



St. Louis Public Schools Continuous Learning for Students High School Science

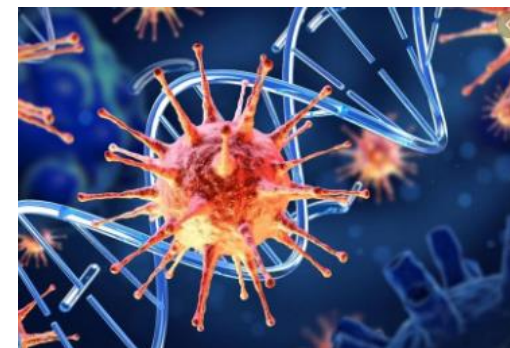


Welcome to Virtual Learning for HS Science STUDENTS! (Hybrid of Online and Offline Materials)

Students are encouraged to maintain contact with their home school and classroom teacher(s). If you have not already done so, please visit your child's school website to access individual teacher web pages for specific learning/assignment information. If you cannot reach your teacher and have elected to use these resources, please be mindful that some learning activities may require students to reply online, while others may require students to respond using paper and pencil. In the event online access is not available and the teacher cannot be reached, responses should be recorded on paper and completed work should be dropped off at your child's school. Please contact your child's school for the dates and times to drop off your child's work.

If you need additional resources to support virtual learning, please visit: <https://www.slps.org/extendedresources>

Overview of Weeks of May 11 and 18: This instructional plan offers 3 options for students to finalize the academic year. **Students may choose ONE option out of 3**, taking in consideration that **Option 3 is offered with teacher permission only** based on where the students are in their learning and support so far. Option 1 is content-based and can serve as a summative assessment with student submittal of the final project. Option 2 is a 9-parts structured interdisciplinary across all sciences project on consumption, trash disposal, and recycling and has an embedded summative assessment in the instructional plan at the end. Option 3 is a mini-unit with a culminating performance task at the end, which can serve as a summative assessment.



To access all instructional fillable pdf files, also available in print, for Weeks of May 11 and 18 go [HERE](#)

For additional information on Continuous Learning go to <https://www.slps.org/keeponlearning>



For questions related to this instructional plan, please contact:

Valentina Bumbu
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Students may choose ONE project option. Option 3 – with Teacher permission ONLY

Project Options	Lesson Objective <i>What will you know and be able to do at the conclusion of this lesson?</i>	Instructional Activities <i>What needs to be done in order to learn the material?</i>	Resources <i>What print and electronic resources are available to support your learning?</i>	Assessment / Assignment* <i>How will you show your teacher that you learned the material? What needs to be turned in?</i>
OPTION 1: Research Project (subject-specific for Physics, Chemistry, or Biology)	To obtain, evaluate, and communicate information on a phenomenon, problem, or scientific question applying scientific principles learned.	<ol style="list-style-type: none"> 1. Use appropriate sources to complete the Scaffolded Research Page for your subject (physics, chemistry, or biology). 2. Use the appropriate rubric to write an essay, make a PowerPoint presentation, or make a poster about your research question. <p>Essay Rubric in pdf Poster Rubric in pdf PowerPoint Presentation Rubric in pdf</p>	<p style="text-align: center;">PHYSICS</p> <p>Print and Electronic: Physics Scaffolded Research Page for planning project in word doc and editable pdf Nuclear Explained Article Nuclear Energy Pros and Cons Article</p> <p>Electronic: Noodle Tools for Citations https://my.noodletools.com/web/express.html</p> <hr/> <p style="text-align: center;">CHEMISTRY</p> <p>Print and Electronic: Scaffolded Research Page for planning project in word doc and editable pdf Reading Why Soap Works Reading Effective Soap vs Virus</p> <p>Electronic:</p>	<p><i>Submit to your teacher:</i></p> <ol style="list-style-type: none"> 1. Completed Scaffolded Research Page including citations. 2. Completed poster, PowerPoint presentation, or essay.

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	<p>To obtain, evaluate, and communicate information on a phenomenon, problem, or scientific question applying scientific principles learned.</p>		<p>EasyBib for citations www.easybib.com</p> <p style="text-align: center;">BIOLOGY</p> <p>Print: Scaffolded Research Page for planning project in word doc and editable pdf. Reading Bacteria vs Virus</p> <p>Online: EasyBib for citations www.easybib.com www.cdc.gov www.who.int</p>	
<p>OPTION 2</p> <p>Buy, Use Toss?</p>	<p>Define problems and design solutions to overconsumption and waste management by applying scientific principles learned.</p>	<ol style="list-style-type: none"> 1. Access the slides or editable pdf. Press on File and click Download. This file is now downloaded on your device and can be accessed in the Downloads folder on your device, moved/copied & pasted anywhere on your device. 2. Open the file from your device. 3. You will notice that this project is divided in 9 parts, where each part can be done daily. 4. Follow the directions in the PPT slides or editable pdf. 5. Type/write/draw in the appropriate boxes. 6. Ensure that you save your work by clicking Files then Save buttons. 7. Complete the Summative Assessment. 	<p>Print and Electronic: SE_Buy.Use.Toss PPT Slides or editable pdf</p> <p>Summative assessment editable pdf</p>	<p>After all parts are completed, save your work in either slides or pdf, and turn it in.</p> <p>Complete summative assessment using editable pdf and turn it in.</p>

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<p>OPTION 3 (with teacher permission)</p> <p>How does a pandemic cause less CO₂?</p>	<p>Explain why concentrations of greenhouse gasses are decreasing as the world-wide spread of the coronavirus increases.</p> <p>Apply science ideas to design a system or process to reduce their family's carbon footprint</p>	<ol style="list-style-type: none">1. Access the slides link. Press on File and click Download. This file is now downloaded on your device and can be accessed in the Downloads folder on your device, moved/copied & pasted anywhere on your device.2. Open the file from your device.3. You will notice that this task is divided in 4 parts, where each part can be done daily. Part III is optional, based on availability of support.4. Follow the directions in the ppt slides or editable pdf.5. Type/write/draw in the appropriate boxes.6. Ensure that you save your work by clicking Files then Save buttons.	<p>Print and Electronic: PPT Slides for Students</p> <p>Electronic: NASA's Earth Minute: Gas Problem https://youtu.be/K9kga9c0u2l Greenhouse Gas https://www.britannica.com/video/185587/characteristics-Earth-atmospheric-gas-molecules-properties-greenhouse How Carbon Dioxide Warms Planet Earth https://www.pbs.org/wgbh/nova/video/carbon-dioxide-warms-earth/ Calculate Your Carbon Footprint Survey https://coolclimate.berkeley.edu A Strict Carbon Diet https://www.pbs.org/wgbh/nova/video/a-strict-carbon-diet/</p>	<p>After all parts are completed, save your work in either slides or pdf, and turn it in.</p>
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3. What are some BAD qualities about using Nuclear Energy? List and describe at least three.

4. Research one or more of the following: Chernobyl, Three Mile Island, Fukushima.

5. What is the pollution output of Nuclear Energy? What percent of electricity is produced by Nuclear energy?

CLAIM: Nuclear energy is _____ (Pick Good or Bad)

EVIDENCE: What evidence did your research uncover that supports your claim?

REASONING: Why does this evidence support your claim?

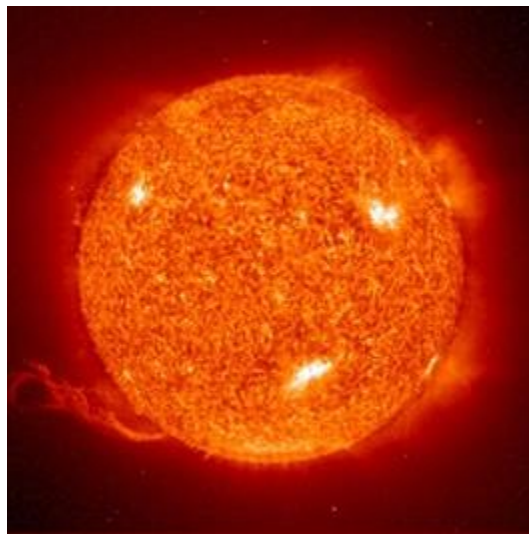
Citations (IN APA FORMAT). Use EasyBib, NoodleTools or another citation generator.

Energy Explained

<https://www.eia.gov/energyexplained/>

Nuclear energy is energy in the core of an atom

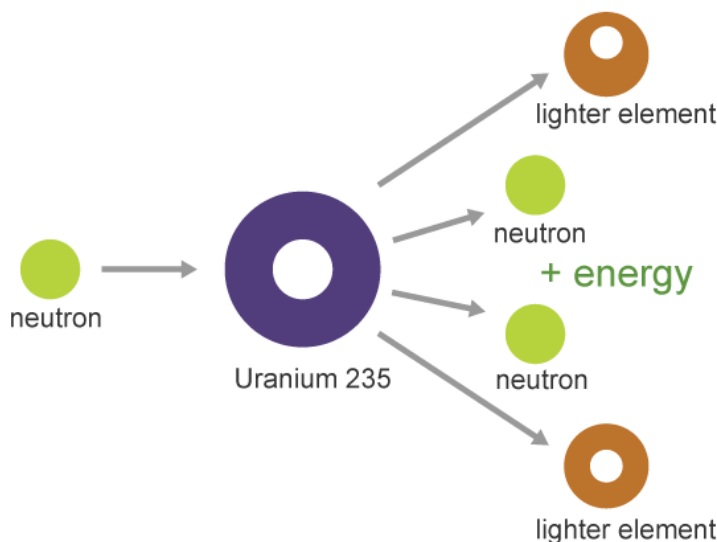
Atoms are the tiny particles in the molecules that make up gases, liquids, and solids. Atoms themselves are made up of three particles called protons, neutrons, and electrons. An atom has a nucleus (or core) containing protons and neutrons, which is surrounded by electrons. Protons carry a positive electrical charge, and electrons carry a negative electrical charge. Neutrons do not have an electrical charge. Enormous energy is present in the bonds that hold the nucleus together. This nuclear energy can be released when those bonds are broken. The bonds can be broken through nuclear fission, and this energy can be used to produce (generate) electricity.



The sun is basically a giant ball of hydrogen gas undergoing fusion and giving off vast amounts of energy in the process.

In nuclear fission, atoms are split apart, which releases energy. All nuclear power plants use nuclear fission, and most nuclear power plants use uranium atoms. During nuclear fission, a neutron collides with a uranium atom and splits it, releasing a large amount of energy in the form of heat and radiation. More neutrons are also released when a uranium atom splits. These neutrons continue to collide with other uranium atoms, and the process repeats itself over and over again. This process is called a nuclear chain reaction. This reaction is controlled in nuclear power plant reactors to produce a desired amount of heat.

How fission splits the uranium atom



Source: Adapted from National Energy Education Development Project (public domain)

Nuclear energy can also be released in nuclear fusion, where atoms are combined or fused together to form a larger atom. Fusion is the source of energy in the sun and stars. Developing technology to harness nuclear fusion as a source of energy for heat and electricity generation is the subject of ongoing research, but whether or not it will be a commercially viable technology is not yet clear because of the difficulty in controlling a fusion reaction.

?

Nuclear power plants have supplied about 20% of annual U.S. electricity generation since 1990.

Nuclear fuel—uranium

Uranium is the fuel most widely used by nuclear plants for nuclear fission. Uranium is considered a nonrenewable energy source, even though it is a common metal found in rocks

worldwide. Nuclear power plants use a certain kind of uranium, referred to as U-235, for fuel because its atoms are easily split apart. Although uranium is about 100 times more common than silver, U-235 is relatively rare.

Most U.S. [uranium ore](#) is mined in the western United States. Once uranium is mined, the U-235 must be extracted and processed before it can be used as a fuel.

Nuclear power comes from nuclear fission

Nuclear power plants heat water to produce steam. The steam is used to spin large turbines that generate electricity. Nuclear power plants use heat produced during nuclear fission to heat water.

In nuclear fission, atoms are split apart to form smaller atoms, releasing energy. Fission takes place inside the reactor of a nuclear power plant. At the center of the reactor is the core, which contains uranium fuel.

The uranium fuel is formed into ceramic pellets. Each ceramic pellet produces about the same amount of energy as 150 gallons of oil. These energy-rich pellets are stacked end-to-end in 12-foot metal fuel rods. A bundle of fuel rods, some with hundreds of rods, is called a fuel assembly. A reactor core contains many fuel assemblies.

The heat produced during nuclear fission in the reactor core is used to boil water into steam, which turns the blades of a steam turbine. As the turbine blades turn, they drive generators that make electricity. Nuclear plants cool the steam back into water in a separate structure at the power plant called a cooling tower, or they use water from ponds, rivers, or the ocean. The cooled water is then reused to produce steam.

?

Nuclear reactors in the United States may have large concrete domes covering the reactors, which are required to contain accidental releases of radiation. Not all nuclear power plants have cooling towers. Some nuclear power plants use water from lakes, rivers, or the ocean for cooling.

Nuclear power plants have generated about 20% of U.S. electricity since 1990

As of January 1, 2020, 96 nuclear reactors were operating at 58 nuclear power plants in 29 states. Thirty-five of the plants have two or more reactors. Nuclear power plants have supplied about 20% of total annual U.S. electricity since 1990. Learn more about the [U.S. nuclear energy industry](#).



Containment dome of a nuclear reactor

The United States generates more nuclear power than any other country

In 2017, 31 countries had commercial nuclear power plants, and in 15 of the countries, nuclear energy supplied at least 20% of their total annual electricity generation. The United States had the largest nuclear electricity generation capacity and generated more nuclear electricity than any other country. France, with the second-largest nuclear electricity generation capacity and second-highest nuclear electricity generation, had the largest share—about 72%—of total annual electricity generation from nuclear energy.

Source: Stock photography (copyrighted)

Top five nuclear electricity generation countries, 2017

Country	Nuclear electricity generation capacity (million kilowatts)	Nuclear electricity generation (billion kilowatthours)	Nuclear share of country's total electricity generation
United States	99.6	805.0	19.8%
France	63.1	381.8	71.5%
China	34.5	232.8	3.7%
Russia	26.1	190.1	18.4%
South Korea	22.5	141.3	26.6%

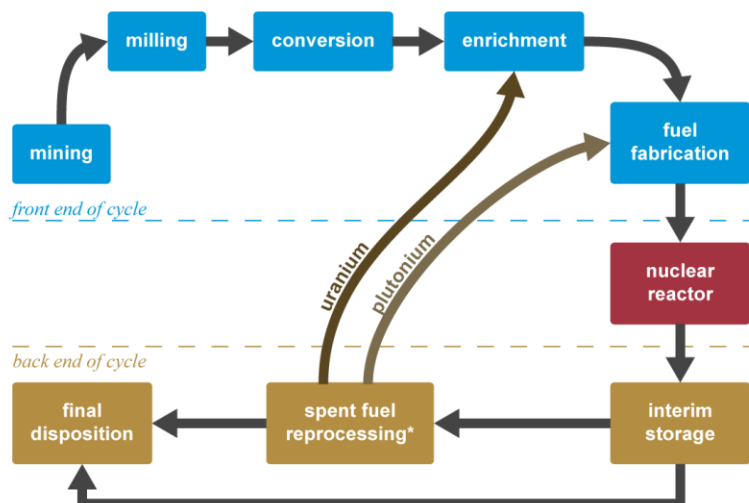
Source: U.S. Energy Information Administration, [International Energy Statistics](#), as of April 16, 2020

The nuclear fuel cycle

The nuclear fuel cycle consists of *front-end* steps that prepare uranium for use in nuclear reactors and *back-end* steps to safely manage, prepare, and dispose of used—or *spent*—but still highly radioactive spent nuclear fuel.

Uranium is the most widely used fuel by nuclear power plants for nuclear fission. Nuclear power plants use a certain type of uranium—U-235—as fuel because its atoms are easily split apart. Although uranium is about 100 times more common than silver, U-235 is relatively rare at just over 0.7% of natural uranium. Uranium concentrate is separated from uranium ore at uranium mills or from a slurry at in-situ leaching facilities. It is then processed in conversion and enrichment facilities, which increases the level of U-235 to between 3%–5% for commercial nuclear reactors, and made into reactor fuel pellets and fuel rods in reactor fuel fabrication plants.

Nuclear fuel cycle



*Spent fuel reprocessing is omitted from the cycle in most countries, including the United States.

Nuclear fuel is loaded into reactors and used until the fuel assemblies become highly radioactive and must be removed for temporary storage and eventual disposal. Chemical processing of spent fuel material to recover any remaining product that could undergo fission again in a new fuel assembly is technically feasible, but it is not permitted in the United States.

Source: Pennsylvania State University Radiation Science and Engineering Center (public domain)

The front end of the nuclear fuel cycle

The nuclear fuel cycle starts with exploration for uranium and the development of mines to extract uranium ore. A variety of techniques are used to locate uranium, such as airborne radiometric surveys, chemical sampling of groundwater and soils, and exploratory drilling to understand the underlying geology. Once uranium ore deposits are located, the mine developer usually follows up with more closely spaced *in fill*, or development drilling, to determine how much uranium is available and what it might cost to recover it.

Uranium mining

When ore deposits that are economically feasible to recover are located, the next step in the fuel cycle is to mine the ore using one of the following techniques:

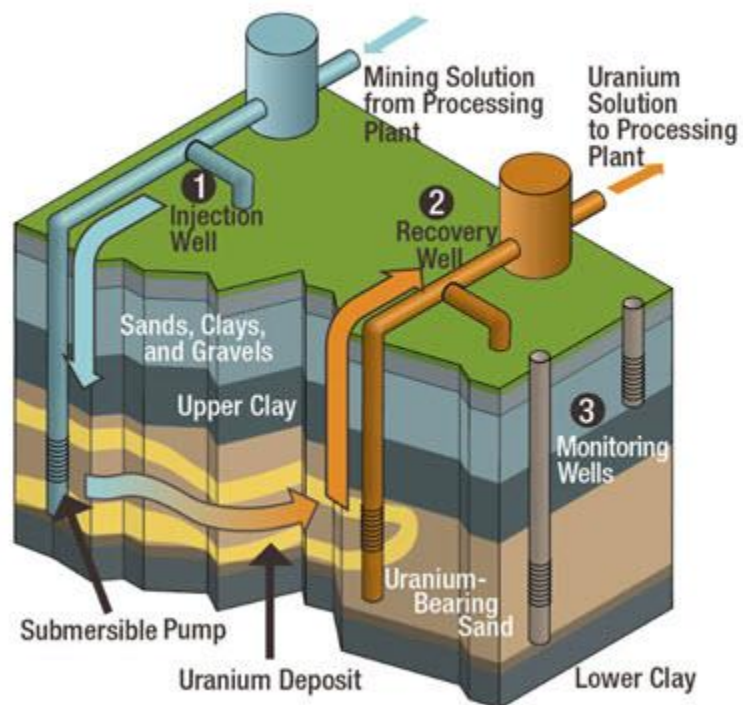
- underground mining
- open pit mining
- in-place (in-situ) solution mining
- heap leaching

Before 1980, most U.S. uranium was produced using open pit and underground mining techniques. Today, most U.S. uranium is produced using a solution mining technique commonly called in-situ-leach (ISL) or in-situ-recovery (ISR). This process extracts uranium that coats the sand and gravel particles of groundwater reservoirs. The sand and gravel particles are exposed to a solution with a pH that has been elevated slightly by using oxygen, carbon dioxide, or caustic soda. The uranium dissolves into the groundwater, which is pumped out of the reservoir and processed at a uranium mill. Heap leaching involves spraying an acidic liquid solution onto piles of crushed uranium ore. The solution drains down through the crushed ore and leaches uranium out of the rock, which is recovered from underneath the pile. Heap leaching is no longer used in the United States.

?

In 2018, about 50 million pounds of uranium (U₃O₈ equivalent) were loaded into commercial U.S. nuclear power reactors.

The in situ uranium recovery process



Source: [United States Nuclear Regulatory Commission](#) (public domain)

Nuclear power and the environment

Nuclear reactors and power plants have complex safety and security features

An uncontrolled nuclear reaction in a nuclear reactor could result in widespread contamination of air and water. The risk of this happening at nuclear power plants in the United States is small because of the diverse and redundant barriers and safety systems in place at nuclear power plants, the training and skills of the reactor operators, testing and maintenance activities, and the regulatory requirements and oversight of the U.S. Nuclear Regulatory Commission. A large area surrounding a nuclear power plant is restricted and guarded by armed security teams. U.S. reactors also have containment vessels that are designed to withstand extreme weather events and earthquakes.

?

Nuclear reactors in the United States may have large concrete domes covering the reactor. A [containment structure](#) is required to contain accidental releases of radiation. Not all nuclear power plants have cooling towers. Some nuclear power plants use water from lakes, rivers, or the ocean for cooling.

Nuclear power reactors do not produce direct carbon dioxide emissions

Unlike fossil fuel-fired power plants, nuclear reactors do not produce air pollution or carbon dioxide while operating. However, the processes for mining and refining uranium ore and making reactor fuel all require large amounts of energy. Nuclear power plants also have large amounts of metal and concrete, which require large amounts of energy to manufacture. If fossil fuels are used for mining and refining uranium ore, or if fossil fuels are used when constructing the nuclear power plant, then the emissions from burning those fuels could be associated with the electricity that nuclear power plants generate.

Nuclear energy produces radioactive waste

A major environmental concern related to nuclear power is the creation of radioactive wastes such as uranium mill tailings, spent (used) reactor fuel, and other radioactive wastes. These materials can remain radioactive and dangerous to human health for thousands of years. Radioactive wastes are subject to special regulations that govern their handling, transportation, storage, and disposal to protect human health and the environment. The [U.S. Nuclear Regulatory Commission \(NRC\)](#) regulates the operation of nuclear power plants.

