MYP Matter Project: Synthetic Materials

Goal: Understanding that synthetic materials are made from natural resources.

Role: You are a researcher/writer for the Governor's campaign.

Audience: Citizens of the state of California.

Situation: The Governor has been invited to a debate on the use of natural resources versus synthetic materials. The governor is expected to take a position on whether natural resources or synthetic materials are best for society.

Product: As the governor's researcher/writer you must prepare a document/presentation (slides) using a specific material/product as the basis for your argument on whether natural resources or synthetic materials are best for society.

Your finished work should adhere to the following guidelines:

- You are to choose between a document report or google slides presentation.
- Number of pages for document: 3 to 4 pages (images or drawings make up part of the pages).
- Font size and spacing for document: font size is 12, double spacing.
- Google slides: 12-15 slides. Font size: minimum 18. Must include *relevant pictures for all slides*.
- Presentation Materials: Posters and/or videos (for document); Images and linked videos (for Google presentation).
- Use this MLA hyperlink: MLA as your guide to format the reference section at the end of your presentation/document.

Your paper/presentation should include the following:

1. How is your synthetic material produced using natural resources?
    - What natural resources are used to make the synthetic product? Explain how it is made.
    - Describe molecules, other chemical and physical characteristics of the materials before and after the process that synthesizes your product.
2. What are the implications of producing the synthetic material versus using the natural alternative?
3. What are some negative and positive impacts to society of making and using synthetic products, compared to making and using a more natural product with a similar function?
    - Are the natural resources used renewable or nonrenewable?
    - Impacts of harvesting, mining, or collecting the natural resources? Impacts of processing the natural resources before using them to make the final product?
    - Impacts of producing the final product?
    - What are the positive impacts to society of using the final product?
    - Impacts of harvesting, mining, or collecting the natural alternative.
    - Impacts of processing the natural alternative.
    - What are the positive impacts to society of using the natural alternative.
    - Use the results of your research to conclude which product would be the best choice for society.

Standards & Criteria for Success: Your success will be measured by Science Criterion D (Reflecting on the Impacts of Science).

Name: _____ Date: _____ Period: _____

MYP Year 3-Grade 8

Criterion D: Reflecting on the Impacts of Science

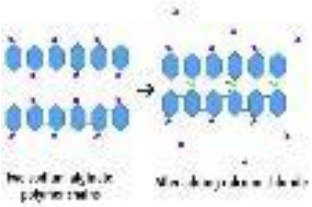
At the end of year 3, students should be able to:
i. **Explain** the ways in which science is applied and used to address a specific problem or issue.
ii. **Discuss and analyze** the various implications of using science and its application in solving a specific
problem or issue.
iii. **Apply** scientific language **effectively**.
iv. **Document** the work of others and sources of information used.

Achievement Level	Level Descriptor
0	The student does not reach a standard described by any of the descriptors below.
1-2	The student is able to: i. **Outline** how the synthetic material is produced using natural resources. ii. **Outline** the implications of producing the synthetic material versus using the natural alternative. iii. **Apply** scientific language to communicate understanding but does so **with limited success**, iv. **Document** sources, **with limited success**.
3-4	The student is able to: i. **Summarize** how the synthetic material is produced using natural resources.. ii. **Describe** the implications of producing the synthetic material versus using the natural alternative. iii. **Sometimes apply** scientific language to communicate understanding. iv. **Sometimes** document **sources correctly**.
5-6	The student is able to: i. **Describe** how synthetic material is produced using natural resources.. ii. **Discuss** the implications of producing the synthetic material versus using the natural alternative. iii. **Usually apply** scientific language to communicate understanding **clearly and precisely**, iv. **Usually** document sources **correctly**.
7-8	The student is able to: i. **Explain** how synthetic material is produced using natural resources. ii. **Discuss and evaluate** the implications of producing the synthetic material versus using the natural alternative. iii. **Consistently apply** scientific language to communicate understanding **clearly and precisely**. iv. Document sources **completely**.

