BIOLOGY & SOCIETY

SPRING 2017 EDITION

ENERGY USE IN NEW HAVEN: Local and Global Effects

Particle Pollution and Asthma Disparities

Climate Change, Race, and Malaria

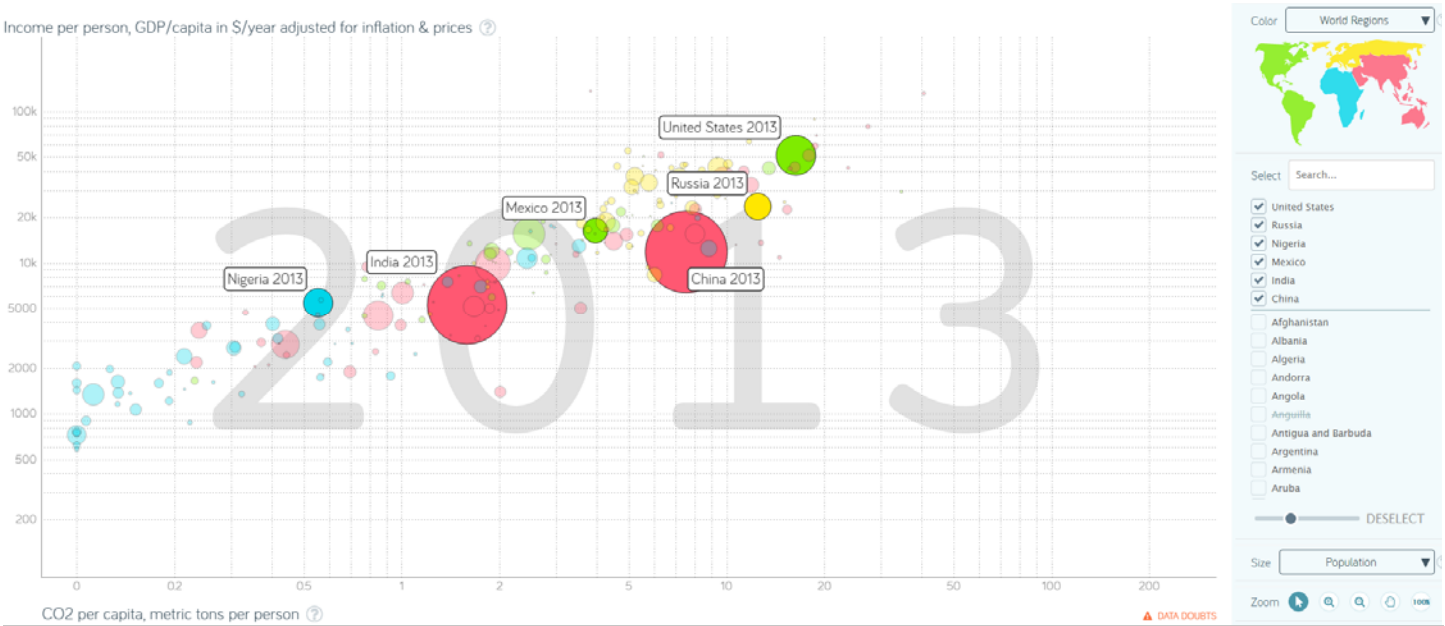
by Mr. Sinusas's "Biology II" Classes

Energy Use in New Haven by ELLIOT FAULKNER

Humans' use of fossils fuels is one of the main reasons why we have become so advanced. The benefits of using this energy have helped the human race rise to the top the Earth's biosphere, to the point where we now endanger our existence, as well as other organisms' existences all around the world. This brings me to the generation of energy in New Haven. In order to understand the effects of energy generation, one has to look at local and global examples.

In New Haven, energy is generated at five main power plants, all of which use fossil fuels. The first and one of the most important power plants in New Haven is the Harbor Generating Station. The plant generates electricity using steam combustion turbine technology by burning oil and natural gas. The second is the Yale Central Power Plant. This plant has been in service for over 90 years and was originally made to burn coal. It has been refitted, and now burns a much cleaner fossil fuel, natural gas. The third plant is the Yale Sterling Power Plant. This plant burns oil, which is a much dirtier fuel when compared with the Yale Central Power Plant's natural gas. It is much harder to find information on this plant, likely based on the dirtier fuel being used. This also occurs with the fourth plant, The Southern Connecticut State University (SCSU) power plant. It is almost impossible to find any information on the type of fuel this power plant uses. This brings up an interesting point. Many power generation companies may purposely choose to not post information on their plants because often they use cheap but dirty fuels. This causes environmentalists to often miss these plants, so many don't even know they exist. When a plant uses cleaner, more modern fuels, the opposite of this situation often occurs. Plants using these more advanced fuels and technology are usually easier to research because the companies are proud of there advancements.

The fifth and final major power plant in New Haven is at St. Raphael's hospital. This plant generates energy with oil for most of the



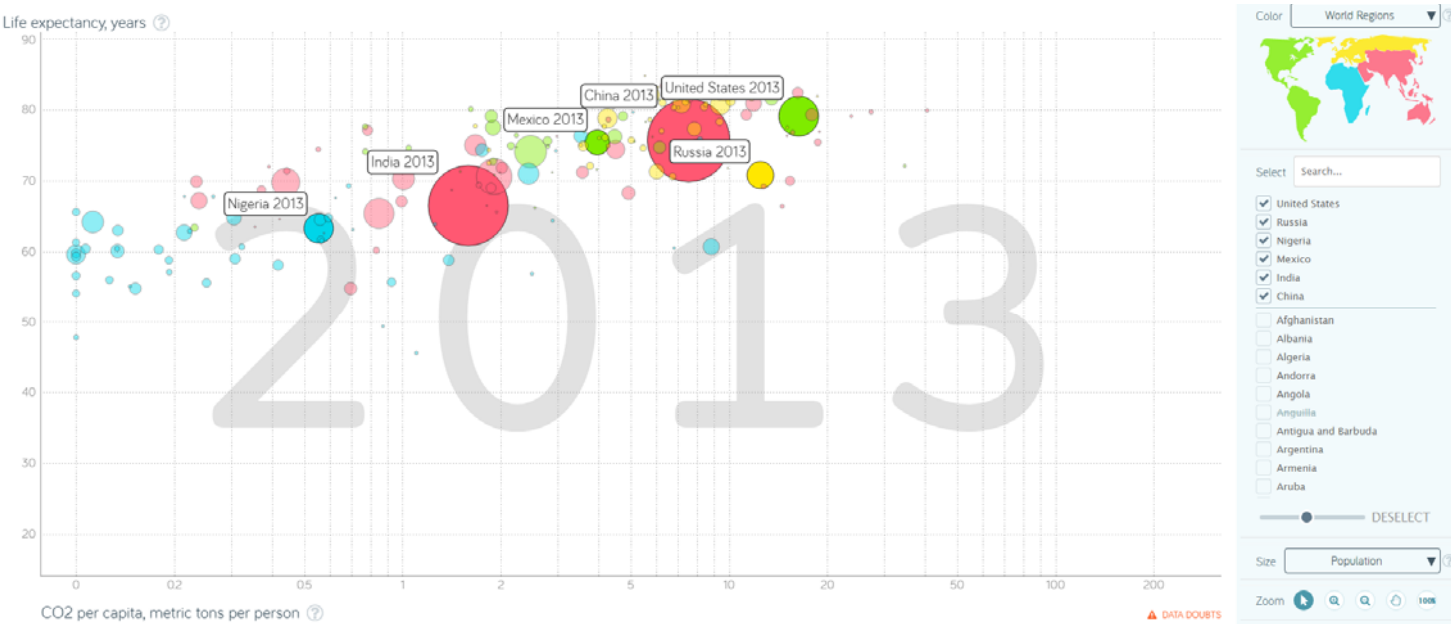
ON THE COVER

Left. Brian Salters uses a pump to inflate a pig lung that was exposed to particle pollution.
Right. Michael Smith, Maximus Phil, Peter Branch, and Jaylin DeJesus set up their air pollution detectors near Southern Connecticut State University's fossil fuel power plant.

year but because of environmentalists intervening, the plant is forced to use natural gas for a certain amount of time per year. According to The Connecticut Fund For The Environment organization, “as a result of the settlement, the hospital will burn natural gas instead of oil from at least April 1 through August 31 each year. This agreement reduces emissions of harmful pollutants, like nitrogen oxide, sulfur dioxide, and particulate matter, by more than 15 tons.” New Haven used to have a sixth major plant, English Station, but this power generation facility stopped electricity generating operations in 1991. It operated as a coal and oil fired thermal plant, and is known to be heavily contaminated with asbestos and PCBs (polychlorinated biphenyl). This has affected the future purpose of the location because the spot has been so badly polluted, nobody wants to buy and use the land.