Radioactive wastes are classified as low-level waste or high-level waste. The radioactivity of these wastes can range from a little higher than natural background levels, such as for uranium mill tailings, to the much higher radioactivity of used (spent) reactor fuel and parts of nuclear reactors. The radioactivity of nuclear waste decreases over time through a process called radioactive decay. The amount of time it takes for the radioactivity of radioactive material to decrease to half its original level is called the radioactive half-life. Radioactive waste with a short half-life is often stored temporarily before disposal to reduce potential radiation doses to workers who handle and transport the waste. This storage system also reduces the radiation levels at disposal sites.

By volume, most of the waste related to the nuclear power industry has a relatively low level of radioactivity. Uranium mill tailings contain the radioactive element radium, which decays to produce the radioactive gas radon. Most uranium mill tailings are placed near the processing facility, or *mill*, where they come from. Uranium mill tailings are covered with a sealing barrier of material such as clay to prevent radon from escaping into the atmosphere. The sealing barrier is covered by a layer of soil, rocks, or other materials to prevent erosion of the sealing barrier.

The other types of low-level radioactive waste are the tools, protective clothing, wiping cloths, and other disposable items that become contaminated with small amounts of radioactive dust or particles at nuclear fuel processing facilities and nuclear power plants. These materials are subject to special regulations for their handling, storage, and disposal so they will not come in contact with the outside environment.

High-level radioactive waste consists of *irradiated*, or *spent*, nuclear reactor fuel (i.e., fuel that is no longer useful for producing electricity). The spent reactor fuel is in a solid form, consisting of small fuel pellets in long metal tubes called rods.

Spent reactor fuel storage and reactor decommissioning

Spent reactor fuel assemblies are highly radioactive and, initially, must be stored in specially designed pools of water. The water cools the fuel and acts as a radiation shield. Spent reactor fuel assemblies can also be stored in specially designed dry storage containers. An increasing number of reactor operators now store their older spent fuel in dry storage facilities using special outdoor concrete or steel containers with air cooling. The United States does not currently have a permanent disposal facility for high-level nuclear waste.

When a nuclear reactor stops operating, it must be decommissioned. Decommissioning involves safely removing from service the reactor and all equipment that has become radioactive and reducing radioactivity to a level that permits other uses of the property. The U.S. Nuclear Regulatory Commission has strict rules governing nuclear power plant decommissioning that involve cleanup of radioactively contaminated power plant systems and structures and removing the radioactive fuel.

Nuclear Energy Pros and Cons

Below you will find a nuclear energy pros and cons list, which covers the most important aspects of typical nuclear power plants.

There are 104 commercial nuclear power plants in the United States producing a whopping 806.2 TWh of electricity, in other words about 20 % of the entire electricity generation (2008). There is no doubt that the potential of nuclear energy is huge, but there are also downsides.



Before we get further into the pros and cons list, what exactly is nuclear energy? The basic gist is this: By

separating an atom into two lighter atoms, there is a net loss of mass. This mass is not exactly lost, but rather

transformed into massive amounts of energy. This is what is referred to as nuclear fission. By controlling these reactions we can harness the energy.

I've made a separate article going deeper into how we harness nuclear energy called [Nuclear](#). If this is not entirely clear yet; you might want to consider reading this before you start with the pros and cons list below.

Advantages of Nuclear Energy

1 Relatively Low Costs

The initial construction costs of nuclear power plants are large. On top of this, when the power plants first have been built, we are left with the costs to enrich and process the nuclear fuel (e.g. uranium), control and get rid of nuclear waste, as well as the maintenance of the plant. The reason this is under advantages is that nuclear energy is cost-competitive. Generating electricity in nuclear reactors is cheaper than electricity generating from oil, gas and coal, not to speak of the renewable energy sources!

2 Base Load Energy

Nuclear power plants provide a stable base load of energy. This can work synergistic with renewable energy sources such as wind and solar. The electricity production from the plants can be lowered when good wind and solar resources are available and cranked up when the demand is high.

3 Low Pollution

It is in most cases more beneficial, in terms of the climate crisis, to replace other energy harnessing methods we use today with nuclear power. The environmental effects of nuclear power are relatively light compared to those.

However, nuclear waste is potential harmful for both humans and the environment.

4 Thorium

Reports show that with the yearly fuel consumption of today's nuclear power plants, we have enough uranium for 80 years. It is possible to fuel nuclear power plants with other fuel types than uranium. Thorium, which also is a greener alternative, has lately been given an increased amount of attention. China, Russia and India have already plans to start using thorium to fuel their reactors in the near future.

It looks like nuclear fuel is of good availability if we combine the reserves of the different types together. In other words, hopefully enough time for us to find cost-competitive greener ways of harnessing energy.

5 Sustainable?

Is nuclear energy renewable or non-renewable? This is a good question. By definition, nuclear energy is not a renewable energy source. As I mentioned above, there is a limited amount of fuel for nuclear power available. On the other hand, you could argue that nuclear energy is potentially sustainable by the use of breeder reactors and fusion reactors. Nuclear fusion is the holy grail of harnessing energy. If we can learn to control atomic fusion, the same reactions as those that fuel the sun, we have practically unlimited energy. At the moment, these two methods both have serious challenges that need to be dealt with if we are to start using them on larger scale.

6 High Energy Density

It is estimated the amount of energy released in a nuclear fission reaction is ten million times greater than the amount released in burning a fossil fuel atom (e.g. oil and gas). Therefore, the amount of fuel required in a nuclear power plant is much smaller compared to those of other types of power plants.

Disadvantages of Nuclear Energy

While the advantages of using nuclear energy seem to be many, there are also plenty of negative effects of nuclear energy. The following are the most important ones:

1 Accidents Happen

The radioactive waste can possess a threat to the environment and is dangerous for humans. We all remember the Chernobyl accident, where the harmful effects of nuclear radiation on humans can even be witnessed today.

Estimates conclude that somewhere between 15 000 and 30 000 people lost their lives in the Chernobyl aftermath and more than 2.5 million Ukrainians are still struggling with health problems related to nuclear waste.

Just last year, on March 18, a major nuclear crisis happened again in Japan. While the casualties were not as high as with the Chernobyl accident, the environmental effects were disastrous.

History shows that we can never really protect us 100% against these disasters. Accidents do happen.

2 Radioactive Waste

Does nuclear power cause air pollution? The nuclear power plants emit negligible amounts, if any, **carbon dioxide** into the atmosphere. However, the processes in the nuclear fuel chain such as mining, enrichment and waste management does.

There are many arguments both for and against nuclear power. All in all I would say that the future of nuclear power looks promising. With new generations of reactors, potential major breakthroughs such as nuclear fusion, the methods we use to harness nuclear energy will get better in the next coming years. The question is: Do we need nuclear power or are the renewables a better choice?

Name: _____ Period: _____

Soap and the Coronavirus: Why does washing your hands with soap stop the coronavirus from spreading?

Guidelines for Completing this Research Sheet:

1. For each section, you answer the assigned research question in complete sentences.
2. As you find the answers online, you must add to your citation sheet.
3. You will use APA citations to record your sources
 - a. APA Citation for an online site (Refer to Purdue OWL APA Citation site for more details, you may also use Noodle Tools, or EasyBib)
 - b. You must have at least 5 sources.
4. You must use credible sources, NO WIKIPEDIA or BLOG SITES.
5. Here are some suggested sites and readings to start your research:
 - a. Reading [Why Soap Works](#)
 - b. https://www.health.harvard.edu/newsletter_article/The_handiwork_of_good_health

Your Research Questions:

1. What is soap? What are soap's chemical properties? What do soap molecules look like?
2. What is the coronavirus? (What is the molecular structure of the virus? What does the virus look like?)
3. How does soap interact with the coronavirus? What chemistry concepts explain this interaction?
4. What is the difference between regular soap and antibacterial soap?

5. What data is out there (if any) supporting that antibacterial soap is more effective than regular soap at removing bacteria, germs, and viruses off of our hands?

6. How does alcohol or hand sanitizer kill the coronavirus? What chemistry concepts explain that phenomenon?

OTHER FINDINGS:

Citations (IN APA FORMAT) Use EasyBib or NoodleTools or another citation generator

Why Soap Works

At the molecular level, soap breaks things apart. At the level of society, it helps hold everything together.

By Ferris Jabr

March 13, 2020

It probably began with an accident thousands of years ago. According to one legend, rain washed the fat and ash from frequent animal sacrifices into a nearby river, where they formed a lather with a remarkable ability to clean skin and clothes. Perhaps the inspiration had a vegetal origin in the frothy solutions produced by boiling or mashing certain plants. However it happened, the ancient discovery of soap altered human history. Although our ancestors could not have foreseen it, soap would ultimately become one of our most effective defenses against invisible pathogens.

People typically think of soap as gentle and soothing, but from the perspective of microorganisms, it is often extremely destructive. A drop of ordinary soap diluted in water is sufficient to rupture and kill many types of bacteria and viruses, including the new coronavirus that is currently circling the globe. The secret to soap's impressive might is its hybrid structure.

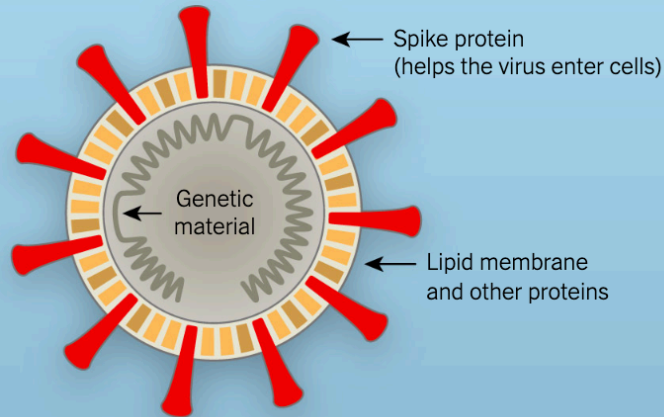
Soap is made of pin-shaped molecules, each of which has a hydrophilic head — it readily bonds with water — and a hydrophobic tail, which shuns water and prefers to link up with oils and fats. These molecules, when suspended in water, alternately float about as solitary units, interact with other molecules in the solution and assemble themselves into little bubbles called micelles, with heads pointing outward and tails tucked inside.

Some bacteria and viruses have lipid membranes that resemble double-layered micelles with two bands of hydrophobic tails sandwiched between two rings of hydrophilic heads. These membranes are studded with important proteins that allow viruses to infect cells and perform vital tasks that keep bacteria alive. Pathogens wrapped in lipid membranes include coronaviruses, H.I.V., the viruses that cause hepatitis B and C, herpes, Ebola, Zika, dengue, and numerous bacteria that attack the intestines and respiratory tract.

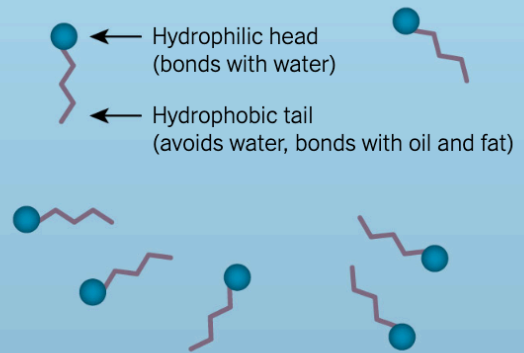
When you wash your hands with soap and water, you surround any microorganisms on your skin with soap molecules. The hydrophobic tails of the free-floating soap molecules attempt to evade water; in the process, they wedge themselves into the lipid envelopes of certain microbes and viruses, prying them apart.

“They act like crowbars and destabilize the whole system,” said Prof. Pall Thordarson, acting head of chemistry at the University of New South Wales. Essential proteins spill from the ruptured membranes into the surrounding water, killing the bacteria and rendering the viruses useless.

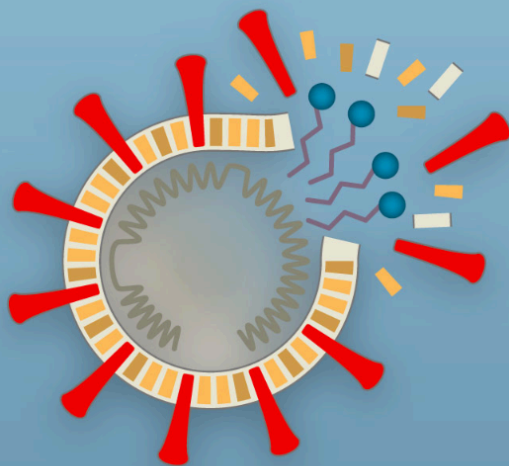
THE CORONAVIRUS has a membrane of oily lipid molecules, which is studded with proteins that help the virus infect cells.



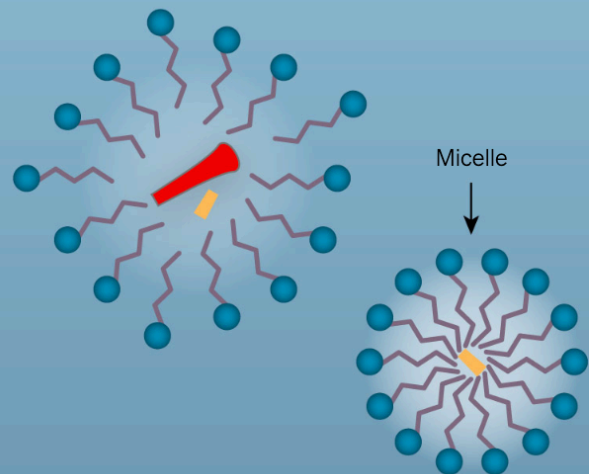
SOAP MOLECULES have a hybrid structure, with a head that bonds to water and a tail that avoids it.



SOAP DESTROYS THE VIRUS when the water-shunning tails of the soap molecules wedge themselves into the lipid membrane and pry it apart.



SOAP TRAPS DIRT and fragments of the destroyed virus in tiny bubbles called micelles, which wash away in water.



By Jonathan Corum and Ferris Jabr

In tandem, some soap molecules disrupt the chemical bonds that allow bacteria, viruses and grime to stick to surfaces, lifting them off the skin. Micelles can also form around particles of dirt and fragments of viruses and bacteria, suspending them in floating cages. When you rinse your hands, all the microorganisms that have been damaged, trapped and killed by soap molecules are washed away.

On the whole, hand sanitizers are not as reliable as soap. Sanitizers with at least 60 percent ethanol do act similarly, defeating bacteria and viruses by destabilizing their lipid membranes. But they cannot easily remove microorganisms from the skin. There are also viruses that do not depend on lipid membranes to infect cells, as well as bacteria that protect their delicate membranes with sturdy shields of protein and sugar. Examples include bacteria that can

cause meningitis, pneumonia, diarrhea and skin infections, as well as the hepatitis A virus, poliovirus, rhinoviruses and adenoviruses (frequent causes of the common cold).

These more resilient microbes are generally less susceptible to the chemical onslaught of ethanol and soap. But vigorous scrubbing with soap and water can still expunge these microbes from the skin, which is partly why hand-washing is more effective than sanitizer. Alcohol-based sanitizer is a good backup when soap and water are not accessible.

In an age of robotic surgery and gene therapy, it is all the more wondrous that a bit of soap in water, an ancient and fundamentally unaltered recipe, remains one of our most valuable medical interventions. Throughout the course of a day, we pick up all sorts of viruses and microorganisms from the objects and people in the environment. When we absentmindedly touch our eyes, nose and mouth — a habit, [one study](#) suggests, that recurs as often as every two and a half minutes — we offer potentially dangerous microbes a portal to our internal organs.

As a foundation of everyday hygiene, hand-washing was broadly adopted relatively recently. In the 1840s Dr. Ignaz Semmelweis, a Hungarian physician, discovered that if doctors washed their hands, far fewer women died after childbirth. At the time, microbes were not widely recognized as vectors of disease, and many doctors ridiculed the notion that a lack of personal cleanliness could be responsible for their patients' deaths. Ostracized by his colleagues, Dr. Semmelweis was eventually committed to an asylum, where he was severely beaten by guards and died from infected wounds.

Florence Nightingale, the English nurse and statistician, also promoted hand-washing in the mid-1800s, but it was not until the 1980s that the Centers for Disease Control and Prevention issued the world's [first](#) nationally endorsed hand hygiene guidelines.

Washing with soap and water is one of the key public health practices that can significantly slow the rate of a pandemic and limit the number of infections, preventing a disastrous overburdening of hospitals and clinics. But the [technique](#) works only if everyone washes their hands frequently and [thoroughly](#): Work up a good lather, scrub your palms and the back of your hands, interlace your fingers, rub your fingertips against your palms, and twist a soapy fist around your thumbs.

Or as the Canadian health officer Bonnie Henry [said recently](#), “Wash your hands like you’ve been chopping jalapeños and you need to change your contacts.” Even people who are relatively young and healthy should regularly wash their hands, especially during a pandemic, because they can spread the disease to those who are more vulnerable.

Soap is more than a personal protectant; when used properly, it becomes part of a communal safety net. At the molecular level, soap works by breaking things apart, but at the level of society, it helps hold everything together. Remember this the next time you have the impulse to bypass the sink: Other people's lives are in your hands.

The handiwork of good health

Alcohol-based hand sanitizers are more effective than antibacterial soaps, but don't give up on plain soap and water.

That our hands are crawling with germs is old, old news. Adults have hectored children about the dangers of unwashed hands for generations. Over a century ago, a few pioneering doctors (Holmes, Semmelweis, Lister) figured out that physicians' hands were infecting patients and making many people sick.

What is new, though, is the range of organisms you might find on even a seemingly clean pair of hands.

It's pretty normal to have staph germs living on your skin (and in your nose): About 25%–30% of us are "colonized" with no ill effects — unless the bacteria get into a break in the skin. But a new version is increasingly prevalent: methicillin-resistant *Staphylococcus aureus* (MRSA), a bacterium that resists not only methicillin but many other antibiotics. MRSA was once almost exclusively found in hospitals. Now outbreaks are occurring at schools, in jails, and among sports teams. Members of the Boston Celtics pro basketball team were infected in the fall of 2006

Clostridium difficile, a bacterium found in feces, is another hospital germ that's flown the health care coop. Hands are often the middleman in the fecal-oral transmission route: *C. difficile* gets on people's hands when they come in contact with a contaminated surface or object, and they inadvertently infect themselves when their hands touch their mouths.

Our hands are much more hospitable to bacteria than to viruses, but you'll find a few of the latter. Most flu is transmitted through the air in virus-laden droplets propelled by coughs and sneezes. But our hands can pick up those droplets from any number of surfaces, so they're often an important link in the chain of transmission. Hand washing is a standard item on flu-prevention lists, and health officials are putting special emphasis on it now because of the bird flu epidemic.

Americans say they wash their hands. Over 90% of those questioned in a telephone survey said they washed up after using a public bathroom. But when the American Society of Microbiology and a trade association group observed people in public restrooms (in stadiums, train stations, etc.), they found that only 75% of men washed their hands. Women weren't perfect, but at 90%, did better than the men. This Mars-Venus disparity extends to those with medical degrees. In one study, female physicians washed their hands 88% of the time after seeing a patient; their male colleagues did so only 54% of the time.

Overkill overdoes it

There are those, both men and women, who overdo the hand washing. Our hands weren't meant to be sterile objects. Having some bacteria on the skin is perfectly natural, and "resident flora," as the experts call it, is probably healthful — unless you're a surgeon about to put your hands inside someone's body. Frequent hand washing, even with mild soap, can damage skin, worsening cuts and causing cracks that can harbor even more bacteria. Dry, damaged skin may also spread germs more easily because it flakes off, taking bacteria with it.

How often should you wash your hands? There's no set frequency; it really depends on your activities. Must-wash occasions include after using the bathroom, before eating or preparing

food, and after being with someone who's ill, particularly if he or she has a respiratory or gastrointestinal infection.

Lathering up

New products clamor for our attention, but plain old soap and water is still a good way to clean your hands. In studies, washing hands with soap and water for 15 seconds (about the time it takes to sing one chorus of "Happy Birthday to You") reduces bacterial counts by about 90%. When another 15 seconds is added, bacterial counts drop by close to 99.9% (bacterial counts are measured in logarithmic reductions). Few of us wash our hands that long — 5 seconds is more like it. One reason you're supposed to use cool or lukewarm water is to increase the chances you'll wash them a little longer. Hot water is also more damaging to skin.

Soap and water don't kill germs; they work by mechanically removing them from your hands. Running water by itself does a pretty good job of germ removal, but soap increases the overall effectiveness by pulling unwanted material off the skin and into the water. In fact, if your hands are visibly dirty or have food on them, soap and water are more effective than the alcohol-based "hand sanitizers" because the proteins and fats in food tend to reduce alcohol's germ-killing power. This is one of the main reasons soap and water is still favored in the food industry.

Even people who are conscientious about washing their hands make the mistake of not drying them properly. Wet hands are more likely to spread germs than dry ones. It takes about 20 seconds to dry your hands well if you're using paper or cloth towels and 30–45 seconds under an air dryer.

Antibacterial soap

By some accounts, almost half of the hand soaps on the market have an antibacterial additive. Many brands are in liquid form, so they're less messy than a traditional bar of soap, but you can, of course, buy plain soap in liquid form, too.

The active ingredient in most antibacterial soaps is a chemical called triclosan. Triclosan in the amounts used in soap doesn't kill many bacteria (concentrations of 0.2% or less), but it keeps the counts down partly because it has residual activity.

The big question has been whether widespread use of antibacterial soaps will worsen the problem of antibiotic resistance. Doctors have worried that bacteria exposed to low levels of triclosan aren't killed outright so much as given an opportunity to mutate so their offspring are more resistant to triclosan and, ultimately, to antibiotics as well. In the lab, that's how it has played out: Bacteria that become less susceptible to triclosan show indications of developing "cross-resistance" to antibiotics.

