breaking of existing bonds and the formation of new ones.
- Many synthetic materials are made from synthesized polymers. This is where small molecules of raw materials are polymerized into long, linear chains.

### EXAMPLES:

1. Nylon: Petroleum is processed through a series of chemical reactions that extract what is needed from the petroleum and then create polymers that are made into nylon.

#### More Detailed Description of How Nylon is Made

Nylon is made when the appropriate monomers (the chemical building blocks which make up polymers) are combined to form a long chain via a condensation polymerisation reaction.

The monomers for nylon 6-6 are adipic acid and hexamethylene diamine. The two molecules are combined to create the polymer and water (H<sub>2</sub>O) is produced as a by-product.

The water is removed from the production process as its continued presence stops the creation of more polymer.

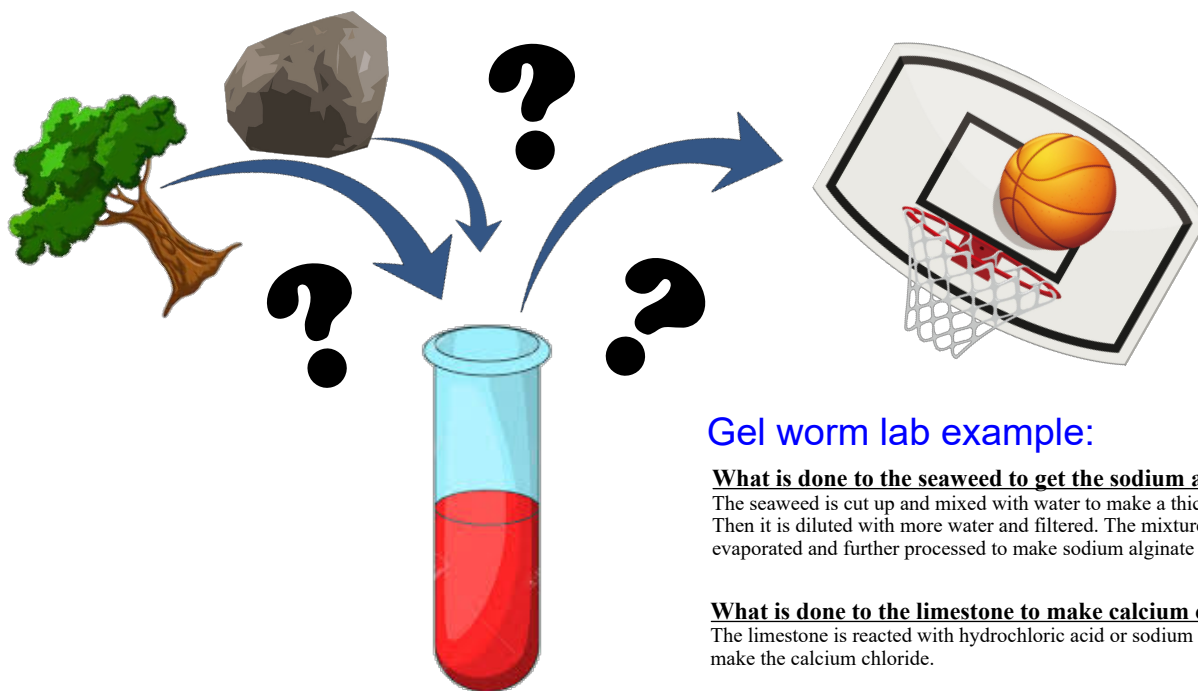
The polymer chain can be made up of over 20,000 monomer units, connected together via an amide group, which contains a nitrogen atom.

2. Cardboard is made by first making kraft paper by 'pulping' woodchips into a strong paper that resists tearing, splitting and bursting. This material is then subjected to a number of chemicals plus processes that include heating, gluing and pressing.