By supplying energy, these plants allow the use of modern technologies, such as electric lights, dish- and clothes-washers, and hot water for showers. These advances allow us to do tasks quickly, when historically, they would take many hours. This gives people free time for education and recreational activities. One may think that these advances are great, but the negative impacts are severe. Availability to these luxuries does come at a high price to ourselves and the environment. For instance, burning fossils fuels, such as natural gas, oil, and coal, releases carbon dioxide into the atmosphere. Light from the sun enters our atmosphere, passing through this carbon dioxide, and hits the surface of the planet. This creates infrared radiation, or heat. This heat cannot escape the carbon dioxide-filled atmosphere, so it gets trapped. This causes global warming which has many negative effects, such as rising sea levels and a quicker change of climate conditions. These power plants can also cause particle pollution, which can cause or make worse conditions such as asthma.

As you can see, energy generation can be taken advantage of and used for good. Burning fossil fuels allows us a constant supply of energy which makes possible valuable luxuries like cars, lights, and hot water. The burning of these fuels, however, can also cause huge environmental and health issues such as asthma and global warming.



These graphs show the relationship between the use of carbon-releasing fossil fuels and measures of development in different countries around the world.

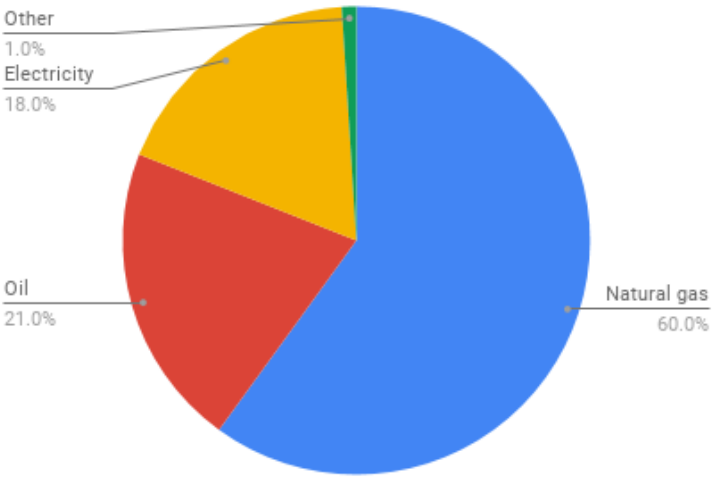
Sources:

Connecticut Fund For The Environment - Save The Sound
www.ctenvironment.org/environmental-justice
International Development Graphs - www.gapminder.org

Pollution and Asthma in New Haven

by AZIZ MUHAMMAD

One key question being investigated is why are asthma rates so much higher in some New Haven neighborhoods than elsewhere? We asked this question after discovering that less than 1% of children under the age of four were hospitalized for asthma-related issues in the 9 wealthiest towns in Connecticut, while in the 4 largest city centers of the state, over 10% of children were. Going into this more deeply, we see similarly troubling statistics in the greater New Haven area. In the "inner ring" of Hamden, West Haven, and East Haven, there were 385 hospital encounters per 10,000 people, while in the towns further out in the county, there were only 136. This is when we decided to start our investigation.



Almost all home and building heating in New Haven is produced either directly by fossil fuels or by electricity generated from power plants that burn fossil fuels.

Graph by TARIQ LOPES

What we did first was construct particle collectors to get a sense of how much pollution was in different areas. We planted some at our school, down the road, and next to the nearby power plant at SCSU. When planting our collectors, we measured out their distance from the road to see if there was any relation to how much pollution was in the air.

Fossil fuels are natural fuels that were formed in the past as a result of once-living organisms being compressed underground. Their main uses in CT are electricity, heat, and transportation. Transportation uses of fossil fuels indeed damage the air quality. At 0.6 meters away from the road there were a lot more particles found per square centimeter than at 3 and 3.6 meters. Collectors at 0.6 meters had the highest particle count with a total of 565 particles per cm^2. At 3-4 meters away the highest amount of particles per cm^2 was only 90 and the lowest was zero. If the fossil fuel-using cars, trucks, and buses didn't affect local air quality, then when we did our test, the particles found per cm^2 would've stayed consistent regardless of how far the particle collectors were from the road.

Particle pollution damages the lungs. In class we looked at two pig lungs, one that was exposed to particle pollution and one that was not. We inflated both of the lungs. The non-exposed lung was pink and when we inflated it, it inflated quickly and in full. The pollution-exposed lung was black, inflated slowly, and didn't inflate fully. Lungs are the organ of the body that bring in air to the bloodstream. Asthma is the restriction or narrowing of the air-

way. Particle pollution is the tiny particles that get into your lung and can cause this narrowing of the airway. What we observed was convincing because of the numerous differences between the two lungs.

The increased rates of asthma due to pollution is a big problem because someone with asthma isn't able to maintain homeostasis, stable internal conditions, as well as someone without it. In class we tested the pulse rate and oxygen levels of those exercising with a restricted airway and compared it to those who didn't have a restricted airway. Those with a restricted airway had a higher pulse rate than those who hadn't. Those with an open airway had a more steady pulse rate. The oxygen level in those who had a restricted airway was lower as well. In short, asthma is a condition in which your airways are tightened and allow for less air to be taken in. If people with asthma were able to maintain homeostasis as those who don't have it, we wouldn't have seen the results that we did. The people with simulated asthma would have had the same oxygen levels and wouldn't have had such a high pulse measurement.

Some people aren't aware that asthma is something that you can develop, it isn't always something you're born with. Particle pollution causes a considerable amount of damage to the lungs, and can sometimes be fatal. It leads to numerous problems which take away from life quality. In today's society, we're so dependent on machines that cause pollution, that if we don't find a way to stop or decrease how much pollution we create, we're on a path towards an unhealthy and polluted world. We as humans need to find a way to change this.

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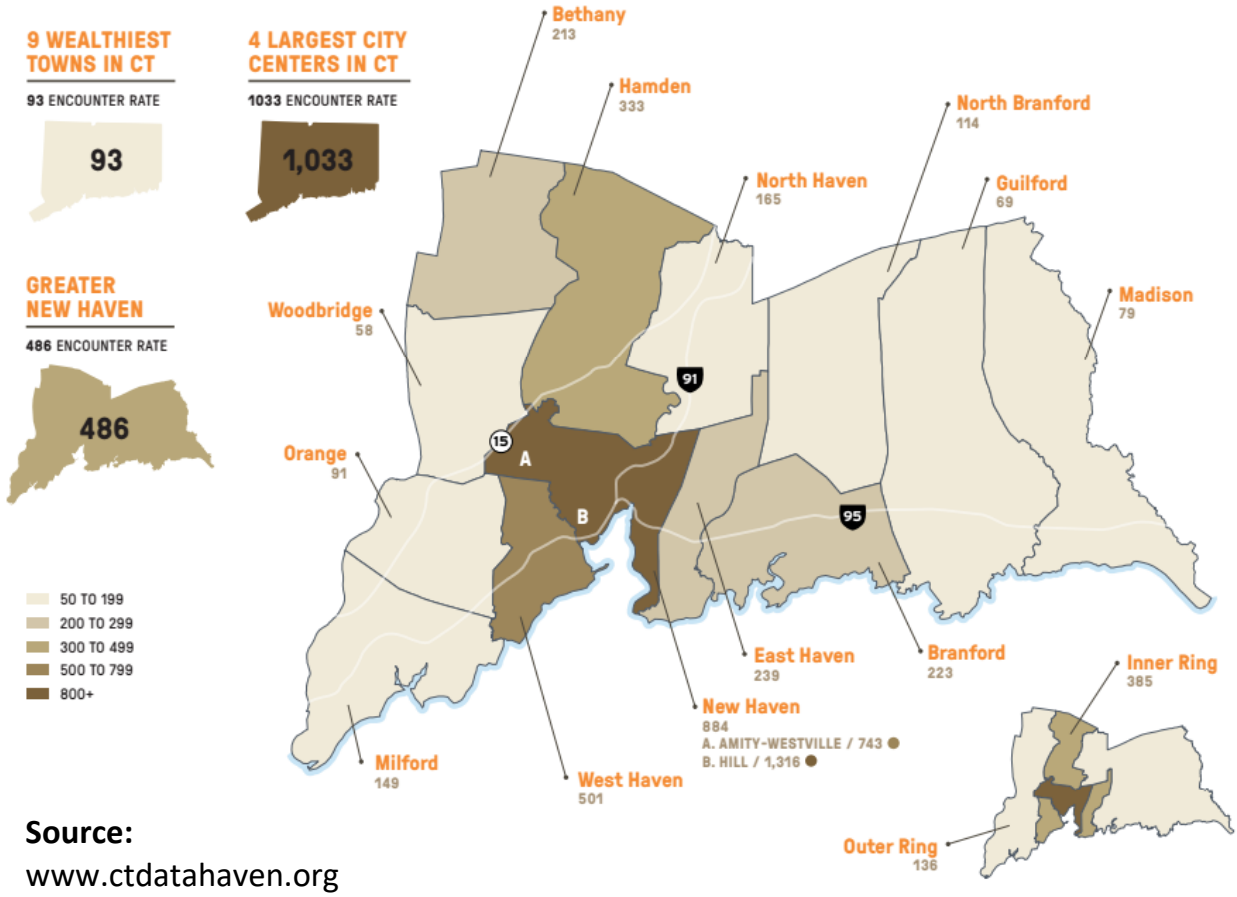
Childhood Asthma, All Hospital Encounters