But what happens outside the lab is less clear. In the biggest study of its kind, researchers recruited about 240 households in upper Manhattan to participate in a "real-world" hand washing study. Half were randomized to use 0.2% triclosan soap; half, to plain soap. After a year, the researchers tested the hands of the primary caregivers in the households for antibiotic-resistant bacteria. The result: no statistically significant difference between antibacterial and plain-soap households. The researchers offered several possible explanations for their findings (resistance may not develop in a year; high antibiotic use may make it difficult to detect small changes), so the case isn't closed, but their findings do counter the lab research.

Even if antibiotic resistance weren't an issue, results from this study (and others) make you wonder if the antibacterial soaps available to consumers add much to hand hygiene. In the Manhattan households, a year of washing with an antibacterial soap didn't lower bacterial counts on hands any more than a year of washing with plain soap. Nor did the antibacterial

soap households experience fewer cold-like symptoms. That's not surprising: Colds are caused by viruses, not bacteria. Still, the finding is a useful reminder that the antibacterial soaps aren't the all-purpose germ fighters that many people expect them to be.

Four dos and don'ts

Don't scrub. Scrubbing can damage skin, especially if you do it a lot. The resulting cracks and small cuts give pathogens a place to grow.

Keep your fingernails short. Bacteria like the area under our fingernails. Long nails make it more difficult to keep those areas clean.

Use hand lotions, especially during the winter. Keeping the skin of your hands intact is essential to good hand hygiene.

Don't be in such a hurry. It takes about a minute to properly wash and dry your hands.

Rubbing it in

The hot new products in hand hygiene are alcohol-based rubs, sold as "hand sanitizers." Purell is the most popular brand-name product, but you'll pay considerably less if you buy a store-brand version. The big advantage of the alcohol-based cleansers is that you don't need water (you just rub the stuff on your hands) or a towel, so they can be used anywhere, not just in the bathroom. Politicians use them on the campaign trail (see box), and we've spotted bottles on people's desks and in their cars. Although many surgeons still scrub in the way seen on television, some have switched to an alcohol-based foam, transforming that iconic image of hand hygiene.

Can we shake on that?

Who touches more dirty hands than a politician on the campaign trail?

In his book, Sen. Barack Obama says President Bush is an enthusiastic user of hand sanitizers. Obama describes a brief conversation he had with the president during a visit to the White House. "Good stuff, keeps you from getting colds," Bush told the Illinois senator before offering him a squirt, which the Democrat says he accepted because he "did not want to appear unhygienic."

Perhaps this is one area of bipartisan agreement. According to *The New York Times*, Obama now keeps his own bottle of an alcohol-based cleanser in his travel bag.

Alcohol's killing power comes from its ability to change the shape of (denature) proteins crucial to the survival of bacteria and viruses. In the United States, most of the alcohol-based hand cleansers sold to consumers are 62% alcohol. By itself, alcohol would completely dry out people's hands, so various skin conditioners are added. Alcohol does a superb job of getting rid of bacteria and even some viruses. In all but a few trials, alcohol-based cleaners have reduced bacterial counts on hands better than plain soap, several kinds of antibacterial soap, and even iodine.

But alcohol doesn't kill everything: bacterial spores, some protozoa, and certain "nonenveloped" viruses aren't affected. That's why it shouldn't be the only cleaner available in hospitals or other health care settings, according to Dr. Duncan Macdonald, a surgeon in Glasgow, Scotland, who

has studied hand hygiene. Dr. Macdonald says hospitals where he has worked go back to soap and water during "winter vomiting outbreaks" caused by nonenveloped viruses.

To be effective, the alcohol-based rubs need to come into contact with all the surfaces of your hands — back, front, in between the fingers, and so forth. For that reason, studies have shown that using small amounts — 0.2 milliliters (ml) to 0.5 ml — is really no better than washing with plain soap and water. Dr. Macdonald reported study results in 2005 that showed coverage with an alcohol-based gel improved considerably when he had hospital staff members double the amount they used from 1.75 ml to 3.5 ml. In another study, Dr. Macdonald found that coverage also improved if staff members saw the areas they missed under an ultraviolet light and were then shown the six hand washing steps designed to maximize coverage, regardless of the type of cleanser (see illustration).

Six steps to super-clean hands



At the *Health Letter*, when we measured a squirt from a bottle of Purell hand sanitizer, it was 0.5 ml at most, which would suggest that a single squirt isn't much better than washing hands the old-fashioned way. So keep in mind that the way we actually use alcohol-based products may not be leaving our hands quite as germ-free as we suppose. On the other hand (pun intended), their convenience may mean people will clean their hands more often, especially if they're on the go, so hand hygiene might improve over all.

Dr. Macdonald sees no need to use alcohol rubs at home: "I use regular soap and hot water and have no intention of throwing out my pleasant-smelling lotions for alcohol rubs. Most of the germs around the home have come from us and live with us in perfect harmony." The exception, he adds, might be if you are caring for someone who's at high risk for infection.

Data Collection Sheet for Your Independent Project

Collect data about your chosen disease to create your project:

1. Pick one on the infectious diseases listed and find the information to answer the questions below:

- Cholera
- Ebola
- SARS (H1N1)
- Measles
- West Nile
- Flu
- Tuberculosis
- Pneumonia

2. Click on www.cdc.com and then find your disease to collect information asked below. You may use other reliable sites such as www.WHO.int, medical articles, etc.

1. Name of disease _____
2. Symptoms of disease
3. Cause of disease (bacteria vs virus) and mode of action (what does it actually do in our body to cause sickness or the symptoms felt by patients?)
4. Mode of transmission (How does it spread from human to human?):
5. Contributing factors in getting the disease (What is known about the patients/conditions that are the most affected by the disease?):
6. Current treatment:
7. Prevention methods (What are the ways to avoid getting the disease?):
8. Recent outbreak of the disease:
9. Contributing factors to the outbreak:
10. Data on infections, deaths, recoveries, and/or treatment effectiveness of the disease:

OTHER FINDINGS:

3. Once your research is complete, you will make a poster presentation, a powerpoint, or video using the rubric to creatively demonstrate what you have learned about your infectious disease.

4. Make sure your final project includes appropriate citations (IN APA FORMAT). Use EasyBib, NoodleTools or another citation generator.

What's the difference between Bacteria and Viruses?

Medically reviewed by [Carmen Fookes, BPharm](#), Last updated on Apr 13, 2020.

- Bacteria and viruses differ in their structure and their response to medications.
- Bacteria are single-celled, living organisms. They have a cell wall and all the components necessary to survive and reproduce, although some may derive energy from other sources.
- Viruses are not considered to be “living” because they require a host cell to survive long-term, for energy, and to reproduce. Viruses consist of only one piece of genetic material and a protein shell called a capsid. They survive and reproduce by “hijacking” a host cell, and using its ribosomes to make new viral proteins.
- Less than 1% of bacteria cause disease. Most are beneficial for our good health and the health of Earth’s ecosystems. Most viruses cause disease.
- Antibiotics may be used to treat some bacterial infections, but they do not work against viruses. Some severe bacterial infections may be prevented by vaccination.
- Vaccination is the primary way to prevent viral infections; however, antivirals have been engineered that can treat some viral infections, such as Hepatitis C or HIV. Antivirals are not effective against bacteria.

What are bacteria?

Bacteria are simple, single celled organisms, called prokaryotes, which means their DNA is contained within a certain area of the cell called the nucleoid, but not enclosed. Bacteria are one of the oldest living things on earth, having been in existence for at least 3.5 billion years. A microscope is needed to see them.

Bacteria come in many shapes and sizes, including spheres, cylinders, threads, rods, or chains. They can be aerobic (those that require oxygen to survive), anaerobic (those that die when exposed to oxygen), and those that prefer oxygen but can live without it. Bacteria that create their energy through light or chemical reactions are called autotrophs, and those that have to consume and break down complex organic compounds to obtain energy are called heterotrophs.

Bacteria are enclosed by a rigid cell wall, which can vary widely in its composition, helping to distinguish between different species of bacteria. When exposed to a dye called a gram stain, gram positive bacteria trap the dye due to the structure of their walls, while gram negative bacteria release the dye readily, because their cell wall is thin. **Inside the cell wall sits all the components necessary for bacteria to grow, metabolize, and reproduce.**

Bacteria may also have protrusions, these are known as pili (help bacteria to attach to certain structures, such as teeth or intestines) or flagella (which help bacteria to move).

Although some bacteria can cause disease, less than one percent make us sick. Many beneficial species are essential for our good health and the overall health of most of Earth’s ecosystems. Inside our bodies, we have tens of trillions of bacteria making up our gut microbiome, and trillions more living, usually harmlessly, on our skin. Many chronic diseases, such as cancer and heart disease, are associated with poor oral health often because of an imbalance of bacteria within our mouth. Infections caused by bacteria include [strep throat](#), [tuberculosis](#), and [urinary tract infections](#) (UTI).

The primary way to prevent bacterial infections is by giving [antibiotics](#); however, because of resistance, antibiotics are usually only used for severe infections, because the immune system of most people is usually strong enough to overcome the infection.

For some severe bacterial infections, such as [diphtheria](#), [meningococcal disease](#), [pertussis](#), or [tetanus](#), vaccinations have been developed and these are the most effective way to prevent against infection.

What are viruses?

Viruses consist of a piece of genetic material, such as DNA or RNA (but not both) surrounded by a protein shell called a capsid.

Sometimes this shell is surrounded by an envelope of fat and protein molecules, and out of this envelope may project glycoprotein protrusions, called peplomers, which can be triangular, spiked, or shaped like a mushroom. These protrusions bind only to certain receptors on a host cell and determine what type of hosts or host cell a virus will infect and how infectious that virus will be.

A microscope is required to see viruses and they are 10 to 100 times smaller than the smallest bacteria.

Because viruses MUST infect a host cell to carry out life-sustaining functions or to reproduce, they are not considered living organisms, although some can survive on surfaces for long periods. **Viruses are essentially like a parasite, relying on a host cell to reproduce and survive.**

When a virus infects a host cell, it uses its genetic material to “hijack” the ribosomes in the host cell. These are the cell structures that make protein. So instead of protein being made that can be used by the host cell, viral proteins are made.

The virus also takes advantage of other components within the host cell, such as ATP (adenosine triphosphate) for energy, and amino acids and fats to make new capsids and assemble new viruses. Once enough new viruses have been made, they burst out of the cell in a process called lysis, which kills the host cell. This is called viral replication and it is the way viruses reproduce.

Once new viruses have been made, they can go on to infect new host cells, and new hosts.

Most viruses cause disease, and they are usually quite specific about the area of the body that they attack, for example, the liver, the respiratory tract, or the blood. Common viruses include [herpes zoster](#), [HIV](#), [influenza](#), the [common cold](#), and the [rabies](#) virus. Viruses can also cause [pneumonia](#) or [sinusitis](#). The new coronavirus SARS-CoV-2 that causes [COVID-19](#) is also a virus.

As well as humans and animals, viruses can also infect plants, although virtually all plant viruses are transmitted by insects or other organisms that feed on plant walls.

The primary way to prevent viral infections is by vaccination; however, antivirals have been engineered that can treat some viral infections, such as [Hepatitis C](#) or HIV. Antibiotics do not treat a viral infection.

Virus vs bacteria: Any difference in symptoms?

Symptoms usually reflect the area of the body infected, and the infecting organism. For example, a bacterial infection of the skin may cause a discharge, swelling, pain and redness in a certain area, whereas a viral infection, such as hepatitis C may cause abdominal pain, joint pain, nausea or vomiting, and yellowing of the skin or eyes. Some illnesses can be caused by either a virus or bacteria, for example pneumonia, meningitis, or diarrhea, and symptoms may be similar, reflecting the body trying to rid itself of the infecting organism, and may include:

- Coughing
- Cramping
- Diarrhea
- Nausea or vomiting
- Sneezing
- Tiredness.

Virus vs bacteria: Any difference in transmission?

Bacteria and viruses can be spread in similar ways, such as:

- Being exposed to droplets expelled when a person coughs or sneezes in your vicinity
- Close contact with an infectious person
- Contact with infected surfaces and then touching your nose, mouth, or eyes
- Contact with infected body fluids through kissing, sex, urine, or feces
- Contact with infected animals or insects such as fleas, ticks, or mosquitoes
- Transmission from mother to child during birth.

High School Science Poster Requirements and Rubric

Poster must include the following:

1. All information should be organized neatly with large headings.
2. Information either needs to be typed, printed, and pasted onto your project OR you can hand write NEATLY. If it is not legible, you will lose points.
3. At least five images. Can be neatly hand drawn OR printed. These should relate to your topic and have a caption that explains what the picture represents.
4. All citations at the bottom right corner (must be in APA style and in alphabetical order.)
5. All key research questions and the overarching topic must be addressed and you should be ready to answer any questions that observers have about your topic.

Scoring Rubric

Points	Exceptional (4)	Strong (3)	Capable (2)	Developing (1)
Coverage of the Topic	Details on the poster capture the important information about the topic and increase the audience's understanding.	Details on the poster include important information but the audience may need more information to understand fully.	Details on the poster relate to the topic but are too general or incomplete. The audience needs more information to understand.	Details on the poster have little or nothing to do with main topic.
Use of Graphics	All graphics are related to the topic and make it easier to understand.	All graphics are related to the topic and most make it easier to understand.	All graphics relate to the topic.	Graphics do not relate to the topic.
Organization	Information is very organized with clear titles and subheadings. There is clear flow of concepts and logic.	Information is organized with titles and subheadings. There some inconsistencies in flow concepts and logic.	Information is organized, but titles and subheadings are missing or do not help the reader understand.	The information appears to be disorganized.
Sources	All sources (information and graphics) are accurately documented.	All sources (information and graphics) are accurately documented, but there are a few errors in the format.	All sources (information and graphics) are documented, but information is incomplete or many are not in the desired format.	Some sources are not accurately documented
Mechanics	No grammatical, spelling or punctuation errors.	Almost no grammatical, spelling or punctuation errors	A few grammatical, spelling, or punctuation errors.	Many grammatical, spelling, or punctuation errors

Total: _____/20

High School Science PowerPoint Presentation Requirements and Rubric

Presentation must be a PowerPoint or Google Slides Presentation and must include the following elements:

1. 1 title slide, at least 5 content slides, and a final citation slide.
2. All information should be organized neatly with large headings that can be read from across the room.
3. Information either needs to be typed neatly in a large enough font to be readable. If it is not, you will lose points.
4. At least five images. These should relate to your topic and have a caption that explains what the picture represents.
5. All citations on the last slide. (Must be in APA style and in alphabetical order)
6. All key research questions and the overarching topic must be addressed and you should be ready to answer any questions that observers have about your topic.

Scoring Rubric

Points	Excellent (4)	Strong (3)	Emerging (2)	Developing (1)
Coverage of the Topic	Details on the presentation capture the important information about the topic and increase the audience's understanding.	Details on the poster include important information but the audience may need more information to understand fully.	Details on the poster relate to the topic but are too general or incomplete. The audience needs more information to understand.	Details on the poster have little or nothing to do with the main topic.
Use of Graphics	All graphics are related to the topic and make it easier to understand.	All graphics are related to the topic and most make it easier to understand.	All graphics relate to the topic.	Graphics do not relate to the topic.
Organization	Information is very organized with clear titles and subheadings.	Information is organized with titles and subheadings.	Information is organized, but titles and subheadings are missing or do not help the reader understand.	The information appears to be disorganized.
Sources	All sources (information and graphics) are accurately documented.	All sources (information and graphics) are accurately documented, but there are a few errors in the format.	All sources (information and graphics) are documented, but information is incomplete or many are not in the desired format.	Some sources are not accurately documented
Mechanics	No grammatical, spelling or punctuation errors.	Almost no grammatical, spelling or punctuation errors	A few grammatical, spelling, or punctuation errors.	Many grammatical, spelling, or punctuation errors

Total: _____/20

Science Writing Rubric

	Exceptional (5)	Strong (4)	Capable (3)	Developing (2)	Weak (1)
(Content) Purpose Evidence Analysis	Creatively communicate understanding of the assignment through awareness of audience, tone and structure. Provides relevant information/data, including clear, accurate analysis of the evidence, and/or summaries of the most important ideas through a unique and innovative perspective.	Consistently demonstrates understanding of the assignment through awareness of audience, tone and structure. Provides relevant information/data, including clear accurate analysis of evidence, and/or summaries of the most important ideas.	Generally demonstrates understanding of the assignment through awareness of audience, tone and structure. Provides relevant information/data, including accurate analysis of evidence, and/or summaries of the major ideas.	Sometimes demonstrates understanding of the assignment through awareness of audience, tone and structure. Provides some irrelevant information, or inaccurate data, or lacks summary of the main ideas.	Fails to demonstrate understanding of the assignment through awareness of audience, tone and structure. Provides information that is generally irrelevant or inaccurate, and lacks summary of the main ideas.
	Exceptional	Strong	Capable	Developing	Weak
(Organization) Topic Sentence Body Paragraph Conclusion	Contains appropriate sections including an introduction. Conclusions are generally logical and based on information. Structure follows a logical progression.	Contains appropriate sections including an introduction. Conclusions are logical and based on information. Structure follows a logical progression.	Contains appropriate sections including an introduction. Conclusions are generally logical and based on information. Structure follows a logical progression	Contains most appropriate sections but lacks a logical progression in structure.	Lacks appropriate sections and/or conclusions. Exhibits no logical progression in structure.
	Exceptional	Strong	Capable	Developing	Weak
(Language) Word Choice Vocabulary Connected to discipline	Consistently uses science terms/units that are appropriate and specific to the subject area/content being analyzed in a complete and thorough manner.	Consistently uses science terms/units that are appropriate and specific to the subject area/content being analyzed in a complete and thorough manner.	Consistently uses science terms/units that are appropriate and specific to the subject area/content being analyzed. The amount/choice of terms may not be complete and thorough.	An attempt to use proper terminology/units but frequently misuses the appropriate language. Demonstrates occasional misunderstanding of the subject through misuse of terms, units, and context.	Minimal to no use of appropriate terms and units; shows frequent misunderstanding of the subject.
	Exceptional	Strong	Capable	Developing	Weak
(Mechanics) Grammar and Conventions	Meets all requirements of scientific writing with respect to sentence structure, grammar, mechanics, and usage	Meets most requirements of scientific writing with few errors that do not interfere or interrupt flow of the written assignment	Meets most requirements of scientific writing, but sometimes has errors that negatively impact the reader's understanding of the information	Meets some requirements of scientific writing, but contains frequent errors that negatively impact the reader's understanding of the information	Fails to meet the requirements of scientific writing with respect to sentence structure, grammar, mechanics, and usage
					OVERALL RATING _____

Your Name:


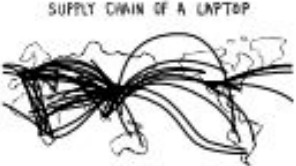








BUY, USE, TOSS?

AN ALTERNATIVE TWO- WEEKS PERFORMANCE TASK FOR HS SCIENCE



Unit Overview

Suggested Scope and Sequence

Introduction		Steps of Materials Economy		
Day 1 Pre-test Garbology 	Day 2 Mapping the Impact *optional activity for 2-day lesson 	Day 3 Drilling down to Sustainability 	Day 4 The Cost of Production 	Day 5 On the Road to Retail 
Steps of Materials Economy (cont'd)		Conclusion		
Day 6 Why Buy? 	Day 7 Defining Happiness 	Day 8 It's a Dirty Job 	Day 9 A System Redesign *optional out-of-class research 	Day 10 Analyzing the Message 

PART I: GARBOLOGY

OBJECTIVES Students will:

- Engage in a critical analysis of consumption
- Examine trends of modern disposal of material goods in the United States
- Analyze ways in which consumption choices reflect people's lifestyle and culture



GUIDING QUESTIONS

- How do material goods reflect our way of life?
- How do our individual consumption habits compare to those of an average American?



PART I JOT YOUR THOUGHTS DOWN

1. List all trash items they have discarded in the past 1-2 days

TYPE your answer here

2. Which, if any, of the materials in your trash are luxury (non-essential) items and which are essential items?

TYPE your answer here

3. What information can be determined by looking at a person's garbage?

TYPE your answer here





PART I “BURIED TREASURE” – A FICTIONAL STORY

VOCABULARY

material consumption—the purchase and use of resources and products

waste disposal—the act of getting rid of unwanted materials

culture—the behavior, art, beliefs, and traditions of a group of people

luxury—a material good or service that is not essential to a person’s life; an extravagance

necessity—a material good or service that is essential to a person’s life; something that is required

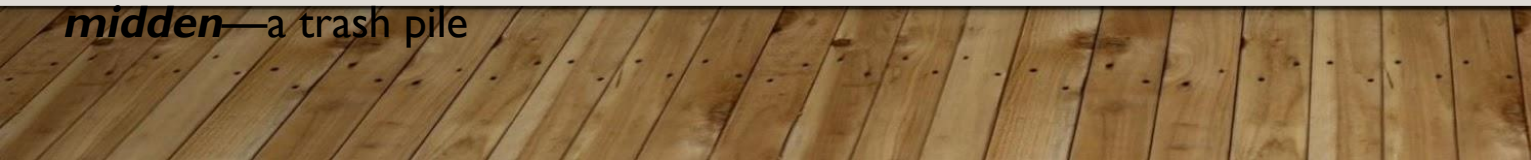
archaeology—the study of past human life and culture by an analysis of artifacts and material evidence

midden—a trash pile

Last May a modern archaeologist, known in some circles as a “garbologist,” came across a midden in an extremely remote location. A midden is a collection of household waste. Most people these days would use the term “dump” to describe a midden. This midden is located 20 yards from an abandoned two-story house.

The location has not been publicly revealed for fear that other interested parties would loot or otherwise destroy the archeological site. Thanks to the geography of this remote location, which is quite dry and cold, the materials are mostly intact. According to newspapers found in the midden, the trash was produced and buried during a 6-month period in 1999.

Dr. Julia Johnston is the archaeologist in charge of cataloguing the discarded items and inferring information about the people who produced them. Johnston has deduced from the contents of the garbage that three or four individuals at most contributed to the midden. In all, an estimated 3400 pounds of garbage were found in the midden.