Guide with Examples

Note: *Links have been provided to online resources for each synthetic product. This list is provided at the end of this instruction. You may choose to use other resources, online or not, that you may find. If you use resources you find on your own, remember to consider the author and author's purpose in providing the information (to be sure the information is reliable).*

Part 1: Chemical Composition and Processes

Key Points for your research (*Answer all).*	***Example on making a synthetic product - a gel worm***
What natural resources are used to make the synthetic product? ***Explain how*** *it is made.*	Example using Gel worm: Sodium alginate and calcium chloride. Sodium alginate is made from brown seaweed called kelp. Calcium chloride is made from limestone which is a common rock that is mined. The limestone is reacted with hydrochloric acid or sodium chloride to make the calcium chloride.
Describe ***molecules, other chemical and physical characteristics*** of the materials **before and after** the process that synthesizes your product	**What were the calcium chloride and sodium alginate solutions like before the reaction?** The calcium chloride solution was clear and colorless. It looked pretty much like water. The sodium alginate solution was also clear and colorless but it seemed thicker. **After you added the calcium chloride solution to the sodium alginate solution and began pulling from the center,** instead of flowing like a liquid, the chemical reaction made it come out of the cup like a gel. 
What chemical processes are used to make the synthetic product?	Add about 10 drops of calcium chloride solution to the center of the cup containing the sodium alginate solution. ***Continue describing the process from beginning to end.*** Explain that since the final product is chemically different from the starting substances, a chemical synthesis occurred and the gel worm is a synthetic material.

Part 2: Impacts to Society

What are some negative and positive impacts to society of making and using a synthetic product, compared to making and using a more natural product with a similar function? Compare these impacts to the impacts of producing and using a less synthetic/more natural alternative with a similar function.	
Are the natural resources used renewable or nonrenewable?	Sodium alginate is renewable because seaweed reproduces within a few years. Calcium chloride is not renewable, because limestone is a rock that took millions of years to form. Fruit slices come from fresh fruit trees, water, and soil nutrients. It is renewable, because new trees can be planted, rain provides water, and good farming practices can replenish soil nutrients.
Impacts of Harvesting, mining, or collecting the natural resources? Impacts of Processing the natural resources before using them to make the final product?	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.
Impacts of Producing the final product?	**Producing the gel worms**: Mass-production of the gel worms in a factory takes equipment and uses energy.
What are the positive impacts to society of using the final product?	**Positive impacts**: People (kids mostly) like eating them.
Impacts of Products with similar functions (more synthetic / more natural)	
Impacts of Harvesting, mining, or collecting the natural alternative.	**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. **Positive impacts**
Impacts of Processing the natural alternative.	**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.
What are the positive impacts to society of using the natural alternative?	People like eating sliced fruit. Fresh fruit contains vitamins and nutrients essential for good health.
Use the results of your research to conclude which product would be the best choice for society.	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.
Presentation	Projection; Comportment; Content; Materials (poster, video, Power point).

Resources

Use the following resources to research for your paper/presentation:

Plastic Bags

- Stopwaste.org, From Oil to Plastic
- The Atlantic, What is Crude Oil, Exactly?
- How Stuff Works, Plastics
- How Stuff Works, Which is more environmentally friendly: paper or plastic?
- Canadian Plastics Industry Association, All About Bags, Paper vs. Plastic Bags
- Ecomyths Busted, Myth: Paper Bags Are Greener Than Plastic

Plastic Bottles

- American Chemistry Council, The Basics: Polymer Definition and Properties
- Thomasnet.com, Plastic Bottle Manufacturing
- Explain That Stuff!, Glass
- Environmental Impact, Environmental Impact of Glass Production
- The Vermont Juice Co., Glass vs. Plastic
- Packaging of the World, Plastic vs. Glass - Why plastic containers are better
- Washington Post, Why glass jars aren't necessarily better for the environment than plastic jars
- Academy of Nutrition and Dietetics, Eat Right, Glass Versus Plastic Containers
- Oregon Public Broadcasting, Which Is Greener? It's Not What You'd Expect