AGE-SPECIFIC ANNUALIZED ENCOUNTER RATE PER 10,000 RESIDENTS AGE 0–4, 2012–2014



Source:
www.ctdatahaven.org

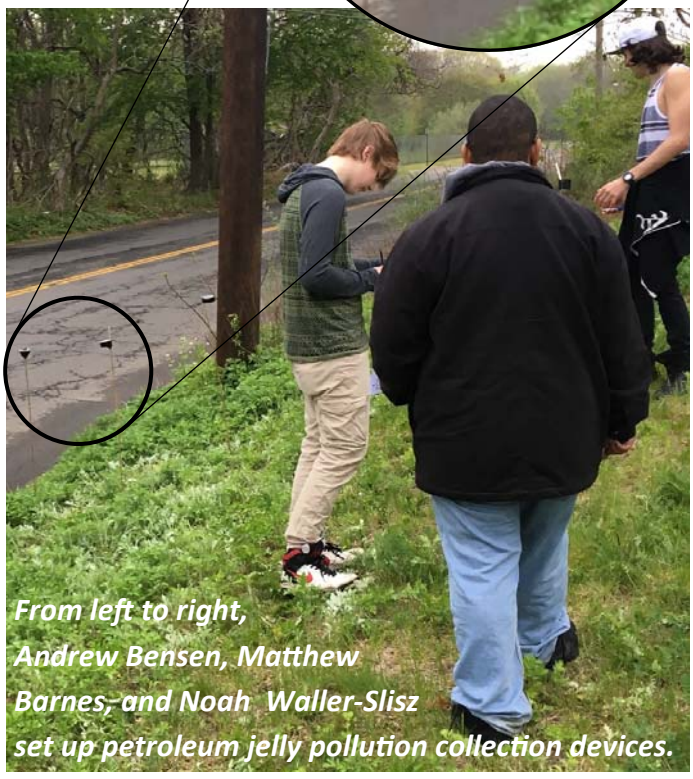
What Are "Fossil Fuels" and How Can We Measure the Pollution They May Create?

by JAELYN ROBERTS

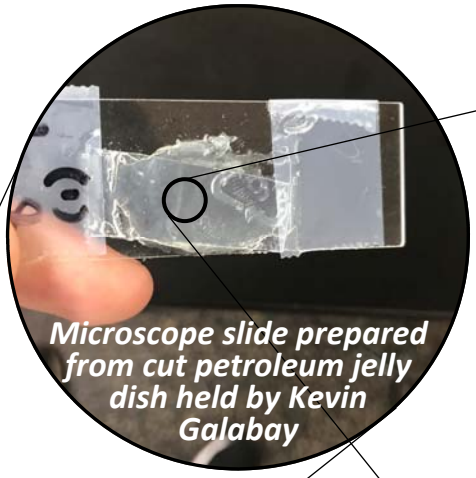
Fossil fuel is created by people digging into the earth's surface and taking the energy from plants that once lived off the sun's energy. The stored energy from the sun from when the ancient plants lived is what makes the fossil fuel become fossil fuel. Coal, oil, and natural gas we use today were once plants living in the ocean that died and sunk to the bottom. When the plant was alive it absorbed energy from the sun and used it to build high energy, unstable sugar molecules and other chemicals. When the plant died, it died with the energy from the sun still stored inside of the chemicals it built. When it sank down uneaten, it created a bottom layer of the ocean which eventually millions of years later was covered in other material and squished together with lots of pressure. The plants that once lived still under the earth are what coal, oil, and natural gas sellers go into the earth for today. The amount of heat and pressure in the earth is what determines whether the material will be formed into a solid (coal), a liquid (oil), or a gas (natural gas).

In New Haven, we use fossil fuels to heat our buildings, generate electricity, and run our transportation systems, like cars, trucks, and buses. Gasoline and diesel fuels made from oil are the most common ways of powering transportation in the United states. Although fossil fuel is useful for transportation, it causes global warming and pollutes the air that we breathe in.

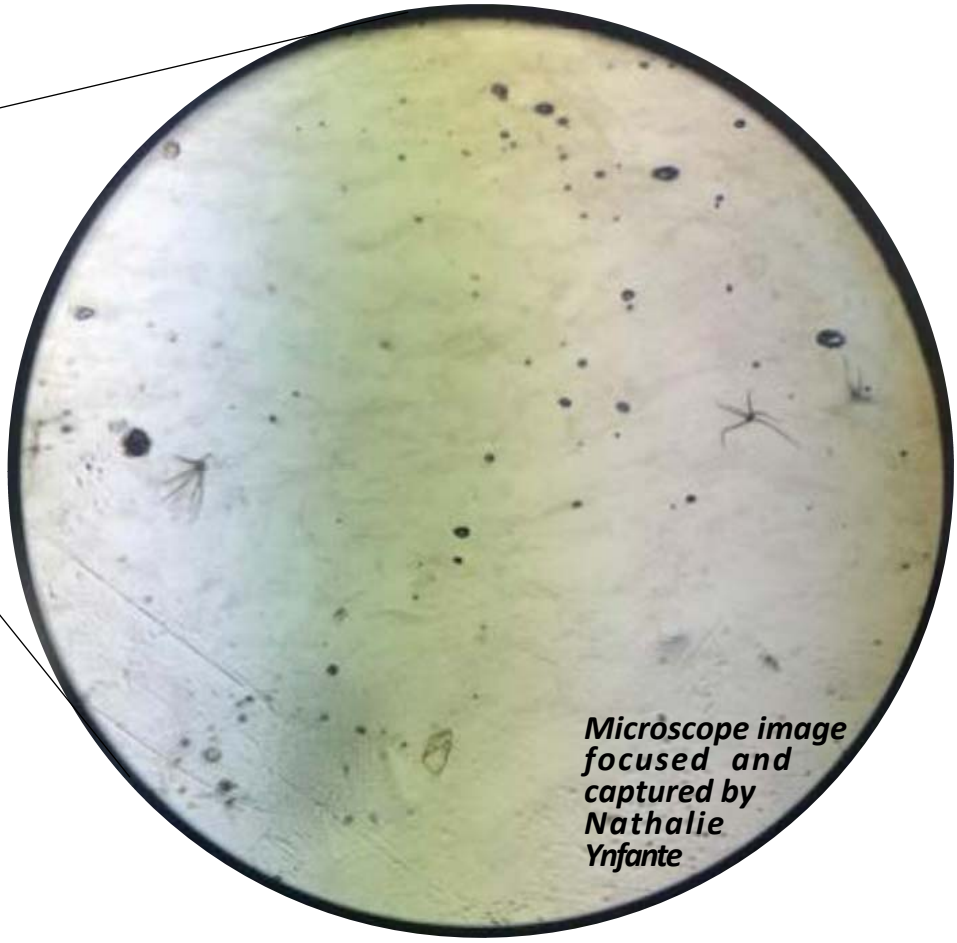
In our biology class, we created air particle detectors. We did this by taking a stick and a cup, once we received the cup we cut it in half and used the part of the cup that holds liquid. We didn't drink out of the cup of course but we taped it to the stick we received earlier to keep the cup sturdy. Next, we put petroleum jelly around the inside of the cup which made the cup sticky inside so it can catch the particles in the air that we were interested in looking at. After that, we stuck the sticks in the ground and let them sit there for a few days. We stuck the particle detectors in the ground spaced out two feet from the one we previously placed in the ground, moving away from the road. After we let them sit for a few days, we picked them back up and took them back to school. We then cut a piece from each petroleum jelly cup and the particles that were stuck to it and put those pieces on a microscope slide. Lastly, we examined the particles on the slide with a microscope and counted how many particles of different types were in each cup.