PART I “BURIED TREASURE” – A FICTIONAL STORY, CONTINUED

REFLECTION QUESTIONS

Dr. Johnston recently released a summary of the items found at the site. Here is the breakdown of the trash items she found:

- 34% paper, a mix of newspapers, glossy magazines, and office paper (more than half the paper appears to have been used for packaging materials such as boxes)
- 13% organic materials from the landscape, including dried leaves and grass clippings
- 12% food, including many items still inside plastic bags and other packaging
- 12% plastic, including food containers and containers that once held liquid cleaning substances
- 8% metal, including aluminum and tin cans
- 7% textiles, rubber, and leather, including discarded clothing, a used tire, and a small rug
- 6% wood (2 broken chairs)
- 5% glass, including beverage and food containers, as well as fragments of other glass items
- 2% personal items, including diapers, cosmetics, and pharmaceuticals/medicines
- 1% electronics (a cell phone and a TV remote)

1. Divide the contents of midden into the following two categories:

Necessities	Luxuries
TYPE your answers here	TYPE your answers here

2. Are the contents of the midden mostly essential items, or are they mostly luxuries?

TYPE your answer here

PART I “BURIED TREASURE” – A FICTIONAL STORY, CONTINUED

REFLECTION QUESTIONS

Now Johnston and her team are trying to learn more about the people who inhabited this remote location. They are looking to the midden contents for clues. Questions they hope to answer include the following:

- Why were the items discarded?
- Did these people have ample resources to survive, or did they struggle?
- What appeared to be important to them?
- How might they have spent their time?
- Did they have a relatively high or low standard of living compared to people in other places around the world?

6. How does the waste from the midden compare to the waste produced by your own household?

TYPE your answer here

3. Why do you think these items were discarded in the midden instead of being reused inside the house?

TYPE your answer here

4. Based on the contents of the midden, how might you characterize the lifestyle of the people who created it?

TYPE your answer here

5. What other conclusions could be drawn about these people? (For example: What was important to them, or how did they spend their time?)

TYPE your answer here

PART 2: MAPPING THE IMPACT

OBJECTIVES Students will:

- Identify resources, processes, and impacts embodied in material goods
- Analyze interconnections among lifestyle, population, economy, and environment
- Determine ways to reduce ecological footprint and other impacts associated with material goods

VOCABULARY

sustainability—meeting current needs without limiting the ability of people to meet their needs in the future

ecological footprint—the area of Earth's productive surface that it takes to produce the goods and services necessary to support a particular lifestyle

resource consumption—the process of using natural resources, materials, or finished products to satisfy human wants or needs



GUIDING QUESTIONS

- What are environmental, economic, and social impacts of commonly used items?
- What can we do to reduce negative impacts associated with resource consumption?

The meat came from cattle grazed initially on public or private land, and later fed grain. Some of the public lands in the western United States have been turned to desert by overgrazing, which happens when livestock eat so much vegetation that it no longer grows back. Streamside lands where cattle graze have been especially damaged.

It took approximately 2 pounds of grain to produce that quarter pound of meat. Grain production from unsustainable farming methods results in topsoil loss due to erosion. Producing that grain also took substantial amounts of pesticides and fertilizers (half of all fertilizer in the United States is applied to feed corn for animals), some of which ran off into surface water or seeped into groundwater supplies. Commercial fertilizers have been linked to climate change. The creation of nitrogen fertilizers releases the greenhouse gas nitrous oxide, which can combine with other greenhouse gases in the atmosphere to make temperatures on Earth warmer.

At a feedlot, where cattle are fattened before they are slaughtered for food, a typical steer will eat about 3,000 pounds of grain to increase in weight 400 pounds. By the time the steer was

Hamburger, Fries, and a Cola, What Did It Take to Produce This American Meal?

finished in the feedlot, it took 600 gallons of water to build that hamburger patty. At the meatpacking plant where the steer was slaughtered and butchered, most of the workers receive low wages and no health insurance or vacation days. These workers face high injury rates.

Once slaughtered and processed, the meat was frozen, shipped by truck, kept cold, and then cooked on a grill using natural gas. Both the diesel fuel to run the truck and the natural gas grill require burning fuels that contribute to climate change.

The 5-ounce order of fries came from one 10-ounce potato grown in Idaho on half a square foot of soil. It took 7.5 gallons of water to raise that potato, plus quantities of fertilizer and pesticides, some of which ran off into the Columbia or Snake Rivers. Because of that, and dams that generate power and divert water for irrigation, the Snake River sockeye salmon is virtually extinct.



PART 2 TASK INSTRUCTIONS

- **(Optional)** Read the short article taking in consideration all the components of the meal and their environmental and socioeconomic impacts.
- **(Required)** Analyze the Sample Impact Diagram for one of components of the American meal – a hamburger and What Does It Take To Make? table (see

Farmers receive a small fraction of the price of the fries, maybe 1 or 2% of the price a customer paid for the fries. Most potatoes are now grown on large farms that require large potato-harvesting equipment. This reduces the number of potato farmers that are required to produce potatoes.

The potato was dug with a diesel-powered harvester and then trucked to a processing plant where it was dehydrated, sliced, and frozen. The freezing was done by a cooling unit containing hydrofluorocarbons (HFCs), some of which escaped into the atmosphere where they may contribute to global climate change. The frozen fries were then trucked to a distribution center, then on to a fast-food restaurant where they were stored in a freezer and then fried in corn oil heated by electricity generated by hydropower.

The meal was served in a fast-food restaurant built on land that was originally forest, then farmland, and then converted to commercial/industrial uses as the city expanded. Many of the workers in the fast-food restaurant are teenagers and young adults who work part-time for minimum wage.

The cola came from a Seattle processing plant. It is made of 90% water from the Cedar River. The high-fructose corn syrup came from Iowa, as did the carbon dioxide used to produce the fizz, which is produced by fermenting corn. The caffeine came from a processing plant that makes decaffeinated coffee. The cola can was made from one-third recycled aluminum and two-thirds bauxite ore strip-mined in Australia. It came to Washington State on a Korean freighter, and was processed into aluminum using an amount of energy equivalent to a quart of gasoline. The energy came from some of the same dams mentioned earlier that have contributed to an estimated 97% decrease in the salmon runs of the Columbia Basin.

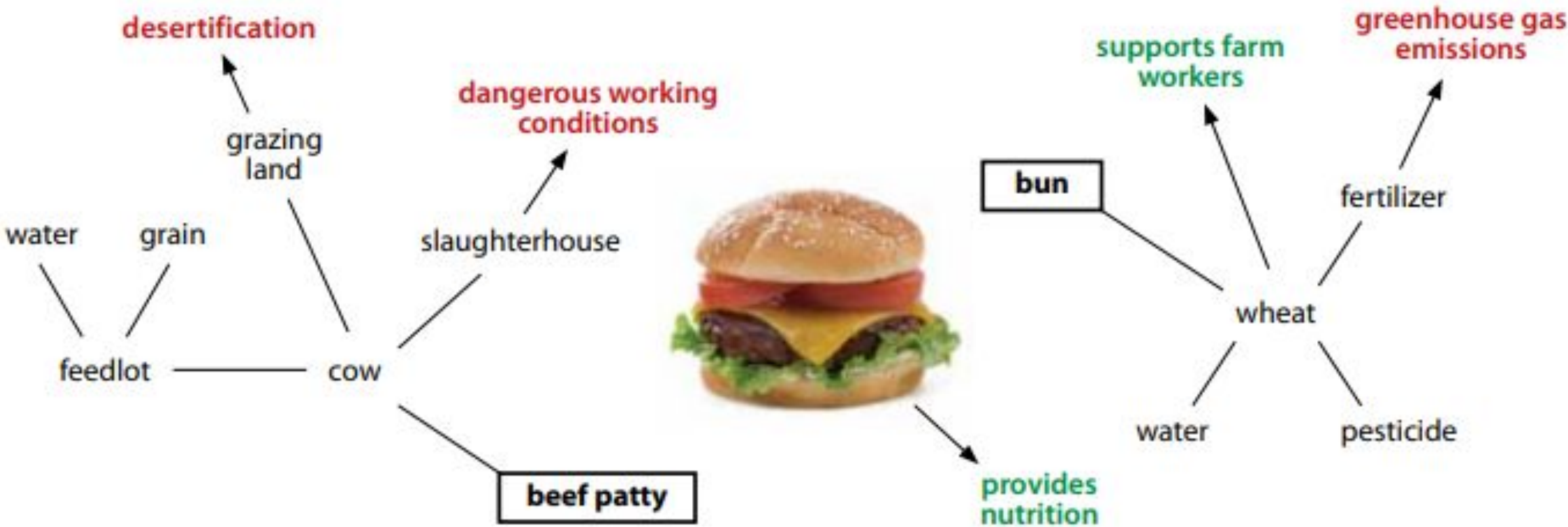
Cola has been called “liquid candy” because of its high sugar content. In the late 1950’s a typical fast-food cola was 8 ounces. Today a large cola might be 32 ounces, containing over 300 calories and a third of the daily maximum amount of sugar recommended for an adult. High amounts of calories and sugars can lead to conditions like obesity and diabetes. In the United States an estimated 34% of adults are obese.¹ Cola is extremely profitable for fast-food restaurants. It costs a restaurant just 9 cents to buy the syrup needed for a medium cola that sells for around \$1.29.

The typical mouthful of food consumed in the U.S. traveled 1,200 miles for us to eat it. Along the way, it required packaging, energy, roads, bridges, and warehouses. Both people and machines were required for each step of the food production.

¹ National Center for Health Statistics, “Health, United States, 2008,” www.cdc.gov/nchs/data/abus/abus08.pdf, 32.



Sample Impact Diagram: Hamburger



KEY for colors in diagram:

- RED – negative impact
- GREEN – positive impact
- BLACK - components

What Does It Take to Make?

Cup of Coffee

Beans

- Beans grown in Colombia
- Pesticide from Germany applied to beans
- Beans roasted in New Orleans

Sugar and Cream

- Sugar produced in Florida
- Cream from dairy near Seattle

Disposable Cup

- Made from 10% recycled paper
- Virgin paper from trees grown in Canada
- Cup lined with a thin layer of plastic, made from oil drilled in Venezuela

T-shirt

T-shirt is 50% cotton / 50% polyester.

Polyester

- Crude oil drilled in Venezuela
- Crude oil refined in Curacao
- Refined oil processed in Delaware to create polyester fiber

Cotton

- Cotton grown in Mississippi
- Cotton fibers spun into yarn in North Carolina

Assembly

- Shirt sewn in Honduras

Newspaper

Newspaper is made of recycled and virgin paper.

Virgin Paper

- Trees grown in British Columbia

Recycled Paper

- Recycled paper processed in Michigan

Assembly

- Virgin and recycled paper are made into newsprint in a Detroit paper mill

Ink

- Made from petroleum drilled in Gulf of Mexico

Computer

Computer Chip

- Made of silicon mined in Washington State
- Silicon processed in Oregon
- Sent to chip manufacturer in California
- Copper from Arizona and gold from South Africa applied to chip

Circuit Board

- Made of tin from Brazil and lead obtained from recycled car batteries in Houston

Monitor

- Assembled in Japan
- Plastic created from oil drilled in Saudi Arabia and processed in the U.S.

Athletic Shoes

Athletic shoes are made of leather and synthetics.

Leather

- Cows raised in Texas
- Cow hides shipped to South Korea for tanning (to make leather soft and durable)

Synthetics

- Synthetic insole made of oil drilled in Saudi Arabia and refined in South Korea
- Synthetic rubber sole made of oil drilled in Saudi Arabia and refined in Taiwan

Cardboard Box

- Made from recycled paper in New Mexico

Bicycle

Metal frame

- Recycled steel from Chicago
- Manufactured and painted in Wisconsin

Aluminum gears, brakes, and spokes

- Made from ore mined in Australia and smelted (where metal is pulled from the ore) in Russia
- Manufactured in Japan

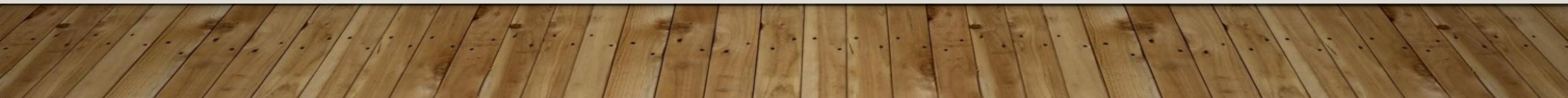
Tires

- Synthetic rubber made in Taiwan from petroleum

PART 2 YOUR TURN

Brainstorm and diagram all of the resources, processes, and impacts associated with one everyday object, such as an item of clothing or a piece of sports equipment. Examples could be favorite meal, an article of clothing, a favorite object, or a mode of transportation.

Component/Part	What is it made of?	What resources are needed?	Is transportation required?	What are the possible environmental, social, economic impacts (positive and negative)?



PART 2 YOUR IMPACT DIAGRAM / WEB

- Decide on one item from the table that will be the focus of your web diagram.
- Create a web diagram similar to sample impact diagram – hamburger and attach it in the space to the right.

For example, if you decide to diagram the impacts of a cell phone, you would write and/or draw it in the center of your diagram, and then write and/or draw the resources and processes required to produce each part of the phone and all the impacts you can think of that might be related to producing and using it.

NOTE: *To draw digitally, you can use google draw, then copy and paste your picture in this slide.*

PART 2 REFLECTION QUESTIONS. USE FULL SENTENCES.

Natural Resource Chosen:

TYPE

1. How is the ecological footprint of a person's lifestyle connected to social and economic impacts?

TYPE your answer here

2. Would the production, use, and disposal of these everyday items be sustainable if only a small number of people purchased the items?

TYPE your answer here

3. How would the impacts associated with an item change if everyone in the world purchased or used it?

TYPE your answer here

4. Does lessening our impacts necessarily mean reducing our quality of life? Why, or why not?

TYPE your answer here

5. How might businesses be encouraged to produce these items in ways that have more positive impacts on the environment and on people?

TYPE your answer here

6. Often negative impacts associated with an item are not paid directly by the people who purchase and use the items. Who might end up paying for those impacts? Why do you think these impacts are not included in an item's purchase price?

TYPE your answer here

PART 3: DRILLING DOWN SUSTAINABILITY



OBJECTIVES

Students will:

Define sustainability and its three key components: the economy, the environment, and society

Identify methods by which natural resources are extracted and the ways in which these methods affect people and places

Determine the sustainability of natural resource extraction

Make connections between resource extraction and consumer demand

VOCABULARY

- **sustainability**—meeting our own needs now without limiting the ability of future generations to meet their needs
- **three components of sustainability**— economy, environment, and society
- **natural resource extraction**—the process of removing materials from the earth for use by humans

GUIDING QUESTIONS

What does “sustainability” mean and how does it apply to human activity?

What are impacts of natural resource extraction on societies, environments, and economies?

How do our consumption habits contribute to resource extraction?
How can an activity be made more sustainable?

Society

- How are people’s lives affected?
- How are cultures affected?
- Do some people benefit at the expense of others?

Environment

- How are plants and animals affected?
- How are air, water, and soil affected?
- What is the long-term impact on the environment?

Economy

- How are local, national, and international economies affected?
- Are meaningful job opportunities provided?
- Is there a long-term economic gain for people and communities?



PART 3 PERFORMANCE TASK INSTRUCTIONS

When a resource is extracted, it is removed from the environment so that it can be used to create products that we buy.

- You are provided a list with various resources (i.e. gold, coal, coffee, etc.). Each resource will contain cards with various roles, which are different perspectives on natural extraction of that particular resource.
- Choose ONE RESOURCE and read all the perspective of each role on that specific resource. You will have to reach consensus on these multiple perspectives to recommend whether or not extraction of the resource should continue.
 - [Gold](#)
 - [Timber](#)
 - [Coal](#)
 - [Coffee](#)
 - [Petroleum](#)
- Complete the PART 3 Reflection questions.

Group A: Gold

I am a **gold miner** in Indonesia. I work at a large open-pit mine owned by a foreign company. Each day, I operate a machine that digs out thousands of pounds of ore (rocks and dirt that contain tiny amounts of gold). I have never actually seen the gold. The ore is transported somewhere else, where

people extract the gold. The area where we remove the ore has become a giant pit that cannot be used for anything else. I make more money than most of my neighbors. In fact, I'm paid over \$600 each month. I have a house and a television, thanks to this job.

I am the vice president of a **cell phone company**. Most people think that gold is only used for jewelry, but our engineers have found small quantities of gold to be extremely useful in cell phones. Gold is a good conductor, meaning that electricity can run through it. This is why gold is used in many electronics. We only use a tiny amount in each cell phone. Cell phones are very important because

people can use them anywhere in the world. People in rural areas can use cell phones to communicate in places that don't even have land-line telephones. If we didn't use gold, we'd find another metal conductor that also has to be mined. Each year more and more people are buying cell phones, and we have to keep up with the demand. That's why we continue to buy gold.

I am an employee of the **national government** in Indonesia. We have seen more and more gold companies come to our country to mine gold for products that will be made and sold in other countries. Since we have been blessed with this resource, why not sell it to make money for our country? It is true that the areas where we currently allow open

pit mining are becoming toxic. However, we will make sure that those areas are safely enclosed so that they don't hurt anyone. We want to make sure that foreign companies continue doing business in our country so that we can invest the money into improving the lives of our citizens.

I am an **environmental scientist**. I worry about how open pit mining is permanently altering the environment. The deep pits that are created are so large they can be seen from space. Also, this type of mining relies on a process called cyanide leaching. A chemical called cyanide is sprayed on dirt and rocks that are removed from the pit. The cyanide bonds

to tiny bits of gold and silver as it trickles down through the ore. Cyanide is very toxic – it is a killing agent used in gas chambers. If it leaks into soil or water, it can contaminate streams, killing fish and other wildlife. Some companies recycle and reuse the cyanide to reduce their environmental impacts.

I am a **resident** of a small community in Indonesia next to a large open-pit mine. At first I thought the mine would be great because it can provide many jobs. Unfortunately, the cost of living is now much higher. The miners make good money, so they are able to pay higher prices for food, electricity, and

land to build homes. Those without mining jobs can no longer afford all of these things. We have also watched the devastation of our environment. The mining company dumps waste rocks onto our beautiful rainforests. What will be left when the company is finished?

Group B: Timber

I am a **forester** in Canada. I make my living by harvesting trees. These trees can be used for all sorts of things everyone needs, like furniture, construction materials, magazines, tissues, and toilet paper. Our company cuts down large areas of trees and then lets those areas grow back for twenty years or more. We

even speed the process up by planting tree seedlings in areas we've harvested. We prefer to plant fast-growing tree species, like pines. When these trees get large enough, we go back and cut them again. So long as people need wood and paper products, I'll have a job.

I am a salesperson at a large **paper company**. We sell paper to companies that print newspapers and magazines. Some of our customers now want paper that has been recycled instead of paper made only from new trees. We find that the best paper is still made mostly from new trees, but we also want to

make sure our customers are happy. If people are willing to pay more for recycled paper, we will start making more of it. Our company wants to make a profit, so we will do what we need to do to make our customers happy.

I am a **furniture maker**. Whereas some wood can be recycled, that's not always true for furniture. Some builders recycle wood to build new homes and businesses. However, I need large, beautiful trees to create luxurious dining tables and chairs. As long as people pay me well to create these items, I will continue to make them. I prefer working with hardwood trees, which are typically older and more

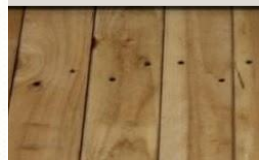
valuable than pine trees. I don't really care where the wood comes from so long as it holds up well. A good piece of furniture can be passed down from generation to generation until it becomes an antique. Cheap furniture, on the other hand, tends to break more easily. I don't want my customers to have to keep buying new tables and chairs because their old ones broke.

I am a **wildlife biologist**. I'm concerned about the effect that large-scale timber harvesting has on ecosystems. There are many species of animals that can't survive without a healthy forest. For example, in the southeastern United States the red-cockaded woodpecker can only be found in older forests. They

create nests in dead trees in mature pine forests. These birds are considered a keystone species because many other forest species (including insects, birds, lizards, and squirrels) use their nests. Scientists know that each species is important because it is connected to the lives of other species in a food web.

I am an **indigenous person** whose family has lived in the same forest for over 100 years. The forest provides us with food, shelter, and medicines. Trees are one of our most valuable natural resources, physically and culturally. Last year a portion of the forest in which my community lives was cut down

by a logging company. That forced several families to move from their homes. We must protect what remains of our forests so that they can continue to provide us with essential resources and help us maintain our culture.



Group C: Coal

I am a site manager for a **coal mining company** in West Virginia. Most of the people I know also work for the mining company. Some of us used to work in mine shafts that went deep underground. The company I work for now prefers to get coal through mountaintop removal. It is a lot faster and doesn't require as many people. Plus, now I don't

have to worry about dying if a mine shaft collapses. In mountaintop removal, we use giant machines to basically blow the top off of a mountain to make it easier to get to the coal inside the mountain. I know my job is important because many power plants in the United States burn coal to create electricity.

I am a **coal miner**. I work in a shaft mine. It's what my father and grandfather did. I don't know how to do anything else. As soon as I graduated high school, I started working as a coal miner. Right now I work in a mine that is 700 feet deep. It is dangerous work, but the number of job-related deaths of

miners is a lot lower than it was in my father's time. Once I was in a mine that partially collapsed. Luckily, emergency crews were able to get me and my coworkers out before we ran out of air. I'm hoping I can stay healthy and safe so that I can continue to provide for my family.