Disposable Diapers

- University of Minnesota, Diaper Choices
- Stanford Alumni, Don't Pooh- Pooh My Diaper Choice
- National Geographic, How Disposable Diapers are Made
- Appropedia, Cloth vs. Disposable Diapers
- Healthline, The Diaper Wars: Cloth vs. Disposable

Synthetic Fiber and Cloth (Polyester, Nylon, Rayon)

- ChemMatters, Nylon
- FiberSource, A Short History of Manufactured Fibers
- Explain That Stuff, Nylon
- Science360, Fabricating Fabric: Profile of Nylon
- Smithsonian, How 75 Years Ago, Nylon Stockings Changed the World
- How Products are Made, Rayon
- Textile Exchange, The Manufacturing Process of Rayon
- Chemistry Explained, Fibers
- How Stuff Works, Why is Cotton More Absorbent than Nylon?
- Quatr.us, What is Polyester?
- Sewing Parts Online, Cotton vs. Polyester
- How Stuff Compares, Cotton vs. Polyester

Kevlar

- ChemMatters, Fabric of Steel
- Explain That Stuff, Kevlar
- How Stuff Works, Stuff or Genius, Stephanie Kwolek
- Making the Modern World, Kevlar
- Science 360, Chance Discoveries, Kevlar

Artificial Sweetener

- ChemMatters, The Skinny on Sweeteners: How Do They Work?
- ChemMatters, Artificial Sweeteners

- Scientific American, Sugar vs. Artificial Sweeteners
- CNN, Real or Fake Sugar: Does it Matter?
- Discovery Communications, Seeker, Artificial Sweetener Leaves Environmental Aftertaste
- American Chemical Society, Environmental Science and Technology, Artificial Sweetener Persists in the Environment
- World Wildlife Fund, Sustainable Agriculture - Sugarcane
- Discover, The Chemistry of Artificial Sweeteners

Synthetic Rubber

- American Chemical Society, National Historic Chemical Landmarks, U.S. Synthetic Rubber Program
- Explain that Stuff, Rubber
- Akron Global Polymer Academy, A Brief History of Rubber
- Discovery Communications, How It's Made - Natural Rubber
- Discovery Communications, How It's Made - Synthetic Rubber

Synthetic Fuel

- ChemMatters, Do You Want Biodiesel with That?
- ChemMatters, Green Gasoline: Fuel from Plants
- How Stuff Works, What is a Synfuel?
- How Stuff Works, Top 8 Synthetic Fuels
- Princeton University, Synthetic Fuels Could Eliminate U.S. Need for Crude Oil

Taxol (Cancer drug)

- National Cancer Institute, Natural Compound Helps treat Breast and Ovarian Cancer
- National Cancer Institute, Success Story - Taxol
- American Chemical Society, National Historic Chemical Landmark - Discovery of Camptothecin and Taxol
- American Chemical Society, Chemical and Engineering News - Taxol

Physostigmine (Glaucoma drug)

- ChemMatters, Percy Julian: Rising above Racism
- Chemical Heritage Foundation, Science Alive, Physostigmine and Glaucoma
- Chemical Heritage Foundation, Science Alive, Synthetic vs. Natural: What's the Difference?
- American Chemical Society, National Historic Chemical Landmark, Percy L. Julian and the Synthesis of Physostigmine
- Chemical Heritage Foundation, Science Alive, What is Synthesis?

Chloroquine (Malaria drug)

- Encyclopedia.com, Chemical Synthesis
- Medicines for Malaria Venture, History of Antimalarials

Cortisone (Arthritis drug)

- Encyclopedia.com, Percy Lavon Julian
- PBS, NOVA, Percy Julian : Forgotten Genius - Making Cortisone from Plants

Aspirin

- ChemMatters, Aspirin
- About.com, Inventors, History of Aspirin
- Chemical Heritage Foundation, Aspirin: Turn of the Century Miracle Drug
- The Conversation, Natural Medicine is Great but Chemists Can Make it Even Better