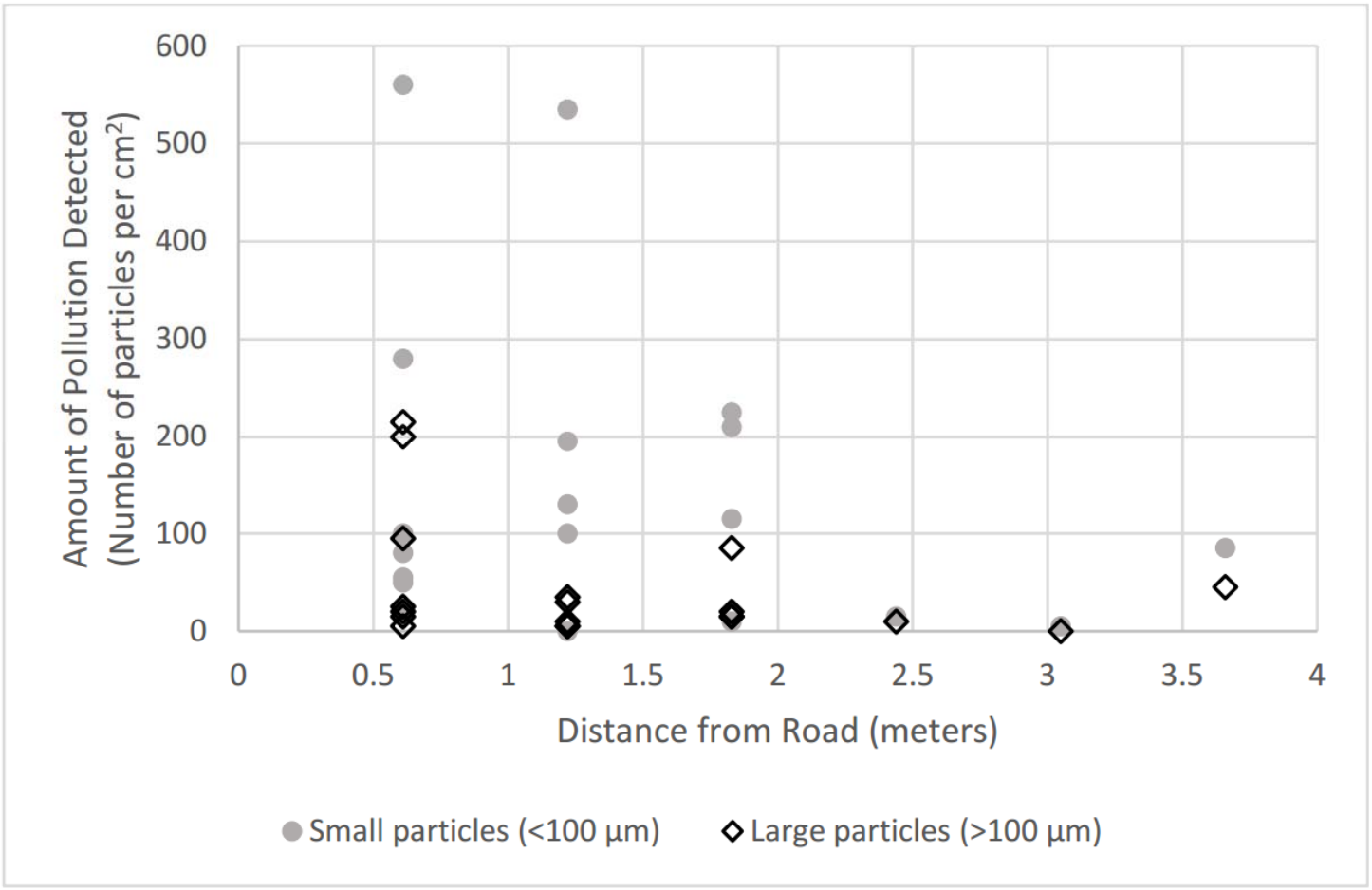
From left to right, Andrew Bensen, Matthew Barnes, and Noah Waller-Slisz set up petroleum jelly pollution collection devices.



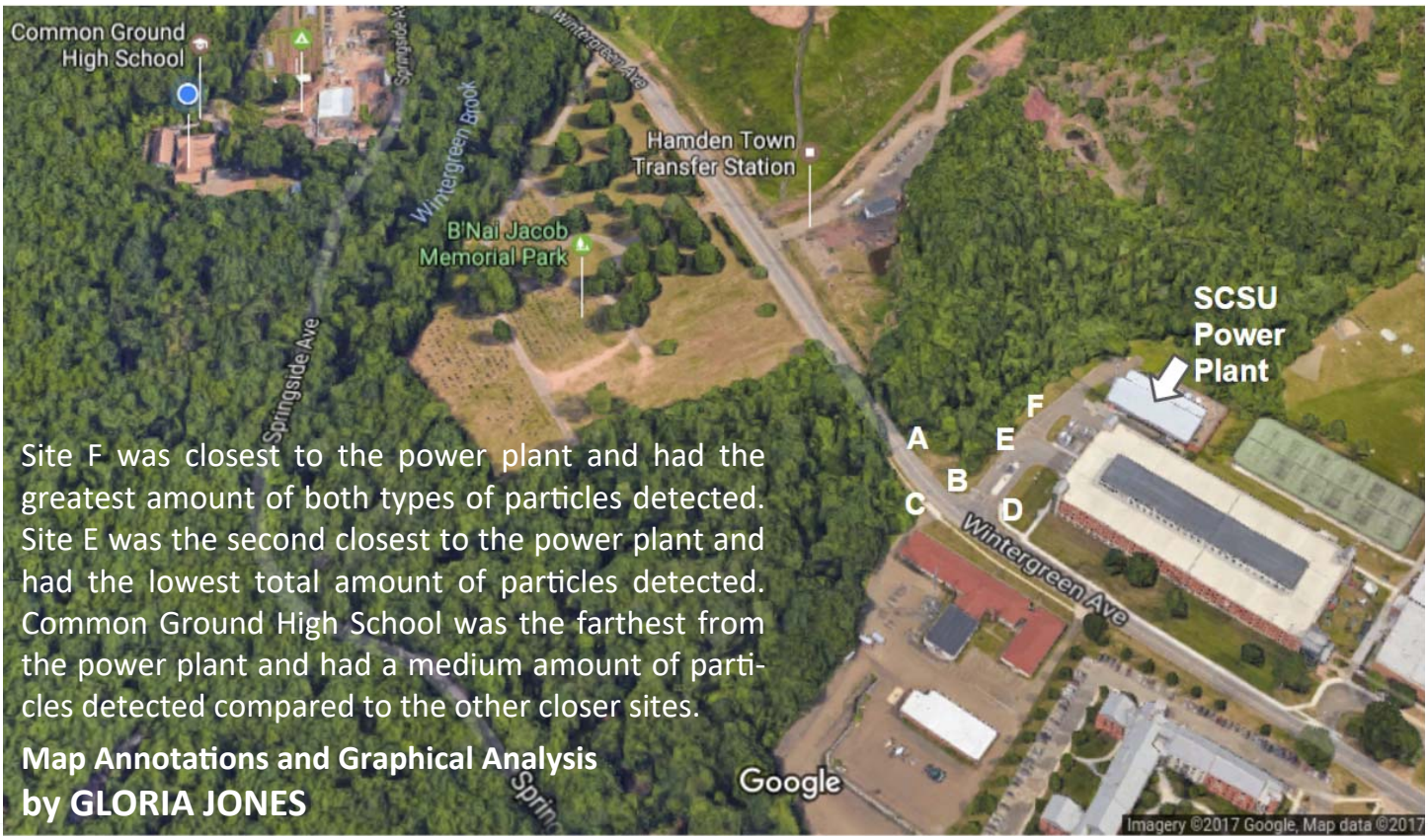
Microscope slide prepared from cut petroleum jelly dish held by Kevin Galabay