I am a **citizen of a small mountain community** in the Appalachian Mountains of West Virginia. Our state has long been known for its beautiful mountains. Lately, however, these mountains have been scarred by mountaintop removal. Not only does mountaintop removal destroy the beauty of the mountains, but it's also ruined my well, which is my family's only source of drinking water. The dirt and rocks

that are exposed during mountaintop removal are usually dumped into nearby valleys. In my community, a company dumped the rubble in a valley where a stream runs through. Now the stream is discolored and cloudy. A lot of people I know have cancer and other diseases that no one used to have. We have complained, but the mining companies keep doing business as usual.

I am the Chief Executive Officer for a company that owns several **coal-fired power plants**. Coal is an ideal fuel source. For one thing, we have tons of it right here in the United States. That makes it much easier and safer to access than oil that has to be imported from the Middle East or South America. For another thing, coal contains more energy that can

be turned into electricity than competing fuels, like natural gas. Our country was built on coal. Some of these people who want to use renewable fuels like wind and solar energy just don't understand how much better coal is. So many power plants are already set up to burn coal that it doesn't make sense to change things while we still have plenty of coal.

I am a **mechanical engineer**. I believe that we can and should stop mining coal. We have other technologies available right now – such as wind turbines and solar cells – that could supply us with all the electricity we need. Burning coal for electricity

releases air pollution, including greenhouse gases that result in climate change. The earth is already getting warmer from our use of dirty fuels like coal. Let's invest in clean alternative fuels now!

Group D: Coffee

I am a **coffee grower** in Ethiopia. Coffee is a wonderful crop to grow because everyone loves coffee! Unfortunately, I cannot get a fair price for my coffee. I sell the beans to a man who then sells them to a company that will roast them to make coffee for drinking. I make hardly any profit. I feel like I have to sell my beans so cheaply because

otherwise I won't sell them at all. My son and daughters have had to drop out of school because I can't pay their fees. The village school requires money to pay for books, uniforms, and teachers. Instead of attending school, my children now help me in the field. I enjoy their company, but I worry that they will grow up to be poor like me.

I am a **shade-grown coffee farmer** in Costa Rica. Coffee is a shrub that grows well in rainforests, where there are tall canopy trees that shade the coffee bushes. This is how coffee was meant to be grown. Unfortunately, some of the major companies selling coffee want coffee growers to grow a type of coffee that can survive in full sunlight. They can get

higher yields for growing coffee in the sun, but the higher yields come at the price of the rainforest ecosystem. To grow full-sun coffee, first all the trees and shrubs have to be cleared from an area. Once they are cleared, the rainforest ecosystem takes many, many years to regrow.

I am a **coffee supplier**. Some people call me the "middleman" in the coffee industry. I talk to coffee growers and buy their beans for as low a price as I can. Then I resell those beans to companies that roast them to make coffee for drinking. I make my living by being the person in the middle of the transaction between the people who produce coffee beans and the people who sell them to coffee

drinkers. Some coffee roasters are starting to engage in direct trade, whereby they send a representative to make deals with coffee growers directly. That means no money for me. I know that coffee growers should make more money because for a long time they haven't been paid fairly for what they grow. But how will I make a living if I'm squeezed out of the process?

I am the **owner of a coffee shop**. I have heard about "fair trade" and "direct trade" programs that provide coffee growers with more money. It makes sense – why should a coffee farmer make only pennies for a cup of coffee I sell for \$2? However, fair trade coffee is more expensive than the coffee I can get from my supplier. The same goes for organic coffee that has

been grown without pesticides or harmful chemicals. My customers complain any time I increase my prices. Since I have never heard a customer ask for organic or fair trade coffee, I'm guessing no one would even care if I did buy those types of coffee beans.

I am an **eco-tourism guide** in Costa Rica. I make my living by providing tours through the rainforest. People from all over the world come to Costa Rica to visit our rainforests. They are eager to see beautiful plants and animals that live in the forest. Sun-grown coffee threatens my business because it

requires cutting down forests to let in sunlight. Forests don't have to be cleared to grow shade-grown coffee, which is good for the animals that rely on the forest and also for people like me who make a living from the rainforest.

Group E: Petroleum

I am a **marine biologist**. I study organisms that live in the oceans. Petroleum drilling like the kind that happens off the coast of Texas and Louisiana worries me. When hurricanes blow over oil rigs (structures that house the machinery that drills into the ocean floor to get petroleum), petroleum can spill into ocean waters. Oil spills can also happen when oil is being transported by boat from one place to

another. When oil enters a marine ecosystem, it can be disastrous. Aquatic birds, mammals, and fish can all become covered in the thick oil, leading to death in some cases. The use of petroleum also has been linked to climate change. Climate change causes oceans to become more acidic, which can kill sensitive species like coral.

I am an **oil company spokesperson**. I believe that petroleum is hands-down the most efficient fuel source for our nation's transportation needs. We already have the technology in place to use petroleum for creating diesel, gasoline, and jet fuel. By drilling off the coast of the United States, we reduce our

need for foreign oil. This is much safer for our country than relying on oil from countries that may have unstable governments. Oil drilling is a relatively safe industry; very few accidents have occurred in recent years. Plus, it provides many jobs in the U.S.

I am a **roughneck on an oil rig**. You have to be in good shape to work on an oil rig, that's for sure! I help set up and carry out the drilling. I'm responsible for maintaining the pipes that carry the oil; I constantly check to make sure there are no leaks. I also help with mechanical maintenance, like making sure the engine is working right. Our rig runs all the time, so I work long hours. I don't really mind, but

my family wishes I spent more time at home. Every once in a while I hear about an accident where a rig blew up or about a storm that sank a rig into the ocean. Those accidents can be fatal for the crew on the rig. I hope I can keep working on the oil rig, though, because it pays pretty well. All of the factory jobs in my hometown have been moved overseas, so this job is even more important now.

I am an **alternative fuels investor**. I fund research on alternative fuels so that we can do all the things we love to do without relying on petroleum. While most people think the only way we can move our cars is with gasoline made from petroleum, I have found that there are quite a few other options that could be profitable. Electric cars could be the wave of the future, especially in places where the electric-

ity is provided by renewable fuel sources like wind power. These cars simply need to have their batteries recharged after use, and they don't require any gasoline. Another possibility is hydrogen fuel cells. The fuel cells convert hydrogen and oxygen into water, producing electricity in the process. Most alternative fuels don't produce air pollution like gasoline does. This could help fight climate change and smog.

I am a **parent** with three children. We have a large vehicle so that everyone has plenty of room when we need to go somewhere. Unfortunately, it takes quite a lot of gasoline to power such a large vehicle. I hope that our country will continue to have enough oil for everyone's needs. I'm afraid that if our oil supply starts declining, gas prices will go up. If we have to pay any more for gas than we already

do, our family will have to cut back on other expenses. We don't have much money left after we pay our monthly bills, so I don't know how we could afford higher gas prices. I understand there might be environmental consequences from oil drilling, but my family and I try to minimize our environmental impacts in other ways.



PART 3 REFLECTION QUESTIONS. USE FULL SENTENCES.

1. What are impacts of resource extraction on the environment?

TYPE your answer here

2. Overall, is extraction of this resource environmentally sustainable?

a) Why, or why not?

TYPE your answer here

b) How could it be made more sustainable?

TYPE your answer here

3. How does resource extraction affect local and national economies?

TYPE your answer here

4. Overall, is extraction of this resource economically sustainable?

a) Why, or why not?

TYPE your answer here

b) How could it be made more sustainable?

TYPE your answer here



PART 3 REFLECTION QUESTIONS, CONT. USE FULL SENTENCES.

5. How does extraction impact people and communities?

TYPE your answer here

6. Overall, is extraction of this resource socially sustainable?

a) Why, or why not?

TYPE your answer here

b) How could it be made more sustainable?

TYPE your answer here

7. On a scale of 1-5, rate the overall sustainability of extracting this resource.

TYPE your answer here

8. Should the natural resource you chose continue to be extracted?

- If yes, is there a particular method that is most sustainable? What is it?
- If not, why should this resource no longer be extracted?

TYPE your answer here



PART 4: THE COST OF PRODUCTION

OBJECTIVES:

Students will:

Explain various factors that might contribute to a company's sourcing decisions

Describe real-life working conditions

Weigh the pros and cons of corporate manufacturing policies

Develop corporate policies with sustainability in mind

Identify costs and benefits of global trade

VOCABULARY

- **production**—the process of manufacturing or creating material goods and products
- **globalization**—the interconnection of economies, societies, and cultures across the globe
- **corporate social responsibility**—an approach to business whereby a company holds itself responsible for the impact of its actions on consumers, workers, communities, and the environment

GUIDING Questions

- How does production of material goods impact people and places where those goods are produced?
- What policies might change these impacts, and in what ways?
- What are pros and cons of manufacturing goods in foreign countries?



STOP and JOT Down!

1. *Where are the clothes that you are wearing now made from? List the countries.*
Type your answer here
2. *We import more material goods from China than from any other country. Why do you think we import so many of our goods from China?*
Type your answer here

PART 4 PERFORMANCE TASK

INSTRUCTIONS:

- Read all parts of *Working for a Living?*
- Complete *You're the Boss* section
- Complete the PART 4 Reflection Questions section



Working for a Living?

If you bought a pair of jeans for \$50, how much money would you expect the worker who sewed the jeans to receive? \$25? \$10? \$5? You might be shocked to learn that a laborer might receive only \$1 from the sale of those jeans. That's just 2% of the retail price.¹

So where does the rest of that money go? Much of it goes to advertising, corporate salaries, store rental fees, and "middle men" (people who connect manufacturers with retailers). Some of it is spent on raw materials, like cotton. Very little goes to the people who actually make the clothing.

American companies import more goods from China than from any other country. Much of China's wealth comes from investment from foreign companies. These companies hire factories in China to make products that will be sold in the United States. In the year 1998, exports from

REFERENCES

¹China Blue website, "The Blue Jeans Business," www.pbs.org/independentlens/chinablue/ (accessed November 11, 2009).

Working for a Living?^{Continued}

China to the United States were around \$71.2 billion. Over the past decade, exports have increased to over \$287.8 billion. Growing exports over the years have been products such as computers, apparel, household items, and furniture.²

Like many countries, China has labor standards designed to protect its workers. According to the International Labour Office, China has laws related to worker hours (generally 8 hours per day), overtime compensation (50-200% greater than the base pay rate), and required rest days (2 per week). Minimum wage is set by each region of the country. The lowest minimum wage is 270 yuan per month (about \$40/month) in the Province of Jiangxi. The highest is 750 yuan per month (\$110/month) in Shanghai City. China also has labor unions that protect workers' rights.³

China is an attractive location for manufacturing for several reasons. Chinese factories are able to keep costs low for foreign corporations. Also, China has a number of major ports and terminals to make shipping easy. And they have the largest labor force of any country in the world.⁴

The True Cost of Labor

The unattractive side of manufacturing reveals the real-life working conditions for Chinese laborers and the toll that production of material goods is taking on the environment. Although China has restrictive labor laws, these laws are often broken. Some factories maintain two sets of books in order to evade inspectors who visit the factories. One estimate suggests that over half of Chinese suppliers submit false pay records to inspectors, and only a small fraction of Chinese factories obey limitations on daily working hours. Apparel manufacturers often do not pay workers for mandatory overtime and may not allow workers more than a few days off each month.⁵

The toxic chemicals that are used to make products impact the health of factory workers. On a daily basis, workers in many factories in China inhale or are exposed to toxic materials like lead, mercury, cadmium, and benzene. Benzene is a colorless and flammable liquid that can be used to make materials like ink, paint, and plastic. Excessive benzene exposure can lead to leukemia, bone marrow damage, and a damaged immune system.⁶

REFERENCES

² Loretta Tofani, "American Imports, Chinese Deaths," Part one of four, The Salt Lake Tribune, October 21, 2007, www.pulitzercenter.org/temp/China_Series.pdf

³ International Labour Office, Minimum Wages Database and Working Time Database, www.ilo.org (accessed November 2, 2009).

⁴ CIA World Factbook, <https://www.cia.gov/library/publications/the-world-factbook/> (accessed November 2, 2009).

⁵ "Secrets, Lies, and Sweatshops," BusinessWeek, November 27, 2006, www.businessweek.com/magazine/content/06_48/b4011001.htm.

⁶ Loretta Tofani, October 21, 2007. "American Imports, Chinese Deaths,"

Working for a Living? Continued

Direct exposure to other industrial materials can result in lung cancer and silicosis, a lung disease. Epidemiologists estimate over 4 million workers throughout China have developed silicosis by ingesting toxic air. A lack of proper ventilation in factories allows these carcinogens (cancer-causing substances) to circulate in the air without proper disposal. Health protections such as good ventilation systems and protective masks could reduce the number of workers who develop diseases and illnesses from working in factories.⁷

In some factories, workers also risk losing fingers and limbs by working with unsafe machines. Within the province of Guangdong, for example, 360,000 workers have lost limbs since 1995. Because of this, the government created a law in 2002 ordering factories to replace unsafe machines over time.⁸

In addition to impacts on workers' health and safety, factories can take a large environmental toll. Factory wastes discharged into rivers and into the air cause pollution, which leads to illness among people who do not even work at the factories. China's primary energy source for providing electricity to factories is coal, which is a fossil fuel that contributes to climate change and smog. Hundreds of thousands of premature deaths have been traced to China's environmental degradation, of which factories play a significant role.⁹

The Bottom Line

The low costs of labor and land in China are a tempting option that can save the United States millions of dollars when importing products. However, the true cost of production in China has had impacts on people and the environment that are not included in the price of products. Governments, businesses, and consumers all play a role in these impacts. Enforced labor practices around the world can result in improved health for the environment, workers, and consumers.

What's a Concerned Shopper to Do?

If you want to buy products that improve the lives of the people who make them, by providing a fair income and a safe workplace, how can you put your money where your mouth is?

For one thing, you can look into the labor and environmental practices of companies that sell products you want to buy. Many companies publish these policies online.

You can also let companies know that the way workers and the environment are treated matters to you. Would you prefer to buy products that are made by workers who are paid a fair wage? Would you prefer to buy products that were produced without causing environmental harm? If so, let companies know!

If you've ever heard the expression "money talks," you know that how you choose to spend money sends a message. Send a message by buying products from companies that you want to support.

REFERENCES: ⁷ Ibid.

⁸ Loretta Tofani, "American Imports, Chinese Deaths," Part two of four, The Salt Lake Tribune, October 22, 2007, www.pulitzercenter.org/temp/China_Series.pdf.

⁹ BBC News, "China 'buried smog death finding,'" July 3, 2007, <http://news.bbc.co.uk/2/hi/asia-pacific/6265098.stm>.

Guiding Question: If you were an executive at a U.S. company that sells clothing sewn in China, what policies would your company require Chinese factories to follow?

1. Of the following, which two things do you think are most important?

Labor Standards	Environmental Impacts
<ul style="list-style-type: none"> • Maximum number of hours in a work day • Guaranteed rest days each week • Required breaks during work day • Health insurance for workers • Safety training and equipment • No child workers • No harassment or discrimination by managers • Other: _____ 	<ul style="list-style-type: none"> • Recycle and reuse waste materials • Use locally sourced materials • Purchase sustainably extracted raw materials • Set and enforce limits for air and water pollution • Find alternatives to replace toxic materials • Record and report on disposal of all wastes • Create durable materials that will not break • Other: _____

TYPE your answer here

2. For the two most important things, write a policy statement for each. For example: Our company is going to require any factories it works with to limit workers to a strict 50-hour work week.

Policy Statement #1: *TYPE your answer here*

Policy Statement #2: *TYPE your answer here*

3. For each policy, determine its pros and cons. **For example:** Pro—Limiting workers to a strict 50-hour work week could increase the productivity and health of workers. Con—Limiting workers to a strict 50-hour work week could increase prices for consumers.

Policy Statement #1 Pro:

TYPE your answer here

Policy Statement #1 Con:

TYPE your answer here

Policy Statement #2 Pro:

TYPE your answer here

Policy Statement #2 Con:

TYPE your answer here

PART 4 REFLECTION QUESTIONS. USE FULL SENTENCES.

1. Why might some countries not want to enforce minimum wage and worker safety laws?

Type your answer here

2. One business professor says that trade is “an instrument of peace and understanding” because it requires countries to cooperate with each other. Based on what you know, do you agree with this statement? Does it change your opinions about globalization?

Type your answer here

3. If workers are to be paid higher wages, who should bear that cost? Should CEO’s be paid less? Should the costs be absorbed by the consumer?

Type your answer here

4. Kofi Annan, the former Secretary General of the United Nations, stated, “We must ensure... that all the world’s people share the benefits of globalization.” Do you think all countries benefit equally from globalized production (that is, making and shipping products all over the world)? If not, what would allow for more people to benefit?

Type your answer here

PART 4 REFLECTION QUESTIONS, CONT. USE FULL SENTENCES

5. Human rights journalist Nicholas Kristof has said that sweatshop labor would be a dream for the poorest people in the world, such as those who survive by scavenging through garbage. Do you think that working in a sweatshop (a factory with substandard working conditions) would be a significant improvement in the lives of people who dig through garbage to survive? If so, should sweatshops be given a break? Do you have other ideas about how the lives of people living in poverty could be improved?

Type your answer here

6. Should consumers be better informed about working conditions? What about environmental impacts of manufacturing? What are some ways that consumers could have access to more information about where and how their goods were made?

Type your answer here

7. When you purchase a product, what sorts of “costs” are not included in its price?

Type your answer here

PART 5: ON THE ROAD TO RETAIL

OBJECTIVES Students will:

Identify the processes and people involved in product distribution

Evaluate the sustainability of distribution methods and practices

Analyze data in order to determine ways to increase sustainability of a distribution system

VOCABULARY

- **carbon footprint**—a tool for measuring the impact of a person, product, or process on Earth's climate; it refers to the amount of greenhouse gases released
- **distribution**—the transport and delivery of material goods from production to consumers
- **externality**—an external effect, often unforeseen or unintended, accompanying a process or activity; often used to describe a cost that is not directly paid, such as pollution or stress
- **retail**—the sale of goods to consumers



GUIDING QUESTIONS

How does the distribution of material goods impact the environment?

How are people directly and indirectly impacted by distribution?

What part do consumers play in determining distribution systems?

PART 5 QUICK THOUGHTS

- What do you think happens after production?

In this part we will focus on the next step in the materials economy - distribution, specifically that of blue jeans.

- Brainstorm about what sorts of things are **included** in the cost of a pair of jeans AND some “costs” that are probably not included (**hidden**) in the price of the jeans.

Included	Hidden
<i>TYPE your answer here</i>	<i>TYPE your answer here</i>

PART 5 PERFORMANCE TASK INSTRUCTIONS

1. Go over *A Better Way?* handout
2. Complete *Distribution Recommendations* worksheet questions
3. (Optional) Share with the class one or several of their recommendations for improving the company’s system of distribution.

A Better Way?

Scenario:

A large company that designs and sells blue jeans in the U.S. recently received some bad publicity. The bad publicity started when a report was released showing how high employee turnover is; the company loses dozens of employees every month. More recently, an environmental watchdog group named the company as a “climate menace,” alleging that it had one of the highest carbon footprints of any similar-sized company. To top it all off, one city is now trying to prohibit the company from locating a new store there, claiming that the company does not appear to care about the communities where it does business.

You have been hired as a consultant to help the company improve its distribution system. That means you will have to investigate the procedures involved in getting the jeans from the factory where they are made into consumers’ hands. The company wants to:

- Lower its carbon footprint
- Retain good employees
- Positively contribute to local economies

Your task is to determine where and how you can improve distribution according to these three goals. First, you need to know how the company currently operates.

A Better Way?

Your investigation begins in Vietnam, where the jeans are sewn. Because the company wants to provide its customers with the latest styles, it flies shipments of the jeans from Vietnam to an airport in Denver at least once a month.

In Denver, the jeans arrive at your company's distribution center. This is essentially a giant warehouse. The jeans are then loaded onto trucks that travel all over the United States and Canada, delivering the jeans to stores. Turnover among the truck drivers is pretty low. They work long hours but make good money. Some of them are members of a union that works to protect their rights; the union established minimum pay rates and maximum working hours for the drivers.

Once the jeans arrive at any of the forty-five retail stores your company owns, they are carefully folded and displayed by retail workers. Most of these workers are young and willing to work part-time. This is cheaper for the company because it does not offer health care and other benefits, such as paid sick days and vacation time, to part-time

employees. Usually store managers are the only retail employees who work full time and receive health care. The part-time retail employees, who work between 8 and 32 hours a week, earn anywhere from \$7.50 to \$12 an hour.

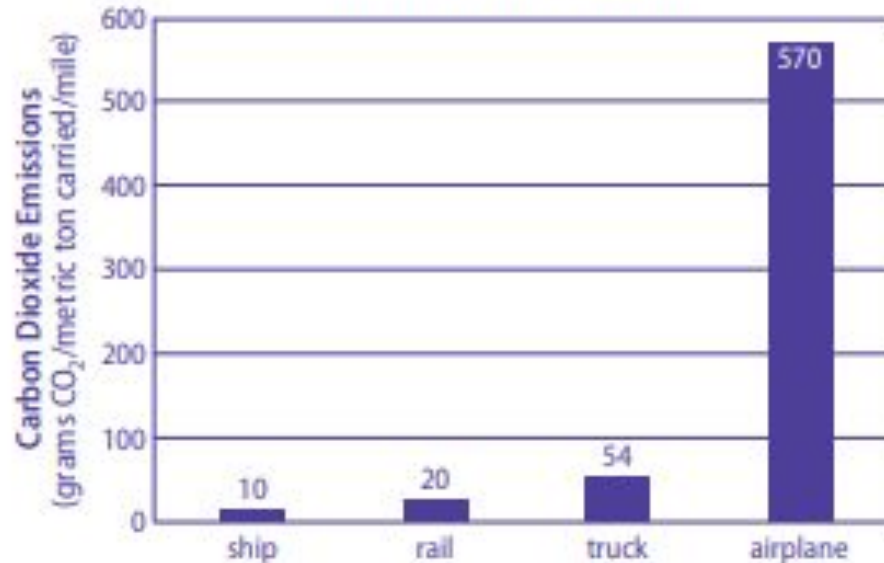
More than half of the stores are located in suburban areas, in large shopping centers. Currently about 20% of the company's entry-level retail positions are vacant. One reason is that people looking for this type of work often live far from shopping centers in places without public transportation options, like buses or trains. 30% of the company's retail employees live more than 15 miles from the stores where they work. In several cities, there are large numbers of unemployed workers in inner-city areas that cannot reach the company's suburban stores.