#### More Detailed Description of How Carboard is Made

- > 1 Manufacturing a corrugated cardboard box begins with the pulping of wood chips in the kraft (sulfate) process. First, tree trunks are stripped of bark and torn into small chips. Next, these chips are placed in a large, high-pressure tank called a batch digester, where they are cooked in a solution, or liquor, made of sodium hydroxide (NaOH) and several other ionic compounds such as sulfates, sulfides, and sulfites. These strongly alkaline chemicals dissolve the lignin, the glue-like substance that holds the individual wood fibers together in a tree trunk.
- > 2 When the pressure is released after several hours, the wood chips explode like popcorn into fluffy masses of fiber.
- > 3 After additional cleaning and refining steps, a consistent slurry of wood pulp is pumped to the paper-making machine, also known as a Fourdrinier machine. Gigantic, square structures up to 600 feet long, these machines contain a wire mesh in which the paper is initially formed. Next, the paper is fed into massive, steam-heated rollers and wide felt blankets that remove the water. At the end, the finished medium, or liner, is rolled for shipment.

**Target 2: I can give examples of chemical processes that are used to make synthetic materials.**



**Gel worm lab example:**

**What is done to the seaweed to get the sodium alginate?**

The seaweed is cut up and mixed with water to make a thick gel. Then it is diluted with more water and filtered. The mixture is evaporated and further processed to make sodium alginate powder.

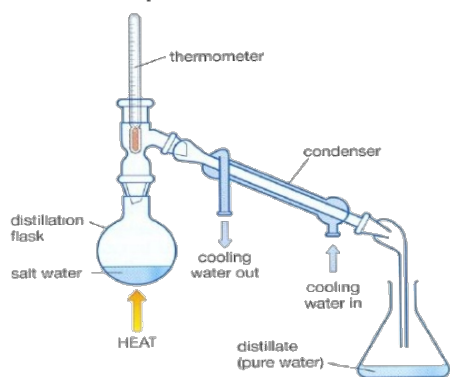
**What is done to the limestone to make calcium chloride?**

The limestone is reacted with hydrochloric acid or sodium chloride to make the calcium chloride.

Catalysts are very commonly used in reactions to make synthetic materials

**Often Physical Processes are used.**

**Simple Distillation**



Dissolving

Crystallization

Filtering

Pressurizing

Target 3: I can evaluate the impacts, both negative and positive, that synthetic materials have on society.

Synthetic Materials: Some Examples of Impacts on Society

\*There are MANY, MANY synthetic materials. Each has different positive and negative impacts on society.

Although some of the following examples only have one positive or one negative impact on society listed, there are probably several that we could list for each product.

Synthetic Product	One Positive Impact	One Negative Impact
Disposable Diapers	<ul style="list-style-type: none"> <li>• Convenience!</li> </ul>	<ul style="list-style-type: none"> <li>• Cause pollution</li> </ul>
Artificial Sweeteners	<ul style="list-style-type: none"> <li>• Cut down on your calorie intake</li> </ul>	<ul style="list-style-type: none"> <li>• May cause issues to your health (such as cancer)</li> </ul>
Synthetic Fuels	<ul style="list-style-type: none"> <li>• Cut down on the use of fossil fuels</li> </ul>	<ul style="list-style-type: none"> <li>• Air pollution from conversion plants; possible water shortages in arid areas</li> </ul>
Kevlar	<ul style="list-style-type: none"> <li>• Extremely hard, durable; used to make sports equipment and bullet proof vests</li> </ul>	<ul style="list-style-type: none"> <li>• Will not decompose in landfills</li> </ul>
Polyester	<ul style="list-style-type: none"> <li>• lightweight; allows sweat to evaporate</li> </ul>	<ul style="list-style-type: none"> <li>• May irritate skin or cause allergies</li> </ul>

**Target 3: I can evaluate the impacts, both negative and positive, that synthetic materials have on society.**

Renewable and Nonrenewable Natural Resources Used to Make Each Snack			
	Main ingredient(s)	Natural resources used to make each	Renewable? Why or why not?
Gel worm	Sodium alginate	Brown Seaweed	Renewable, because seaweed reproduces within a few years.
	Calcium chloride	Limestone	Not renewable, because limestone is a rock that took millions of years to form.
Fresh fruit slices	Fruit	Fruit tree, water, and soil nutrients	Renewable, because new trees can be planted, rain provides water, and good farming practices can replenish soil nutrients.

**Impacts from making synthetic gel worm snack**

**Sodium alginate**

Brown seaweed is harvested from the ocean in the wild. It is home and food for ocean creatures. Harvesting brown seaweed from the ocean could affect other organisms in the ecosystem. Processing seaweed into sodium alginate takes energy and produces waste which has to be controlled.