Microscope image focused and captured by Nathalie Ynfante

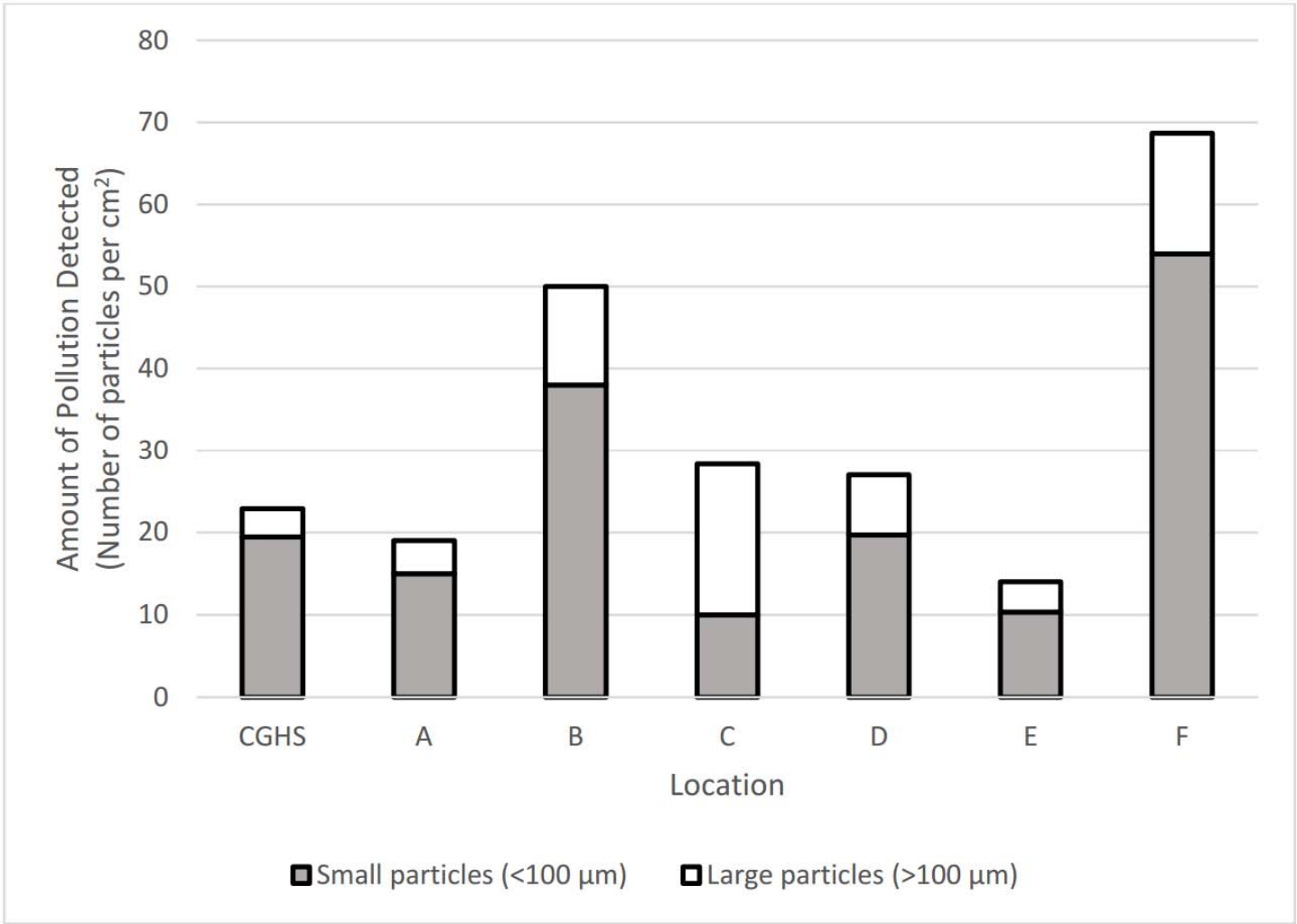


Graph created from the combined data collected by all the biology classes.



Site F was closest to the power plant and had the greatest amount of both types of particles detected. Site E was the second closest to the power plant and had the lowest total amount of particles detected. Common Ground High School was the farthest from the power plant and had a medium amount of particles detected compared to the other closer sites.

Map Annotations and Graphical Analysis by GLORIA JONES



Graph created from the combined data collected by all the biology classes.

Do Transportation Uses of Fossil Fuels Affect Local Air Quality?

by GERNO ALLEN

Transportation uses of fossil fuels affect local air quality. Closer to the road are more particles of all types than farther from the road. For example, when the distance was about a half meter away, the amount of pollution was about 550 particles, and when the distance was about 3 meters away the pollution measured was close to zero. The evidence supports my claim because it shows that the closer you are to the road, the more particles there are in the air. If transportation did not affect the air, there wouldn't be this change.

Do Electricity-Generating Uses of Fossil Fuels Affect Local Air Quality?

YES. I think that electricity generating uses of fossil fuels affects local air quality. There is more pollution near the power plant than away from it. Our data shows that there were more particles close to SCSU. We don't know what fuels they are using to produce electricity, but we assume, based on what we could find online, that they are using either natural gas or oil. I think that if the power plant didn't affect the air quality, then the pollution found in the air would be spread out and not concentrated close to the power plant.

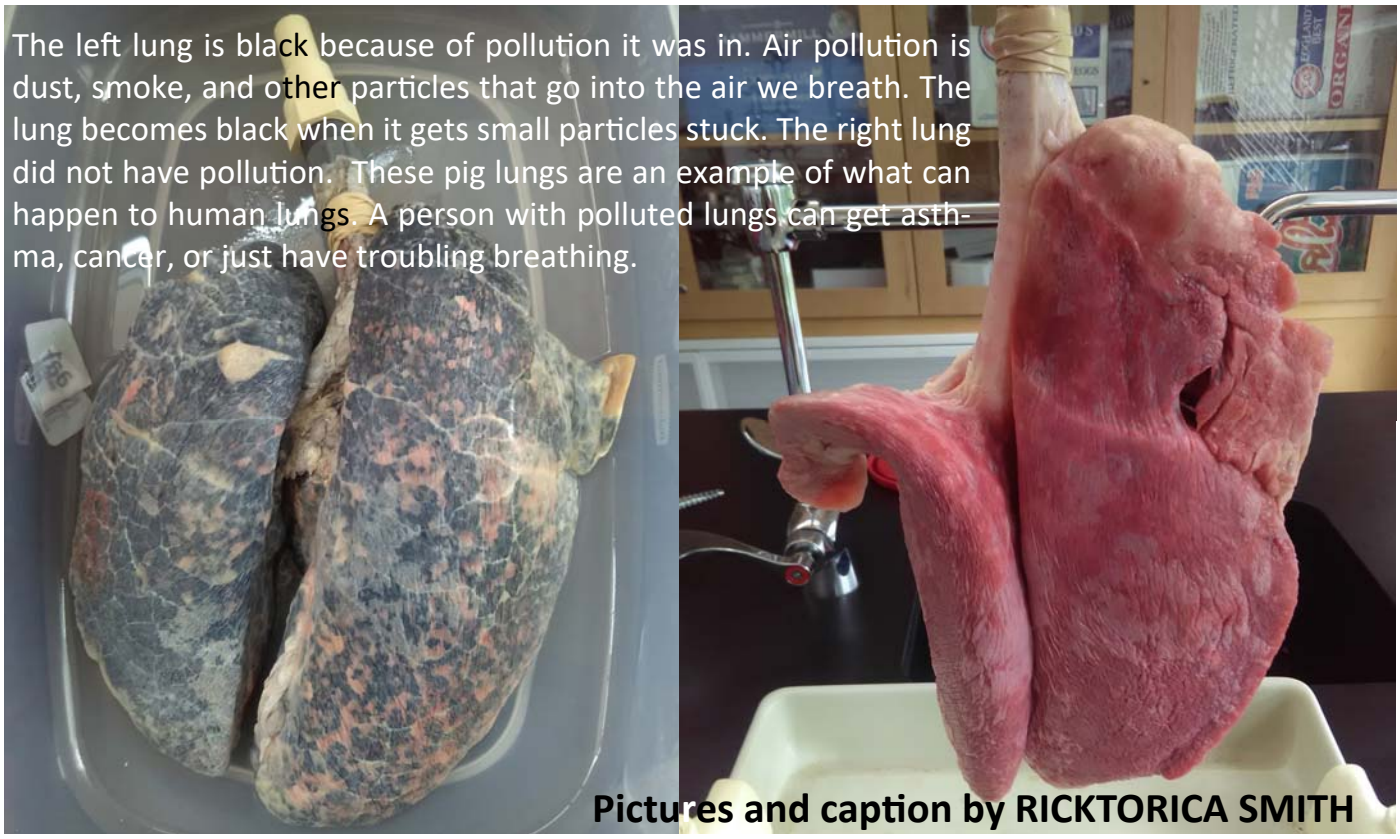
by TYLER DUBOSE and JADA BURNETT

NO. I think the power plant by SCSU doesn't affect the air because even though the closest one to the power plant had a high number of collected particles, the one next to it was very low. So, I think wherever the cars are mostly by is what caused the pollution differences.