Four stores currently participate in recycling programs. These stores, located in cities that have established recycling programs, recycle the cardboard boxes that the jeans arrive in.

Transportation is responsible for 17% of the world's carbon dioxide (CO₂) emissions, second only to electricity and heat production in the amount of greenhouse gases released.¹ The vast majority of transportation fuels (such as gasoline, diesel, and jet fuel) are made from petroleum. When petroleum fuels are burned, carbon dioxide is released.

Carbon dioxide is a greenhouse gas linked to climate change. As the amount of carbon dioxide in the atmosphere goes up, so does the earth's average temperature. Climate change has warmed the earth so that glaciers and areas that have been frozen for thousands of years are now melting. It has also caused sea levels to rise around the world.

Greenhouse Gas Emissions from Transportation²



Greenhouse Gas Emissions from Solid Waste³

Recycling and Source Reduction	Emissions Prevented
2000 pounds cardboard recycled	3.1 metric tons of CO ₂
2000 pounds cardboard source reduction	5.6 metric tons of CO ₂

Employee Wages⁴

People in Family	1	2	3	4	5	6	7	8
Poverty Guidelines	\$10,830	\$14,570	\$18,310	\$22,050	\$25,790	\$29,530	\$33,270	\$37,010

REFERENCES

¹ Samantha Putt del Pino, Ryan Levinson, and John Larsen, "Hot Climate, Cool Commerce: A Service Sector Guide to Greenhouse Gas Management" (Washington, D.C.: World Resources Institute, 2006), 5.

<http://pdf.wri.org/hotclimatecoolcommerce.pdf>

² Greenhouse Gas Protocol Initiative, cited by Nelly Andrieu and Lee Weiss in "Transport Mode and Network Architecture: Carbon Footprint as a New Decision Metric," June 2008, Thesis (Master of Engineering in Logistics), Massachusetts Institute of Technology.

³ U.S. Environmental Protection Agency, "Measuring Greenhouse Gas Emissions from Waste," www.epa.gov/climatechange/wy/cd/waste/measureghg.html (accessed March 29, 2010).

⁴ U.S. Department of Health and Human Services, "The 2009 HHS Poverty Guidelines," <http://aspe.hhs.gov/poverty/09poverty.shtml> (accessed March 18, 2010).

Distribution Recommendations

Guiding Question: As a consultant, what recommendations would you make to improve the distribution system according to the considerations below?

1. Carbon Footprint In what ways could the company reduce its carbon footprint (its CO₂ emissions) during distribution? List at least two ideas, and explain how each results in a lower carbon footprint.

TYPE your answer here

2. Worker Retention In what ways could the company retain its employees for longer periods of time? List at least two ideas, and explain why each promotes greater employee retention.

TYPE your answer here

3. Local Economies In what ways could the company contribute more positively to local economies where its stores are located? List at least one idea, and explain how it contributes to local economies.

TYPE your answer here

4. What challenges might a company face when considering a sustainable approach to improving its system of distribution?

TYPE your answer here

PART 5 REFLECTION QUESTIONS. USE COMPLETE SENTENCES

1. Do you think it is reasonable to require companies to provide information about their carbon footprint on clothing labels or in stores? Explain why or why not.

TYPE your answer here

2. A t-shirt sewn in California from cotton grown in Turkey and shipped to a distribution center in Reno travels 7840 miles before ever reaching a store.¹ Why might a company choose to spread out its distribution and production all across the globe?

TYPE your answer here

3. Do you think hidden costs, such as pollution and employee health, should be included as part of pricing products like jeans?

TYPE your answer here

4. Would you be willing to pay more money for a product if you knew it contributed substantially to the local economy, such as if it was made locally by citizens who pay local taxes?

TYPE your answer here

5. Many people have no idea what goes into distributing goods to consumers. Why do you think that is? Would more information influence your purchasing decisions?

TYPE your answer here

6. How can you as a consumer work to influence components of distribution systems?

TYPE your answer here

PART 6: WHY BUY?

OBJECTIVES Students will:

- Recognize the connections among advertising and consumption choices
- Become critical consumers of youth directed marketing and advertising
- Determine whether corporations have a responsibility to disclose information to consumers

VOCABULARY

media literacy—the ability to locate, evaluate, and understand messages from any media source (television, radio, newspapers, etc.)

marketing—activities that promote the transfer of goods from a seller to a buyer

advertising—persuasive messages that inform the public about a product or service for sale



GUIDING QUESTIONS

- What kinds of ad techniques appeal to youth?
- How does advertising influence consumption?

PART 6 QUICK THOUGHTS

Statement: “The point of an advertisement is to make us unhappy with what we have.”

- Decide whether you agree or disagree with this statement. Explain why you agree or disagree.

TYPE your answer here

- Read following **statistics**:

- ❖ The average young person in America watches around 40,000 television ads per year.¹
- ❖ Companies spent \$100 million advertising to kids in 1983. By 2007, they were spending \$17 billion per year.²
- ❖ 8- to 12-year-olds spend \$30 billion each year.³

Why do you think youth advertising has boomed so much in recent years?

TYPE your answer here

Identify some positive effects of advertising. Conversely, what are some negative effects?

TYPE your answer here

PART 6 PERFORMANCE TASK INSTRUCTIONS

1. Find an ad that sparked your interest
2. Complete *Analyzing an Ad* handout using that ad
3. (Optional) Present his/ her ad and analysis to the class.
4. Complete Reflection Questions

REFERENCES¹ American Academy of Pediatrics, Committee on Communications, “Children, Adolescents, and Advertising,” *Pediatrics* 118 (2006): 2563-2569.

² Christine Lagorio, “Resources: Marketing to Kids,” CBS Evening News online, May 17, 2007, www.cbsnews.com/stories/2007/05/14/fyi/main2798401.shtml.

³ Ibid.

PART 6

Analyzing an Ad

1. What product or service is being advertised?

TYPE your answer here

2. What advertising technique does the ad employ? Choose from one of the following (*check or highlight*):

- Humor—Is the ad funny?
- Celebrity Endorsement—Does a celebrity promote the product/service?
- Personal Testimonial—Is a user of the product/service promoting it?
- Image—Will the product/service enhance your image? Does it look cool or sexy?
- Product Quality—Is the product/service of high quality?
- Sale or Promotion—Is there a special sale or limited-time offer advertised?
- Other (explain): *TYPE here if applicable*

3. What is the message of the ad?

TYPE your answer here

4. What about the ad immediately appeals to you?

TYPE your answer here

5. What demographic (age and sex) do you think the ad is targeting?

TYPE your answer here

6. Does the ad provide you with information related to what is most important to you when choosing what to buy? (If not, why do you think this information is not included?)

TYPE your answer here

7. Do you think the ad is misleading? Why, or why not?

TYPE your answer here

PART 6

Analyzing an Ad

8. What are ways you would change the ad to make it meet your needs as a consumer?

TYPE your answer here

9. Do you think the product/service advertised would improve your life? Why, or why not?

TYPE your answer here

10. Are there more sustainable alternatives to buying this product/service—that is, alternatives that would more positively impact local and global economies, societies, or environments?

TYPE your answer here

11. Which one of the following MOST influences what you bought recently (in the last few weeks)? (*check or highlight*)

- Advertising: Encouragement from a company to buy its product
- Appearance: How a product looks
- Brand loyalty: You have a commitment to a certain brand and continue to buy this brand repeatedly
- Country of origin: Where a product was made
- Durability: How long something lasts
- Environmental impact: Environmental damage caused by creating the product
- Labor: How the workers who made the product are treated and paid
- Popularity: Bought and used by many people
- Price: How much something costs
- Product warranty/guarantee: A promise from a company to repair or replace something that breaks
- Recommendation: Someone you know encouraged you to buy a product that he/she uses

3. Do you think this is a good reason to buy a product? If not, how will you shop differently in the future?

TYPE your answer here

PART 6 REFLECTION QUESTIONS. USE FULL SENTENCES

1. How does advertising relate to consumption?

TYPE your answer here

2. If you lived in a different country, and your only knowledge of U.S. culture came from watching American commercials, what would you think were the most important values of our society?

TYPE your answer here

3. What would you think were the most important values of teenagers? Do you think these are accurate reflections of your culture?

TYPE your answer here

4. Should sustainability concerns, including the true environmental and social costs of a product, be included in advertisements? Why, or why not?

TYPE your answer here

5. How could the unseen side of production of a consumer product be highlighted to a company's advantage?

TYPE your answer here

6. Would having more information about the unseen side of production influence what you buy? Why, or why not?

TYPE your answer here

7. Do you think we are sufficiently informed about the sustainability of our consumption habits? If not, how can we become more informed about the global impacts of our consumption?

TYPE your answer here

8. Whose responsibility is it to ensure products are safe and that people know the ingredients? Consumers/ citizens? Government? Companies/ manufacturers?

TYPE your answer here

PART 7: DEFINING HAPPINESS

OBJECTIVES Students will:

- Identify factors that improve quality of life
- Evaluate how time use and personal choices impact quality of life

VOCABULARY

- **quality of life**—the level of well-being of an individual or group of people
- **consumption**—the process of using natural resources, materials, or finished products to satisfy human wants or needs

GUIDING QUESTIONS

- What factors contribute to quality of life?
- How closely do our lifestyles reflect our personal values?
- Do our consumption choices contribute positively to our quality of life?



PART 7: JOT THOUGHTS

1. What do you think “quality of life” might mean?

TYPE your answer here

2. How are “quality of life” and “happiness” related, and how could they be different?

TYPE your answer here

PART 7 TASK 1 PICK 5

1. Choose five options that you think are most essential to have a good quality of life. (*check or highlight*)

- democratic government
- good physical and mental health
- healthy natural environment
- spending time with family and friends
- monetary wealth
- having a nice home
- volunteering or helping others
- participating in local or national politics
- spirituality/religion
- being famous
- living in a clean and safe neighborhood
- time for watching television
- time for hobbies and recreation
- travel and vacation
- time participating in community events
- education
- being able to buy nice things
- a rewarding job
- saving money for retirement
- peace and security

2. How do you think these choices compare to the average U.S. youth? (80% of youth ages 12-24 say that having lots of close friends is important.¹)

TYPE your answer here

3. Would your choices look different if you were 30 years older?

TYPE your answer here

4. Do you spend your time and energy according to the things you think will improve quality of life? Explain.

TYPE your answer here

REFERENCES ¹ MTV and Social Technologies, "Happiness," www.mtv.com/thinkmtv/research/pdf/MTV_Happiness_FINAL.pdf (accessed May 17, 2010).

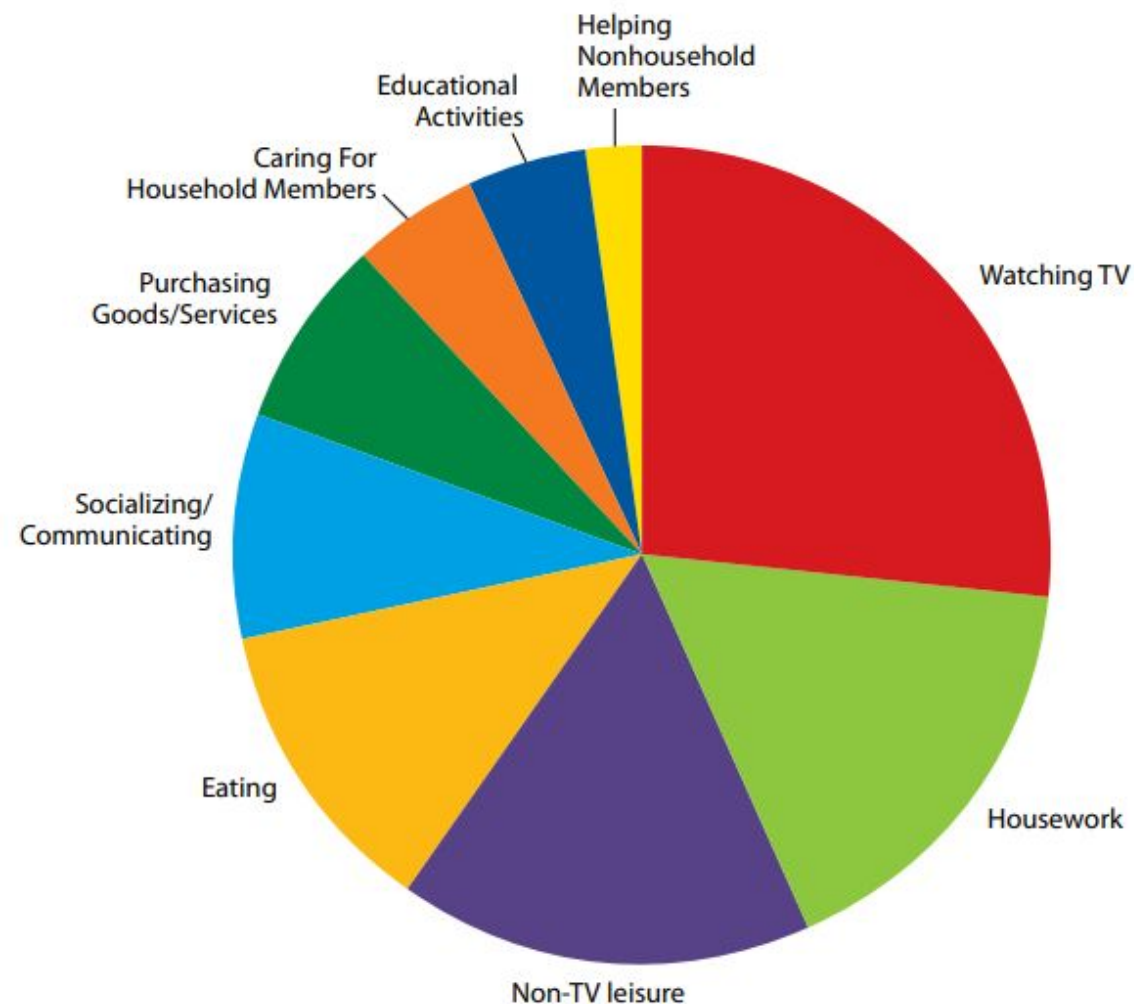
PART 7 TASK MAKE YOUR PIE CHART

Determine how a person could divide 8 hours of daily “free time” to reflect your or the class’s quality of life goals. Draw or attach a pie chart to indicate roughly how those 8 hours should be divided, keeping in mind the class’s top five values. (NOTE: 8 hours of “free time” is based on a 24-hour day with 8 hours of sleep and 8 hours of work/school time.)

PART 7 TASK 3 HOW AMERICANS SPEND THEIR TIME

OBSERVE the graph *How Americans Spend Their*

How Americans Spend Their Free Time



Use the following questions for a class discussion related to the graph:

1. How does your or your group's pie chart compare to the graph *How Americans Spend Their Time*?

TYPE your answer here

2. According to the graph, what is the main activity Americans do outside of work and sleep?

TYPE your answer here

3. How does American time use compare to your ideas about quality of life?

TYPE your answer here

4. Do you think the ways in which we spend our time contribute positively to our quality of life?

TYPE your answer here

PART 7 REFLECTION QUESTIONS. USE FULL SENTENCES.

1. Do you actively try to achieve the five things you said are most essential to your quality of life?

TYPE your answer here

2. Why might some people not be able to spend time or money on things that would improve their well-being?

TYPE your answer here

3. How do your consumption patterns relate to the five things you said were most important for a good quality of life? How could you consume differently to better meet your quality of life goals?

TYPE your answer here

4. In 2004, the United States accounted for less than 5% of the world's population and 33% of global consumption. The rise in consumption has not led to a rise in happiness among U.S. consumers. Only one-third of people in the U.S. report being "very happy," the same fraction as in 1957, when they had half the wealth.¹ If people make more money and own more stuff, why do you think they are not happier? Why might people buy more and more "stuff" if it doesn't make them happier?

TYPE your answer here

5. In what ways does consumption contribute positively to quality of life? Negatively?

TYPE your answer here

6. How might consumption contribute to a better quality of life for some people while reducing the quality of life for others?

TYPE your answer here

PART 8: IT'S A DIRTY JOB

OBJECTIVES Students will:

Understand economic, social, and environmental factors connected to waste disposal

Take on perspectives of community stakeholders

VOCABULARY

waste disposal—the act of getting rid of unwanted items or things that are no longer useful

sustainable design—the practice of creating products, buildings, and communities in such a way that negative impacts on the environment and human health are minimized, while economic benefits are maximized

environmental justice—the fair treatment of all persons in regards to creating and enforcing environmental laws, and the equitable protection of all persons from environmental and health hazards

stakeholder—a person who has an interest in something and is affected by its wellbeing, such as a business or a community

landfill—a place where garbage is buried

incinerator—a facility in which waste is burned



GUIDING QUESTIONS

- What are different options for disposing of or reducing solid waste?
- What are pros and cons of different methods for dealing with consumer waste?
- How does waste from consumer products affect people, environments, and local economies?
- What are sustainable solutions for waste management?

PART 8 JOT THOUGHTS

1. Respond to the following statement with a “thumbs up” (if agree) or a “thumbs down” (if disagree): “When I throw something away, I know where it is disposed of.”

TYPE your answer here

2. If thumbs-up, where does the garbage travel after it’s thrown away? If thumbs down, brainstorm why you don’t know more about your garbage.

TYPE your answer here

PART 8 PERFORMANCE TASK INSTRUCTIONS

Majority of waste in the U.S. is disposed of in landfills. (NOTE: Landfills are different than dumps, which are not lined and not covered with dirt.)

Today you are the Mayor of Ashland. Present to you their idea for dealing with Ashland’s waste based on the reading.

- Read the SCENARIO
- Choose and read ONE GROUP (there are 6)
- Answer the Group Questions based on the reading
- Complete the PART 8 Reflection Questions

Scenario:

You live in Ashland, a community of 325,000 residents. Ashland's current landfill has been filling very quickly, and the landfill manager estimates that in another two years it will be at maximum capacity. Now the community must decide what to do about waste disposal after the landfill is capped and sealed. Some say a new landfill should be built. Others are interested in building an incinerator to burn the trash. Some people think Ashland shouldn't spend much money on waste disposal but instead should invest in reducing waste in the first place.

You can already see this isn't going to be an easy decision. There are lots of things to consider—jobs, environmental health, and cost, just to name a few. The mayor has organized a meeting with various stakeholder groups with the hope that a good plan for dealing with future waste emerges from the meeting. Your stakeholder group must present a well-articulated, compelling plan for dealing with Ashland's waste. Your goal is for the mayor to choose and move forward with your plan.

PART

8

Group 1: Landfill Workers United

The total cost to build this landfill would be \$210 million. If you translate the cost to a per-capita figure, that's \$646 per resident. While many residents couldn't afford to pay this, you're confident that there's a way to pass along the cost of the new landfill to taxpayers. A couple of years ago the people of Ashland managed to pay for a new bridge that cost \$250 million.

You know a lot of people aren't crazy about building another landfill. Although landfills have a plastic liner to protect the surrounding soil and groundwater, it's public knowledge that they eventually break and can leak hazardous materials into the environment.³

You're hoping to convince people that burying trash in a landfill would be cheaper and cleaner than an incinerator, which is a facility that burns trash. Incinerators pose a risk to public health. Burning trash produces a group of toxic chemicals, including dioxins which can cause cancer.⁴



REFERENCES

¹ Elizabeth Royte, *Garbage Land* (New York: Little, Brown and Company, 2005), 75.

² Royte, 64.

³ Royte, 57.

⁴ World Health Organization, "Dioxins and Their Effects on Human Health," Fact Sheet No. 225, 2010, www.who.int/mediacentre/factsheets/fs225/en/index.html.

Group 2: Waste-to-Energy Enthusiasts

PART

8

REFERENCES

¹ Elizabeth Royte, *Garbage Land* (New York: Little, Brown and Company, 2005), 77.

² Royte, 79.

³ U.S. Department of Labor, Occupational Safety & Health Administration, "Safety and Health Topics: Toxic Metals," www.osha.gov/SLTC/metalsheavy/index.html (accessed May 24, 2010).

⁴ World Health Organization, "Dioxins and Their Effects on Human Health," Fact Sheet No. 225, 2010, www.who.int/mediacentre/factsheets/fs225/en/index.html.

⁵ Brenda Platt, Institute for Local Self Reliance, "Resources up in Flames: The Economic Pitfalls of Incineration versus a Zero Waste Approach in the Global South," 2004, p. 25. www.ilsr.org/recycling/upinflames.pdf

⁶ Elisabeth Rosenthal, "Europe Finds Clean Energy in Trash, but U.S. Lags," *The New York Times*, April 12, 2010.

⁷ Estimate based on Frederick County Government, "Frederick Regional WTE Facility Bond Size Estimate," [www.frederickcountymd.gov/documents/Utilities & Solid Waste Management/ Solid Waste Issues & Initiatives/Frederick-Carroll Cost Share Estimate.PDF](http://www.frederickcountymd.gov/documents/Utilities%20&%20Solid%20Waste%20Management/Solid%20Waste%20Issues%20&%20Initiatives/Frederick-Carroll%20Cost%20Share%20Estimate.PDF) (accessed May 11, 2010).

Some people are afraid that building an incinerator will discourage recycling. After all, a waste-to-energy plant runs on trash. People also argue that the amount of energy saved through recycling is greater than the energy generated by burning trash.⁵ In Denmark, local governments have created laws to make sure that recyclable materials do not end up in incinerators.⁶ You might be in favor of doing something similar in Ashland.