**Calcium chloride**

Have to mine limestone. This takes equipment which uses energy and pollutes. Processing limestone to make calcium chloride produces waste which has to be controlled.

**Producing the gel worms**

Mass-production of the gel worms in a factory takes equipment and uses energy.

**Positive impacts**

People (kids mostly) like eating them.

**Impacts from making real fruit slices**

**Grow and maintain the fruit trees**

Prepare the land using large equipment. This uses energy and adds to pollution. Fertilize and water the trees. Some fertilizers can be pollutants if they get into lakes and rivers. In some areas, water may be less available than in others. Use of pesticides can be a possible pollutant.

**Harvesting and slicing the fruit**

Harvesting by hand is not polluting but harvesting by machine uses energy and adds to pollution. Cutting up the fruit into snack-size pieces would probably be done by machine which uses energy and adds to pollution.

**Positive impacts**

People like eating sliced fruit. Fresh fruit contains vitamins and nutrients essential for good health.

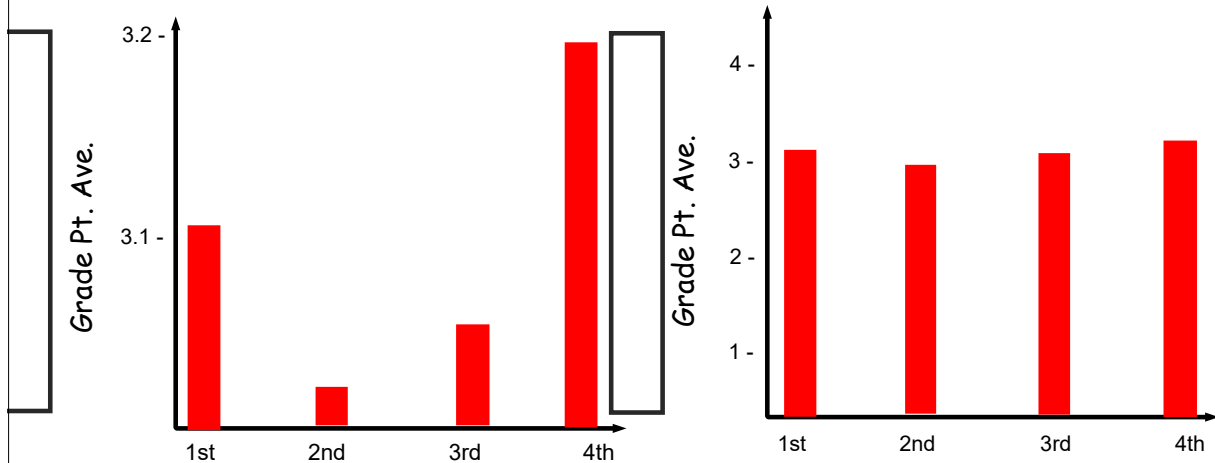
**Conclusion**

Real fruit is probably healthier and might have fewer negative impacts. But if synthetic fruit snacks could be made with vitamins, other nutrients, and not too much sugar, they might be a possible alternative to real fruit slices.

**Target 4: I can determine whether the resources that I am using to gather information are relevant and without bias.**

Example: Changing the scale of a graph changes the impression it makes.

*The effect of the class hour on the grade point average of students in Mrs. Stone's 1st four hours*



Example: Different priorities, different points to make.

### Is Plastic Safe?

Person who makes money selling plastic products

- Plastic is used to save many lives every day.
- Plastic is cheap and saves money.
- Plastic can be recycled

Marine Biologist

- Plastics kill many organisms every day.
- Plastic ends up floating in the ocean
- Plastics do not biodegrade and remain in landfills forever

**Avoiding Bias: A few QUESTIONS to ask yourself as you research:**

1. Is this site relevant to my needs and purpose?
2. What is the purpose of this site?
3. Who created the information at this site, and what is this person's level of expertise?
4. When was the information at this site updated?
5. Where can I go to check the accuracy of this information?
6. Why did this person or group put this information on the internet?
7. Does the website present only one side of the issue, or are multiple perspectives provided?
8. How are information and/or images at this site shaped by the author's stance?
9. Is there anyone who might be offended or hurt by the information at this site?
10. How can I connect these ideas to my own questions and interpretations?