by JAYVON EDWARDS

MAYBE. Transportation is not the only reason our air quality can be lowered. Electricity-generating uses of fossil fuel is also a factor in damaging air quality, but it's not a major one. In a graph based on the data from our experiment, we related the amount of pollution detected to approximate distance from the SCSU power plant. I expected that the traps placed closest to the power plant would produce the most caught pollution particles, but that assumption was wrong. The trap placed at the power plant did have a lot of pollution detected (55 small particle and around 20 large ones on average), but among the other locations, there were varied amounts of particles with no pattern related to its distance relative to the power plant; all of the other five locations (CGHS, A, B, C, and D) had collected more particles than location E, which was the second closest to the plant itself. Based on this data, the way in which this power plant generates electricity probably does not cause significant damage to our local air quality. If the electricity generator was a major polluter, we would have caught a lot of particles in all of our traps near the plant, but we didn't.

by ADAIAH STEVENS



The left lung is black because of pollution it was in. Air pollution is dust, smoke, and other particles that go into the air we breath. The lung becomes black when it gets small particles stuck. The right lung did not have pollution. These pig lungs are an example of what can happen to human lungs. A person with polluted lungs can get asthma, cancer, or just have troubling breathing.

Pictures and caption by RICKTORICA SMITH

Particle Pollution's Effects on the Lungs

by NATALIE LEONFFU

You'd never think that breathing air could prematurely kill you. Within the air, there are particles that we breathe. But let's ask the question everyone wants to know: *How* do these particles harm us? Particle pollution harms the lungs' structure and function by causing inflammation, or swelling, that interferes with a person's ability to maintain homeostasis.

Particle pollution damages both how the lungs look and how they function. When looking at examples of pig lungs that were and were not contaminated with particle pollution, we could see how bad pollution is for the lungs. The unpolluted lung was pink and red. When blowing up the lung, it expands to be about two times its original size. In addition, it's easy to blow up. Meanwhile, the polluted lung was grey with some pink spots and a bit of blue and green; overall it was highly discolored. It's also not easy to blow up this polluted lung and it can't expand as much. It even rejects the pump a bit.

Asthma, lungs, and particle pollution. What are they and how are they connected? Asthma is a condition that restricts airways leading into the lungs, making it hard to breathe. Lungs are a pair of breathing organs that help bring needed oxygen into the body. Particle pollution consists of tiny particles that are in the air. There are different types, including many in vehicle exhaust. Breathing particle pollution can cause a variety of illnesses including asthma. It can lead to hospitalization and even early death.

In our particle pollution experiment, we showed how much particle pollution we breathe in without realizing. The data shows that the closer you were to the road the more particle pollution you inhaled. The most particle pollution we detected was about 560 small particles and about 218 large particles at a distance of 0.6 meters from the road. At the farthest distance from the road, 3.65 meters, we had about 93 small particles and about 46 large particles. Particle pollution is a serious health

risk as we breathe it in without realization. But all this talk about particle pollution, what actually is it? Particles in the air come in different sizes. Large particles will get stuck in our nostrils or at the beginning of our throat. Our bodies will then naturally sneeze or cough to release them back into the air. There's also ultra-small particles. These particles will slip through the alveoli at the end of our lungs' airways and move into our bloodstream. These may cause future problems in our bodies, but they don't cause lung problems because of their size. However, the small but not ultra-small particles do the most damage to our lungs. They're small enough to get to the airways, but big enough that they get stuck in them, clogging them up. This can lead to illnesses and early death.

Homeostasis is the ability to maintain stable conditions inside our bodies. A person with asthma isn't able to maintain homeostasis because their airways get clogged. We did an experiment to investigate this. To recreate the restricted airway of asthma, we had participants breathe through a straw while exercising. These individuals dropped in the amount of oxygen in their bloodstream, increasing their pulse and breathing rate immensely in an attempt to compensate. When allowed to breathe normally, as in an unrestricted airway, there only was a drastic change in their pulse when they first started exercising. After each minute, their pulse lowered as it got used to the exercise. Their oxygen levels stayed the same through the whole thing as well.

Asthma is a condition that results in difficulty breathing; it can be caused by an overreaction to inhaled particles. This is a problem because it makes it harder to get the oxygen our cells need to produce energy. All of our cells produce energy through a process called cellular respiration.

Cellular Respiration Equation:

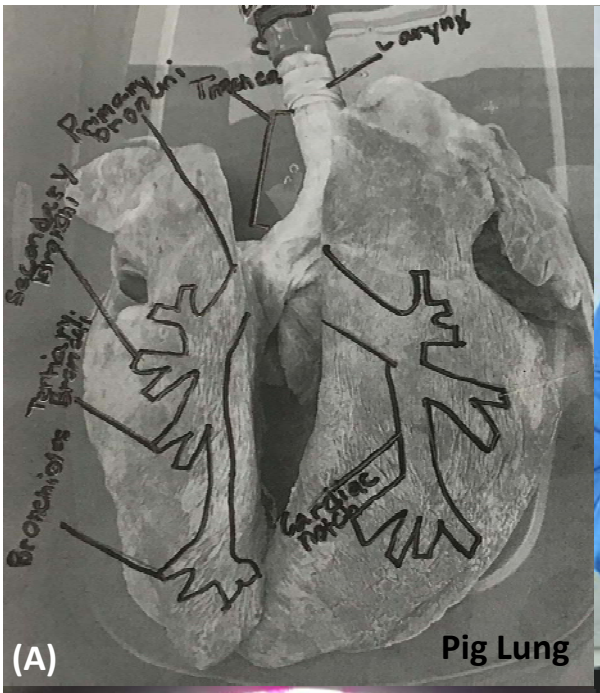
glucose + oxygen → carbon dioxide + water + energy
(sugar)

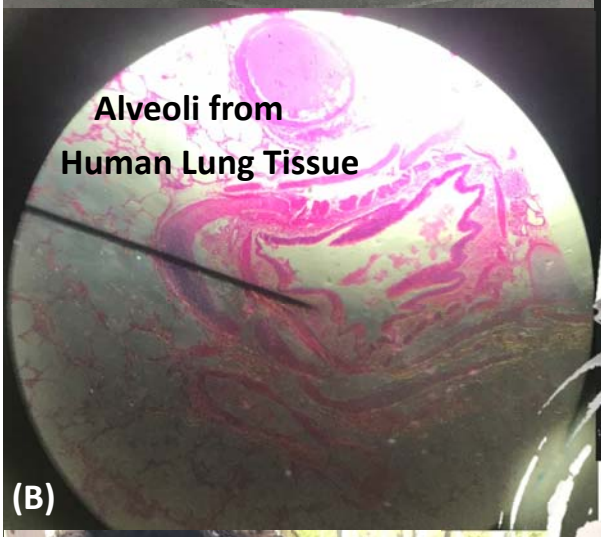
Cellular respiration takes glucose (sugar) and oxygen and turns it into energy and nutrients. So, how are all these things related? Well, asthma doesn't allow people to maintain homeostasis. Their bodies aren't able to have a stable amount of oxygen, which can be shown through drops in their oxygen saturation on the oximeter (the device we used to measure oxygen levels). Cellular respiration converts sugar and oxygen into carbon dioxide and water, releasing needed energy in the process. The people in our experiment had a hard time breathing when having restricted airways, just like people with asthma. If asthma didn't affect a person's ability to maintain homeostasis, then the pulse and blood oxygen data would have been the same for both restricted and unrestricted airway conditions. Exercising requires energy, which uses up oxygen to produce. In response, our bodies need to take in more oxygen than at rest in order to keep our bodies going. Asthma keeps people from being able to breathe correctly, so if they exercise, they have to make sure that they have an inhaler nearby to help return their airways to normal.