The cost of building an incinerator could run more than \$500 million,⁷ higher than the cost of a landfill. If the waste-to-energy plant is a publicly owned utility, taxpayers will bear its cost. On the other hand, you could entice a private company to open the plant, lowering the initial costs to taxpayers.



There are 89 waste-to-energy plants in the U.S.; they burn 13% of the nation's garbage.¹ Waste-to-energy plants are incinerators that capture energy from burning trash. A waste-to-energy plant could generate electricity for homes in Ashland, resulting in cheaper electricity bills for Ashland residents. You want to bring this technology to Ashland, where people are looking for ways to lower their electricity bills.

Incinerators reduce the volume of garbage that has to be buried in a landfill. Burning trash can reduce its weight by 75%.² Because the ash that results from incineration must be buried in a landfill, you propose that the incinerator be built right next to the existing landfill. You will need to ensure that the landfill has adequate capacity for disposing of the ash over the coming years.

Convincing people to build a waste-to-energy plant won't be easy. No new waste-to-energy plant has been built in the U.S. since 1996. Incinerators face a lot of public opposition because burning trash releases chemicals such as lead, mercury, and dioxins. Lead and mercury can damage the nervous system,³ and dioxins can cause cancer.⁴

Group 3: Citizens for Corporate Responsibility

Ashland probably still needs a waste disposal facility for some things. Landfill Workers United estimates that a new landfill would cost about \$200,000 per acre to build. Your accountant has discovered that the real cost of a new landfill would be closer to \$500,000 an acre if all permitting and construction costs are included. It looks like an incinerator would be even more expensive, especially since you still need a landfill for the ash resulting from incineration. According to Recycle Ashland, building a recycling facility would be cheaper than building a landfill or an incinerator.

Some people have expressed concern that companies forced to take back broken goods would simply make items more expensive, thus passing along the burden to consumers. You've thought about that possibility, but considering the average income in Ashland, you doubt that prices could be raised very much. Otherwise, no one would be able to buy luxuries like electronics.



REFERENCES

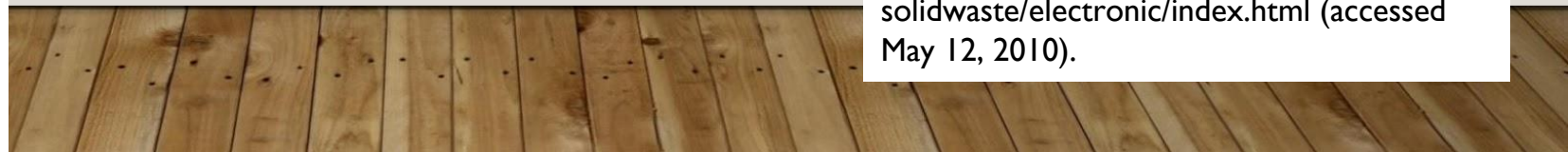
¹ Franklin Associates, A Division of ERG, as cited in US EPA, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States, Detailed Tables and Figures for 2008," 2009, Table 23,

www.epa.gov/waste/nonhaz/municipal/pubs/msw2008data.pdf (accessed June 11, 2010).

² National Center for Electronics Recycling, "Laws," www.electronicrecycling.org/public/ContentPage.aspx?pageid=14 (accessed May 12, 2010).

³ US EPA, "Electronic Waste and eCycling," www.epa.gov/ne/solidwaste/electronic/index.html (accessed May 12, 2010).

³ US EPA, "Electronic Waste and eCycling," www.epa.gov/ne/solidwaste/electronic/index.html (accessed May 12, 2010).



Group 4: Recycle Ashland PART

8

Your organization thinks it's high time to build a recycling facility in Ashland. Building a recycling plant would reduce the community's need for an expensive new landfill or incinerator. Plus, it would save natural resources, cut energy use, and reduce air pollution.¹

A recycling facility in San Francisco cost \$38 million,² and another in Indiana cost \$8.2 million.³ If these numbers are any indication, building a recycling plant will be much cheaper than paying for a new landfill or an incinerator, both of which would cost hundreds of millions of dollars. A recycling plant also could employ ten times more people than a landfill or incinerator.⁴

Experts estimate that over 60% of Ashland's waste could be recycled. If Ashland opened its own recycling plant, it could sell the reclaimed materials to help pay to keep the plant operating. One challenge may be finding markets to sell all of the recycled materials to. Items like aluminum and steel are big money makers, but you'll be lucky to break even on glass.⁵

While recycling could become a money-making venture for the city, that's beside the point. Because a recycling facility is much cheaper to build than a landfill or incinerator, it's by far more economical than building a landfill or incinerator.

You will need to educate people about what is recyclable and encourage them to recycle more, which will take money and time. One example of a program that encourages recycling is in the city of Seattle—people are required by law to recycle; those who put recyclables in their garbage may be fined.⁶ To further encourage recycling, Seattle provides recycling services free of charge, while residents are charged money for throwing away garbage.⁷

Unfortunately, not all materials can be recycled at this time. That could mean that either a small new landfill will need to be built, or Ashland could pay another community to take its waste.



REFERENCES

¹ Elizabeth Royte, *Garbage Land* (New York: Little, Brown and Company, 2005), 145.

² Royte, 263.

³ DeKalb County, "News Release: Transfer Development Corp. to Start Recycling Operation in Waterloo," November 3, 2006, www.dekalbcountyedp.org/pdf_files/Transfer_Development_Corporation.pdf.

⁴ Royte, 284.

⁵ Royte, 278.

⁶ Seattle Public Utilities, "Ban on Recyclables in Garbage," www.seattle.gov/util/About_SPU/Recycling_System/History_&_Overview/Ban_on_Recyclables_in_Garbage/index.asp (accessed May 14, 2010).

⁷ Seattle Public Utilities, www.seattle.gov/util/ (accessed May 12, 2010).

Group 5: Citizens for Environmental Justice

Did you know that the percentage of people of color who live within 3 kilometers of hazardous waste facilities is about two times higher than the percentage of people of color who live 5 kilometers or further away from them? Or that the poverty rate close to a hazardous waste facility is 20%, whereas it is 13% farther away from hazardous waste facilities.¹

Ashland's current landfill is only a few miles away from a neighborhood where mostly immigrants live. The people who live in this neighborhood are considered "working poor." Most have low-paying jobs, many in factories. Because some of them do not speak English well, and others simply don't have any spare time, these residents have not organized a strong environmental justice campaign. Your group wants to ensure that Ashland's waste no longer ends up near their homes.

Modern landfills are lined with thick plastic so that waste can't contaminate the surrounding soil and groundwater. Unfortunately, these plastic liners don't last forever. Eventually they break and leak leachate (the liquid that comes from our garbage) into soil and groundwater.² Despite Ashland's best efforts,

hazardous wastes like paint and batteries, as well as everyday items like bleach and nail polish remover, have ended up the landfill, making the leachate toxic. If the plastic liner breaks, you fear that people in the surrounding neighborhood will become ill.

You have similar concerns with building an incinerator. Burning trash in incinerators releases toxic chemicals such as dioxin and mercury. These are known to have serious effects on human health, including cancer.³ Plus, the toxic ash left over from burning trash still must be taken to a landfill.

You think that if Ashland's leaders vote to build a new waste facility, they should locate it far away from the immigrant community. If that means that it will cost more because the land elsewhere is more expensive, then you think that people who live in wealthier neighborhoods should pay the extra cost through higher property taxes. However, since no one wants pollution in their backyard, you would be in favor of a solution that ensures everyone's safety.



REFERENCES

¹ Robert D. Bullard, Paul Mohai, Robin Saha, and Beverly Wright, "Toxic Wastes and Race at Twenty: 1987-2007," 2007, 43, [www.snre.umich.edu/sites/webservices.itcs.umich.edu/drupal.snre/files/Toxic Wastes and Race at Twenty Rpt \(2\).pdf](http://www.snre.umich.edu/sites/webservices.itcs.umich.edu/drupal.snre/files/Toxic+Wastes+and+Race+at+Twenty+Rpt+(2).pdf), (accessed June 1, 2010).

² Elizabeth Royte, *Garbage Land* (New York: Little, Brown and Company, 2005), 57.

³ US EPA, "Taking Toxics out of the Air," 2000, 31 www.epa.gov/airquality/takingtoxics/index.html (accessed June 1, 2010).

Group 6: People for Packaging Reform

Also, source reduction would be much cheaper than alternative options. For example, it costs an average of \$50 to incinerate a metric ton of garbage and between \$10 and \$40 to landfill a metric ton.² Although it's cheaper than a landfill or incinerator, processing recycled materials also costs money. Source reduction is free!

You propose that Ashland pass a law requiring all manufacturers to use minimal packaging. If a company does not use minimal packaging, it should not be allowed to sell products in Ashland, where residents have to pay to dispose of the packaging.

Of course, this doesn't completely solve the problem of dwindling landfill space. Ashland will still need to find a solution for disposing of non-packaging wastes, which likely means investing in one of the following: a landfill, an incinerator, or a recycling facility.



REFERENCES

¹ US EPA, "Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks," 2006, Executive Summary, 13 <http://epa.gov/climatechange/wycd/waste/SWMMGHGreport.html> (accessed June 1, 2010).

² Brenda Platt, Institute for Local Self Reliance, "Resources up in Flames: The Economic Pitfalls of Incineration versus a Zero Waste Approach in the Global South," 2004, 11. www.ilsr.org/recycling/upinflames.pdf



Your group formed a few years ago when you learned that one-third of Ashland's trash is from packaging. Packaging waste takes the form of boxes, tissue paper, mailing envelopes, packing peanuts, plastic cushioning material, metal cans, and plastic and glass containers. Natural resources like trees, water, and oil are required to create these materials. Using these resources once, only to have them end up in a landfill, is not responsible.

One example of reduced packaging is flat pack furniture; it is designed to fit in the smallest box possible. If a company had to ship a fully assembled chair from Indonesia, where it was made, it would have to put the chair in a giant box. That would mean fewer chairs could fit on the cargo ship that traveled across the ocean to deliver it to the store where it is sold. And cargo ships don't run on air; they use natural resources, too (in this case, diesel fuel made from petroleum).

Reducing the amount of materials that we discard—a concept called *source reduction*—has benefits beyond saving natural resources. Source reduction reduces greenhouse gas emissions (that contribute to climate change) more than any other means of dealing with waste, including recycling.¹

PART 8 GROUP QUESTIONS

Group Choice: *TYPE your answer here*

1. How should Ashland's waste be dealt with?

TYPE your answer here

2. What will be the cost (monetary or otherwise) to taxpayers?

TYPE your answer here

3. Will there be other sources of financial support?

TYPE your answer here

4. Aside from the general public, who will benefit from this plan?

TYPE your answer here

5. What do you think are the major merits of your plan?

TYPE your answer here

6. What do you think critics will say in response to your plan?

TYPE your answer here



PART 10: ANALYZING THE MESSAGE

OBJECTIVES Students will:

- Critically analyze a persuasive film
- Determine the accuracy and reliability of a media source
- Identify techniques that can be used to effectively deliver a convincing argument

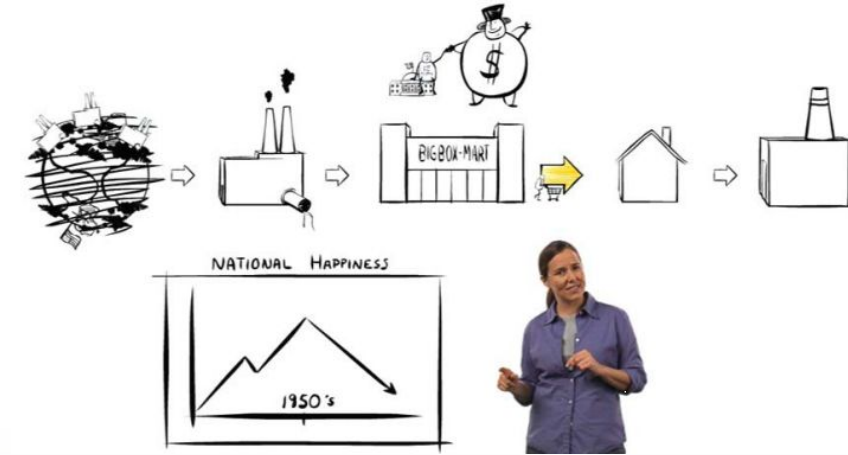
VOCABULARY

media literacy—the ability to access, analyze, evaluate, and create messages in a variety of forms that communicate information

bias—a particular tendency, inclination, or prejudice

persuasive techniques—procedures and methods that influence or encourage a person to do something

credible—believable; trustworthy



GUIDING QUESTIONS

- ❑ What are ways to critically analyze media messages?
- ❑ How can critical thinking help us make sustainable choices?

PART 10 JOT THOUGHTS

1. Two statements with students and ask them to discuss how the statements differ. Does one sound more accurate than the other? Is one more impressive? Are the two statements mutually exclusive?

- “In the United States, we have less than 4% of our original forests left.”
- “Between 1920 to 2000, the number of forests in America have actually increased.”

TYPE your answer here

3. Why might it be important to differentiate between original forests and total number of forests?

TYPE your answer here

3. (Optional) Observe the graph from the United States Forestry Service at www.fia.fs.fed.us/slides/major-trends.pdf (see page 2) that was used to support the second statement. What can you conclude from the graph and do you believe the second statement is an accurate interpretation of the data shown?

TYPE your answer here

4. Why two different people or groups would communicate different facts or statistics?

TYPE your answer here

PART 10 PERFORMANCE TASK INSTRUCTIONS

- Watch the video *The Story of Stuff* (www.storyofstuff.org) in its entirety.
- Read the questions from *The Story of Stuff: A Critical Analysis* and take notes during the video as you hear possible answers to the questions on the handout.
- Optional: You may access the annotated script available at www.storyofstuff.org.
- Complete the questions in *The Story of Stuff: A Critical Analysis*
- Complete the Part 10 Reflection Questions

The Story of Stuff: A Critical Analysis

1. What is the overall message of The Story of Stuff?

TYPE your answer here

2. What audience do you believe Annie Leonard is trying to reach?

TYPE your answer here

3. What persuasive techniques does Annie use to convince people of this message?

TYPE your answer here

4. Why do you think Annie uses the format of a 20-minute video rather than another format, such as a report, web blog, or poster?

TYPE your answer here

5. What bias does Annie have?

TYPE your answer here

6. Who might disagree with Annie's message? Why do you think they would disagree?

TYPE your answer here

7. What is your analysis of The Story of Stuff—do you believe it makes a convincing argument? Explain why you think the video is convincing or not.

TYPE your answer here

8. Has The Story of Stuff affected the way you think about consumption? If so, how?

TYPE your answer here

PART 10 REFLECTION QUESTIONS. USE FULL SENTENCES

1. Why is it important to critically analyze any media, from newspaper articles to advertisements?

TYPE your answer here

2. What sorts of criteria could you use to determine whether an author or media source is credible?

TYPE your answer here

3. Overall, what are the strengths of Annie's argument? What are the weaknesses?

TYPE your answer here

4. If you wanted to deliver a message similar to the one presented in The Story of Stuff, how would you do it? What form of media would you use, and why?

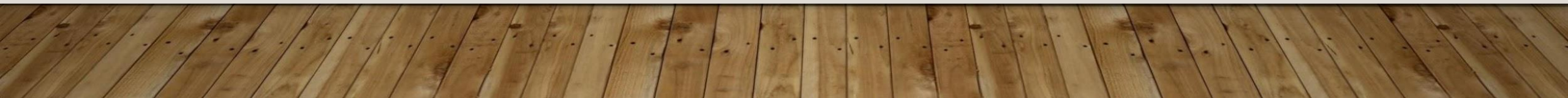
TYPE your answer here

5. How might ethics (moral principles or culturally established rules of conduct) be related to creating and sharing messages with others?

TYPE your answer here

6. What power and authority does (or should) government have over media?

TYPE your answer here



Buy, Use, Toss?: A Closer Look at the Things We Buy, page 1

Post-Assessment

Multiple Choice

Circle the letter of the correct answer.

- Which of the following is not one of the three pillars of sustainability?
 - environmental health
 - economic prosperity
 - social well-being
 - emotional stability
- Which of the following would not be considered an externalized (or “hidden”) cost of a product?
 - the reduction of a natural resource base
 - increased asthma and cancer rates from pollution
 - kids dropping out of school to work in factories
 - factories providing fair wages and health care for their workers
- Which of the following could best be described as a sustainable consumption choice?
 - making and spending as much money as possible on goods and services
 - researching the impacts on people and the environment when making a purchase
 - buying products only if they are endorsed by famous people
 - writing to a business convincing them to make more of your favorite product
- Which of the following could be a barrier to improving quality of life?
 - unsafe working conditions
 - a democratic government
 - good physical and mental health
 - volunteering or helping others
- Which one of the following is not a solution when considering a redesign of the materials economy?
 - green chemistry
 - closed loop production
 - toxics in air and water
 - extended producer responsibility
- What role can a government play in creating a sustainable materials economy?
 - enforcing corporate social responsibility
 - convincing people to buy more products and services
 - creating labor laws that pay workers low wages to attract foreign companies
 - extracting unlimited natural resources

Buy, Use, Toss?: A Closer Look at the Things We Buy, page 2

Post-Assessment

Vocabulary

7. Define each of the following steps of the materials economy.

a. extraction: _____

b. production: _____

c. distribution: _____

d. consumption: _____

e. disposal: _____

Personal Attitudes and Beliefs

Directions for 8-10: Below each question, circle a number to indicate your response. 1 means never and 10 means all the time.

1 = never

10 = all the time



8. When making consumption choices, how much do you consider impacts on the environment?

1 2 3 4 5 6 7 8 9 10

9. When making consumption choices, how much do you consider impacts on the economy?

1 2 3 4 5 6 7 8 9 10

10. When making consumption choices, how much do you consider impacts on society and people?

1 2 3 4 5 6 7 8 9 10

11. Complete the following sentence:

Two ways I can be a more thoughtful consumer are...

ACADEMIC INTEGRITY STATEMENT

By signing or typing my name below, I certify that this assessment was completed independently, without the use of outside help (including, but not limited to: web searches, peer assistance, adult help, and copying).

Student Name (Type or Sign)

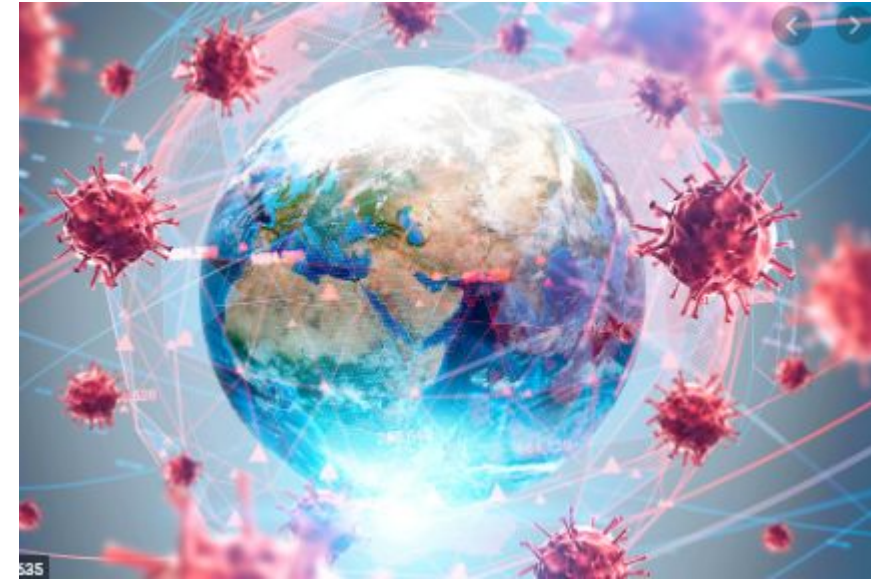
Today's Date (Type or Print)



TYPE Your Name:

How does a Pandemic Cause Less CO₂?

An SLPS Daily Task in MS Science



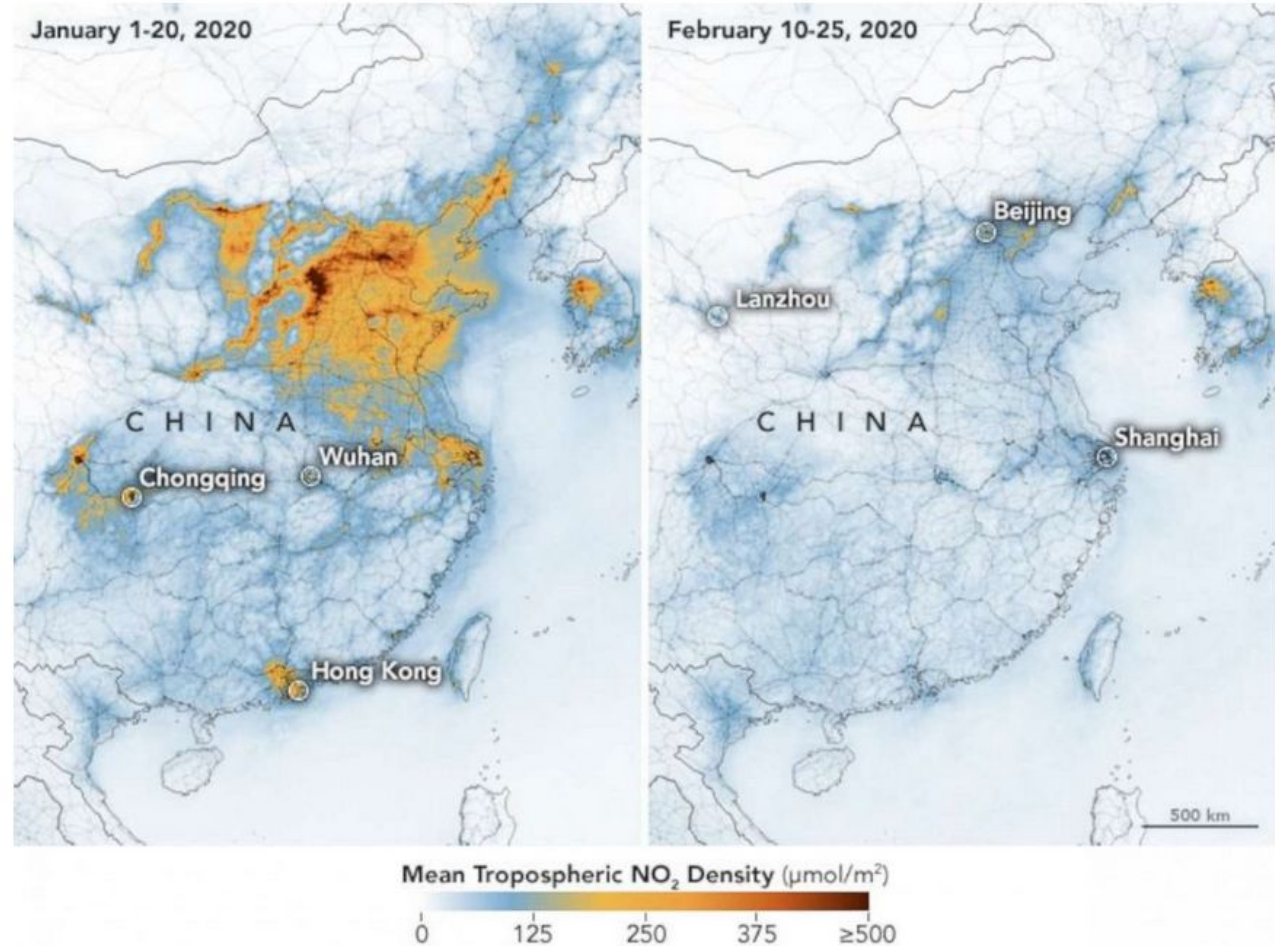
Introduction

- Closed schools and non-essential businesses and official stay-at-home mandates have kept millions of people at home and across the globe. Will we be able to return to our once-familiar daily routines after the pandemic is over? Will we still want to?
- In this task, you and your families make sense of the phenomenon of HOW concentrations of greenhouse gasses are decreasing as the world-wide spread of the coronavirus increases. You will then apply the science ideas they build to design a system or process to decrease their contribution of carbon dioxide to the atmosphere- in other words, reduce your family's carbon footprint.

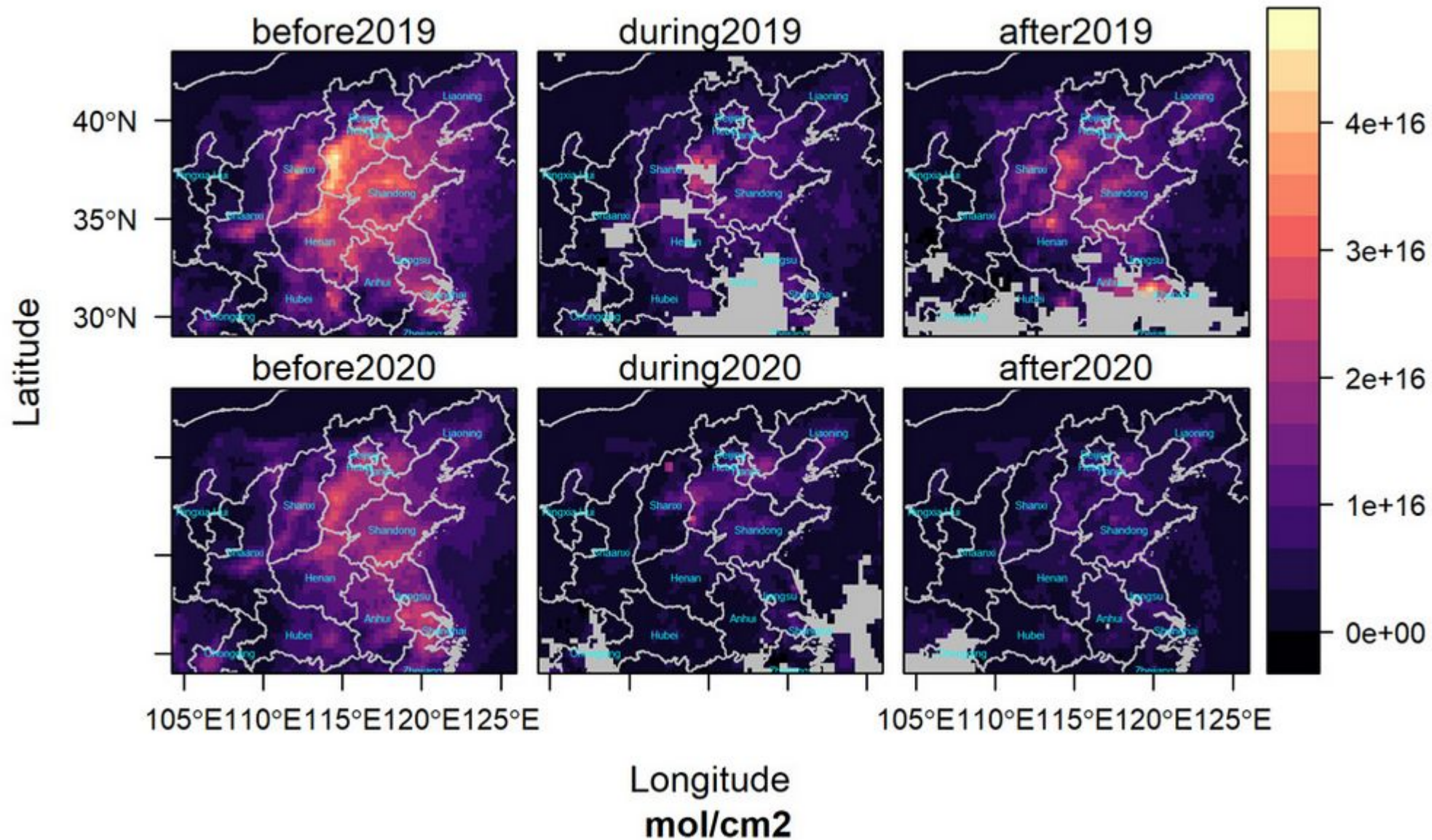
PART I:

Let's take a look at nitrogen dioxide (NO_2) concentration data for Greater China and Wuhan, China

Please observe the 3 sets of maps very closely and include your observations and wonderings in the following slides.

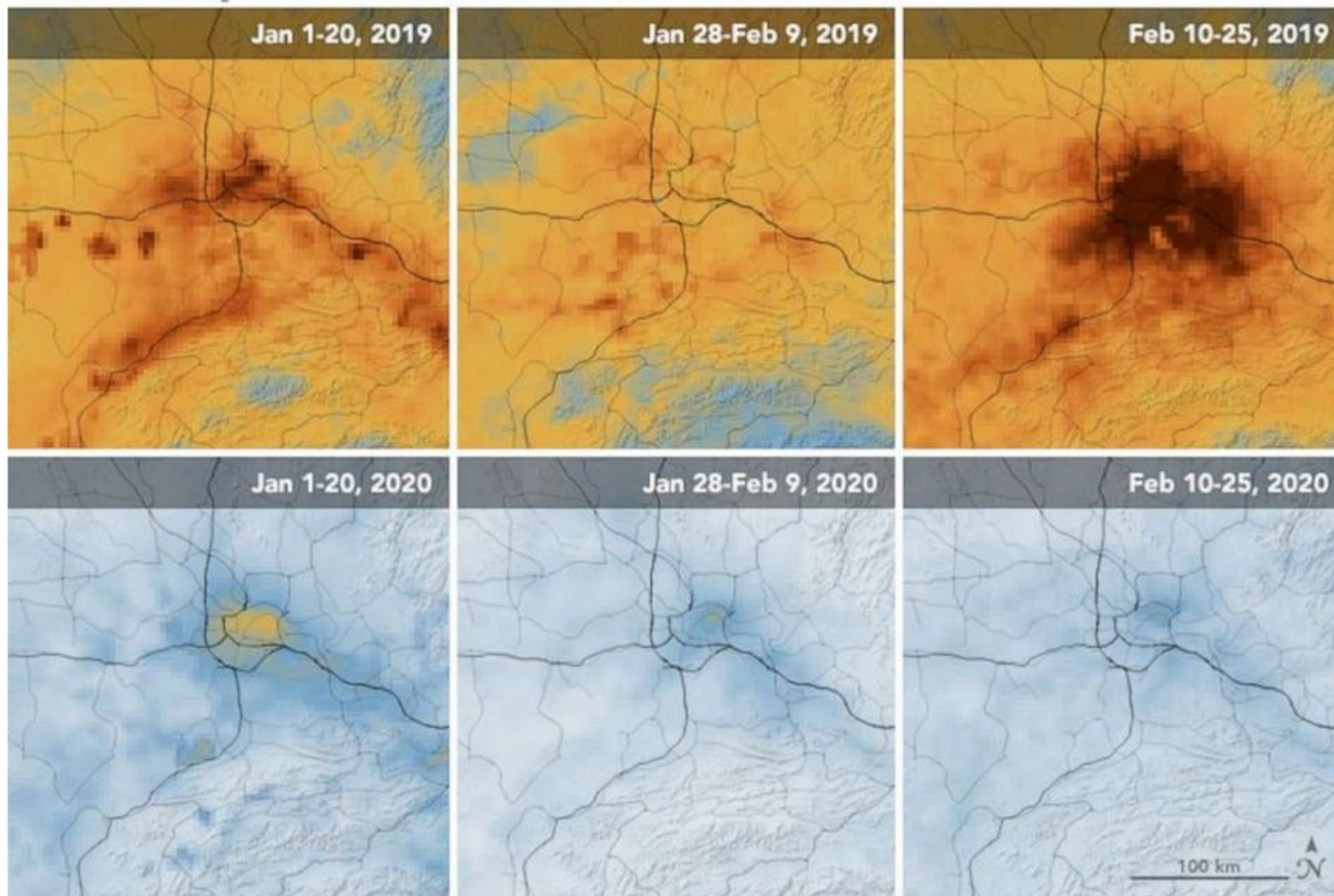


Satellite-based NO2 levels before, during and after the Chinese New Year holiday



Pollutant Drops in Wuhan—and Does not Rebound

Unlike 2019, NO₂ levels in 2020 did not rise after the Chinese New Year.



Mean Tropospheric NO₂ Density ($\mu\text{mol}/\text{m}^2$)

0 125 250 375 ≥ 500

Nitrogen dioxide (NO₂) concentration data for Greater China and Wuhan, China

NO₂ is a harmful gas emitted by motor vehicles, power plants and industrial facilities into the atmosphere. These same sources also emit carbon dioxide (CO₂).

What patterns do you observe in the data presented in each set of maps?

TYPE your answer here

WHAT QUESTIONS DOES THIS RAISE FOR YOU? LIST AT LEAST 2.

TYPE your answer here

PARTII: Why NO₂ is measured and why it's in the news? Let's investigate this next.

- One reason scientists are excited about the current decrease in NO₂ concentrations over China is because it indicates CO₂ has also decreased.
- We're going to shift our focus to CO₂ because it is a greenhouse gas while NO₂ contributes to the formation of a greenhouse gas (ozone) through a series of reactions at an unknown rate.

What do you already know about greenhouse effect or climate change? Draw an initial model.

THINK ABOUT:

- What absolutely needs to be included in your model? In other words, what are the *components* of the model?
- How could you show how the components on your model are interacting? (i.e. arrows, lines, labels, text)

Create a model to explain how changing the amount of carbon dioxide (CO₂) in the atmosphere causes Earth's average temperature to change.

SMALL amount CO ₂ in atmosphere	LARGE amount CO ₂ in atmosphere
Earth's surface	Earth's surface

NOTE: You can draw your model by copying the attached empty model to google draw or you can draw on a piece of paper, put your name on it, take a picture of it, and attach it on the next slide.

Watch the 3 videos and make changes/additions to your previous model based on the new information you learned

- [NASA's Earth Minute: Gas Problem](https://youtu.be/K9kga9c0u2l)

<https://youtu.be/K9kga9c0u2l>

- [Greenhouse Gas](https://www.britannica.com/video/185587/characteristics-Earth-atmospheric-gas-molecules-properties-greenhouse)

<https://www.britannica.com/video/185587/characteristics-Earth-atmospheric-gas-molecules-properties-greenhouse>

- [How Carbon Dioxide Warms Planet Earth](https://www.pbs.org/wgbh/nova/video/carbon-dioxide-warms-earth/)

<https://www.pbs.org/wgbh/nova/video/carbon-dioxide-warms-earth/>

Attach your updated model below

Based on your model, what do you predict caused the CO₂ (and NO₂) to decrease between winter 2019 and winter 2020?

TYPE your answer here. *NOTE: If you are thinking the answer to be just the coronavirus, please elaborate on the implication of virus on daily activities.*

PART III (online option only): How can we measure our carbon footprint?

- It seems like we think people sheltering-in-place is causing the decrease in the amount of CO₂ (and NO₂) being emitted into the atmosphere.
- A carbon footprint is the amount of greenhouse gases - primarily carbon dioxide - released in the atmosphere by all of a person's, family's, community's, or nation's activities.
- Complete the [Calculate Your Carbon Footprint](https://coolclimate.berkeley.edu/calculator) survey
(<https://coolclimate.berkeley.edu/calculator>)

to determine your family's carbon footprint BEFORE the COVID-19 pandemic and AFTER schools and businesses closed. (You will complete the survey twice.)

- The survey results give you the total number of pounds of CO₂ per year emitted to the atmosphere as a result of your family's typical activities (home, travel, eating, and shopping). Students can see how much CO₂ (pounds) each activity contributes to the total.

NOTE: In any event you cannot take the survey due to lack of access to technology/internet, skip to PART IV.

Reflection questions

1. After you finished taking the survey before and after pandemic, what is the percent change in your carbon footprint from pre-COVID-19 pandemic to post-pandemic? (Subtract the amounts)

TYPE your answer here

2. If every household in your community had the same percent change as your family did, what would be the total reduction in CO₂ emitted to the atmosphere each year as a result of your community's activities? (NOTE: Students will need to look up their community's population)

TYPE your answer here

3. If every household in Wuhan, China had the same percent change as your family did, what would be the total reduction in CO₂ emitted as a result of the Wuhan, China community's activities?

TYPE your answer here

Reflection Questions, continued

4. Return to the Wuhan, China NO₂ data they observed at the start of the task Part 1, last image. Can changes in daily activities explain why the NO₂ emissions (remember CO₂ is closely linked to NO₂) have changed? What is your evidence?

TYPE your answer here

5. Return to their initial models. What would you add to/change to explain how changes in CO₂ causes changes in Earth's average temperature.

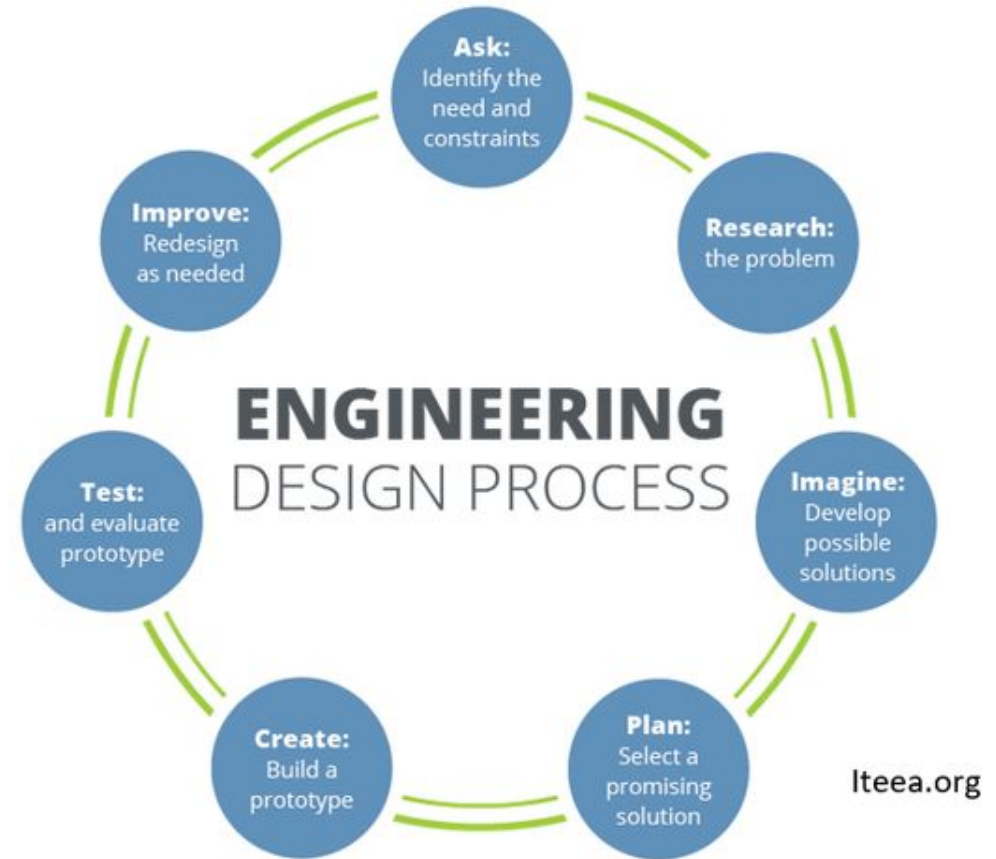
TYPE your answer here

PART IV: Engineer a solution to reduce your family's carbon footprint!

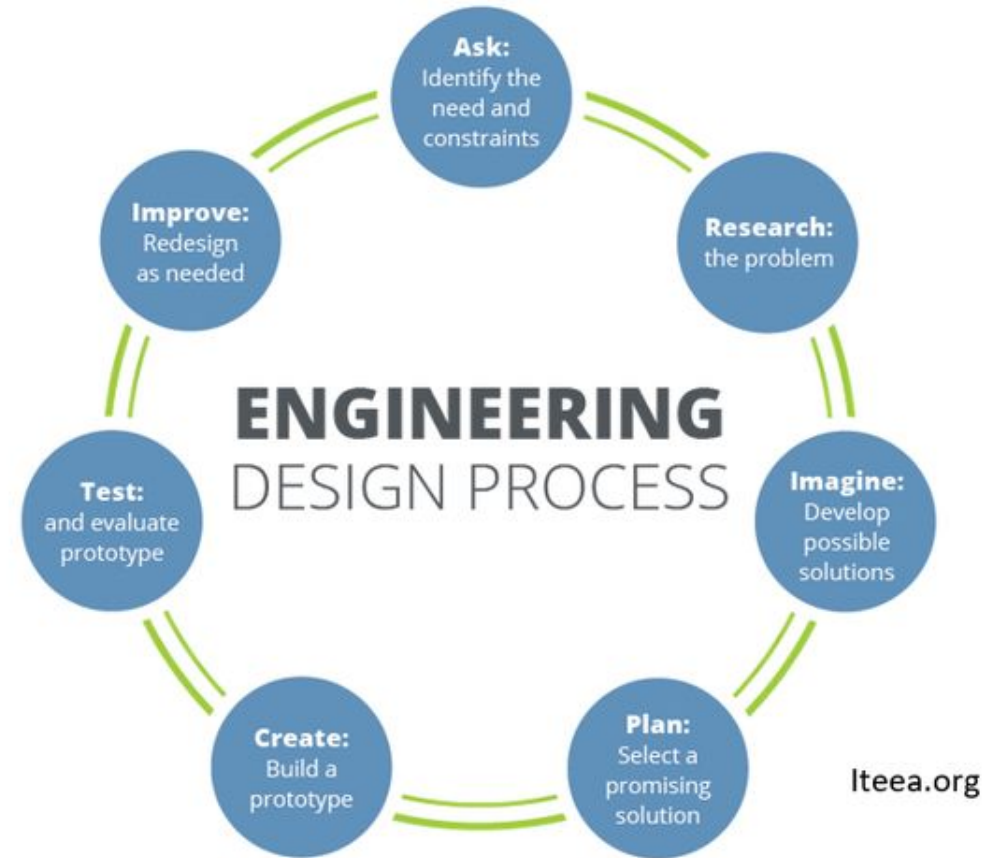
1. When we go back to our normal daily activities, what might you do to continue to reduce your carbon footprint?

TYPE your answer here

The Engineering Design Process (EDP) comes in many forms. Engineers enter the EDP to create a new technology - or improve an existing one - to meet a need or want. Engineers on the job may start at any step, depending on the needs of a particular project.



Watch the video, *A Strict Carbon Diet* (<https://www.pbs.org/wgbh/nova/video/a-strict-carbon-diet/>) to find out how engineer Saul Griffith is helping his family reduce their carbon footprint. As you watch the video, can you identify the steps of the EDP Griffith uses to design a solution to the problem of lowering his family's carbon footprint? What's your evidence?



TYPE your answer here

Like Griffith, you can use the EDP to reduce your family's or community's carbon footprints and share your plan below. *(Note: address as many steps in the EDP cycle in your response)*

- TYPE your answer here

Take it Further

- You can really make a difference by getting your friends, teachers, school and district thinking about reducing their carbon footprints! One way is to explore even more changes to make by checking out the Energy Star website.
- You can also track and change their carbon footprint in real-time by trying one of these mobile Apps: *Mobile Carbon Footprinting* or *Carbon Footprint ACP*.

Extension! Explore STEM Careers: Environmental Engineer

- Now that you are engineering ways to help the environment, meet Marielle Thillet and explore her STEM Career as an Environmental Engineer!
- <https://youtu.be/z6cJ9IULgMk>
- What are some challenges and rewards of job as an Environmental Engineer?

TYPE your answer here