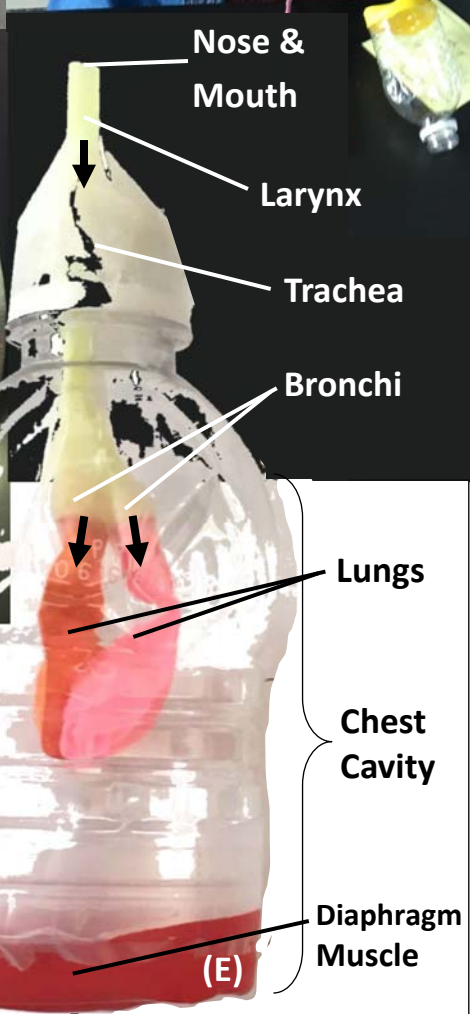
Particle pollution harms the lungs' look and function by damaging the lungs. The pollution causes swelling and interferes with a person's ability to maintain homeostasis. These are the ways particle pollution affects us. Particles will go unnoticed by many, but now you know a little more about the pollution in our air. All these health effects are caused by tiny pollution particles we can't even see.

Particle pollution getting stuck in alveoli and other parts of the lungs can cause major damage to lung structure and function.

Photographs, diagram, & caption by NOAH WALLER-SLISZ



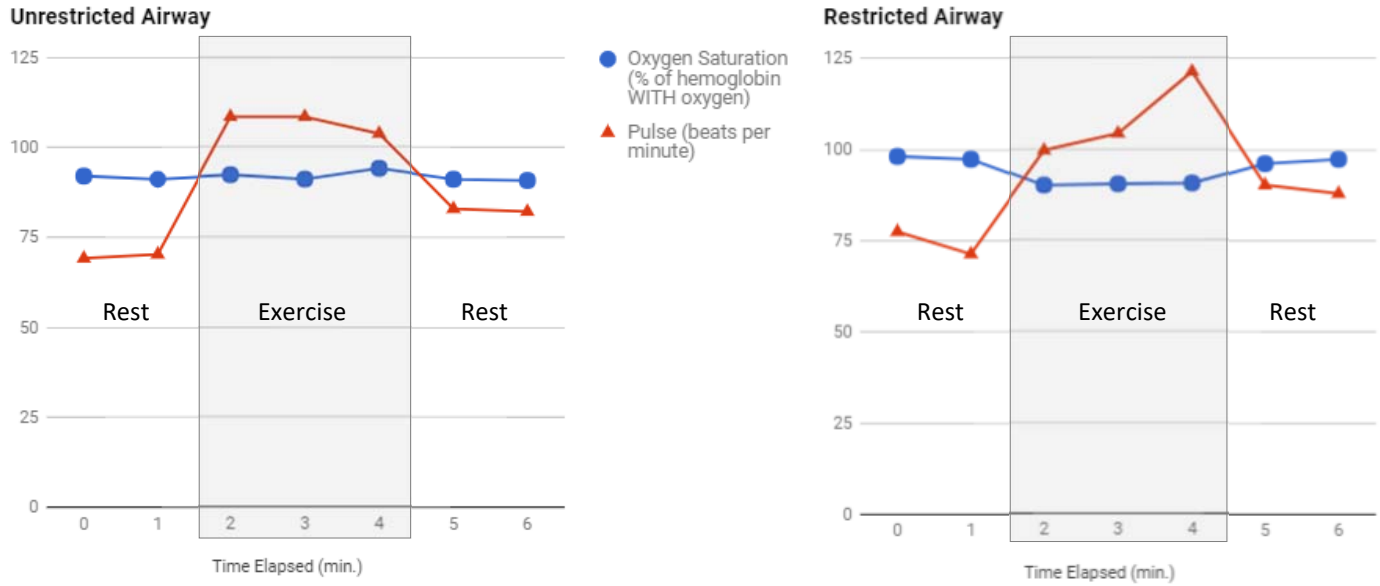




Photograph of pig lungs taken and labeled by Bartolomei Rivas (A). Microscopic image of human lung tissue focused and captured by Kevin Galabay. (C). Johhan Alverenga-Salinas, (C) Samera Reid, and Madyson Valentin (D) work on creating physical models (E) of the lungs.

HOW BREATHING WORKS

(1) *Your brain sends conscious or unconscious signals to your diaphragm muscle to "pull down," which increases the amount of space in your chest cavity.* ***(2)*** *There's not enough air in your chest cavity, so air has to rush in from outside to fill the now bigger internal space.* ***(3)*** *This air enters through the nose or mouth and flows all the way to the tiny ends of the lungs called the "alveoli" where it meets up with tiny blood vessels to exchange oxygen and carbon dioxide with red blood cells.*



Graph created from the combined data collected by all the biology classes. Description below by SAM PASCUCCI.

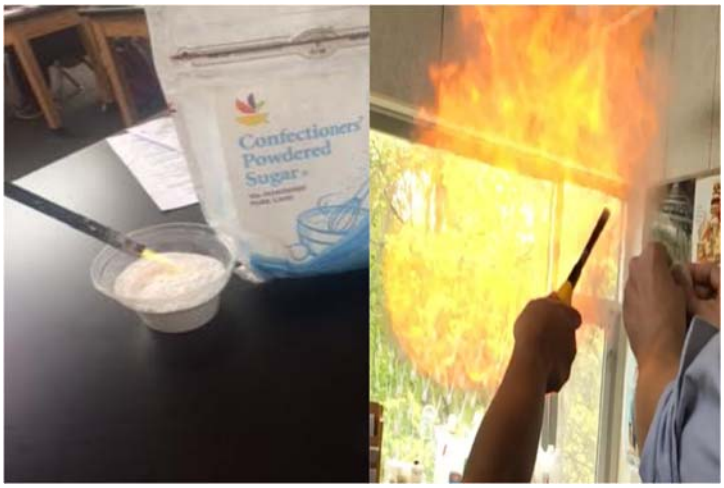
Having restricted airways or asthma from air pollution can definitely affect your health. In class, we wanted to see the effects of having restricted breathing and how it affects your pulse and oxygen saturation. If you didn't already know, your pulse is how many times your heart muscles beat per minute to push blood through your body. Oxygen saturation is a measure of the amount of oxygen in your blood. The average human's blood oxygen level is 95-100%. To see how having restricted breathing affects these things, we did an experiment where a couple students put pulse and blood oxygen readers on themselves. What we did was have some people who breathed normally out of their mouths and some people who breathed through a straw which mimicked restricted breathing. Next, we had both groups exercise and rest. What we saw was that those who had restricted airways had a higher pulse and a bigger drop in oxygen saturation levels. This means that the body had to work harder to supply the body with oxygen. Those who had normal air access did not have a large drop in oxygen saturation level and their pulse did not increase much.

Left. After exercising, Tariq Bolden watches his increased pulse on a computer readout of the electrical signals being sent from his brain to his heart muscles. **Right.** Michael Smith and Evann Meyers simulate exercising with restricted airways, as in asthma, by breathing through a straw.

Why We Need to Breathe

by JENISHA KHADKA

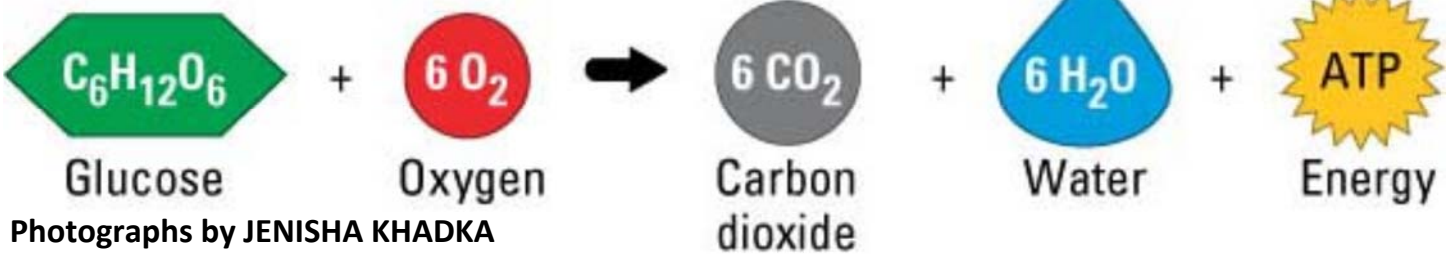
We need to breathe because we need oxygen in our body. Oxygen is needed to burn the fuel, mostly sugar, in our cells. We did an experiment in class which showed why oxygen is needed in our body. We put sugar in a pile and tried to light it on fire, but nothing happened to that pile of sugar because there was not enough oxygen mixed with it. On the other hand, when we sprayed the sugar into the air through the lighter, a giant fireball was created.



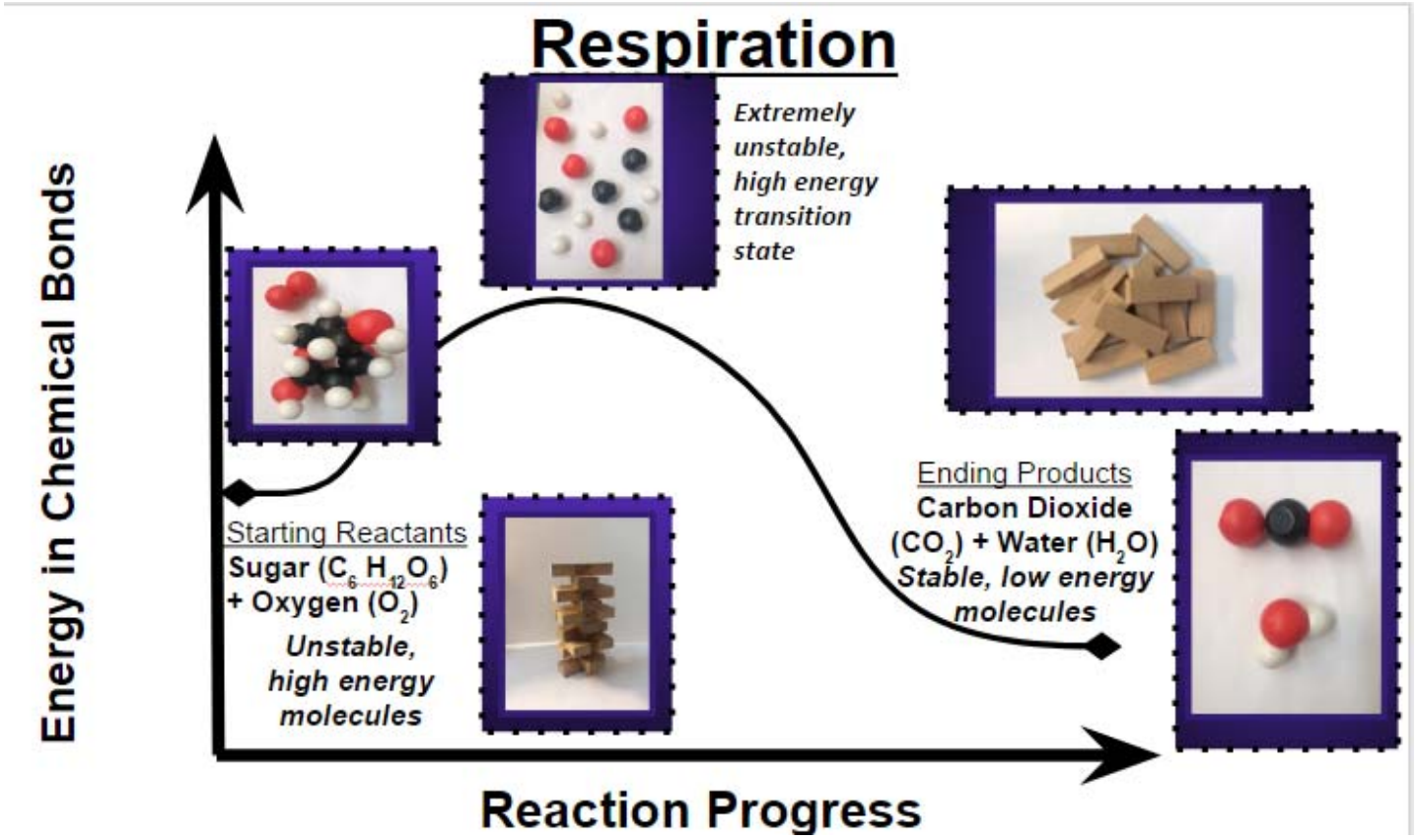
Your body cells use the oxygen you breathe to get energy from the food you eat, which is called the process of cellular respiration. During cellular respiration, the cell puts in a little bit of energy to break down the bonds in sugar and oxygen. When the new, more stable bonds in carbon dioxide and water are formed a lot of energy is released. This process releases more energy than it requires, producing the all of the energy your body needs to keep living.

This process in your cells is very similar to sugar burning in the fireball. As the sugar burns, it is combining with oxygen to create water and carbon dioxide and to release heat energy. When the cell uses oxygen to break apart sugar in your body, carbon dioxide and water are created, and energy is released. But instead of heat energy, the energy produced in cellular respiration is stored chemically for the cell to use later in a special chemical form called ATP.

In a chemical reaction, the molecules produced by the reaction are called products. Molecules are the smallest unit of most materials, and are made up of two or more atoms held together by chemical bonds. The main products of cellular respiration, in addition to ATP, are carbon dioxide and water. No new atoms are created and no atoms are destroyed. In a chemical reaction, reactants contact each other, bonds between atoms in the reactants are broken, and atoms rearrange and form new bonds to make the products. In respiration, the bonds in the sugar are broken and new connections between atoms are formed as carbon dioxide and water. Everything on the left side of the equation breaks down and is rearranged, forming new bonds between the atoms to make the molecules on the right side of the equation, which releases a lot of energy in this case.

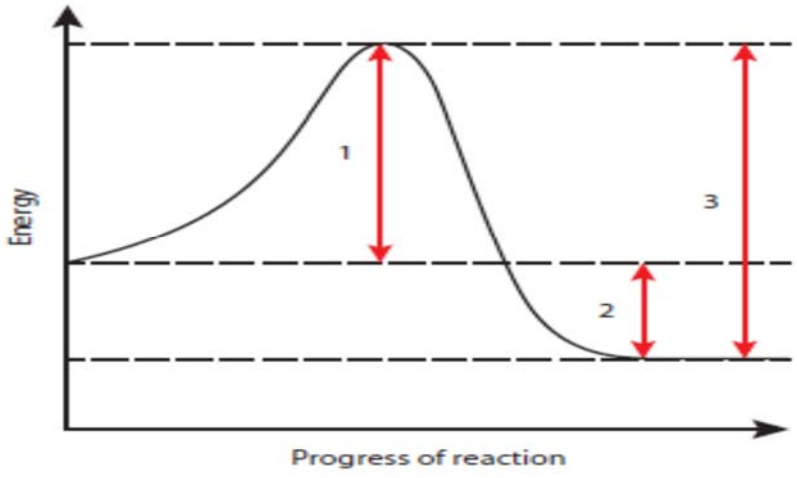


Photographs by JENISHA KHADKA
Diagram source: www.khanacademy.org



Photographs, reaction diagram, and description by EVANN MEYERS and JAYLIN DEJESUS

At first energy is put into the reaction to break the bonds, or connections between atoms, in sugar and oxygen. These starting reactants were very unstable and high energy, like a tall, wobbly tower of blocks. After going through a very brief and extremely unstable transition state, new stronger bonds are formed between atoms as carbon dioxide and water molecules form. These stable, low energy molecules are like a collapsed pile of blocks. The difference in energy between the unstable and stable molecules is released to the environment, just like the noise and motion of a collapsing tower of blocks going from its unstable to stable form.



Graphical analysis by SHAWN WILLIAMS-WELLONS

Image source: www.kentchemistry.com

1. The amount of energy it takes to break the bonds holding together the reactant molecules

2. The difference between the amount of energy it takes to break bonds in the reactants and the amount of energy released when new bonds of the products form, in this example more energy is released than stored

3. The amount of energy released when new bonds are formed in the product molecules

How Our Use of Fossil Fuels Has Changed the Carbon Cycle

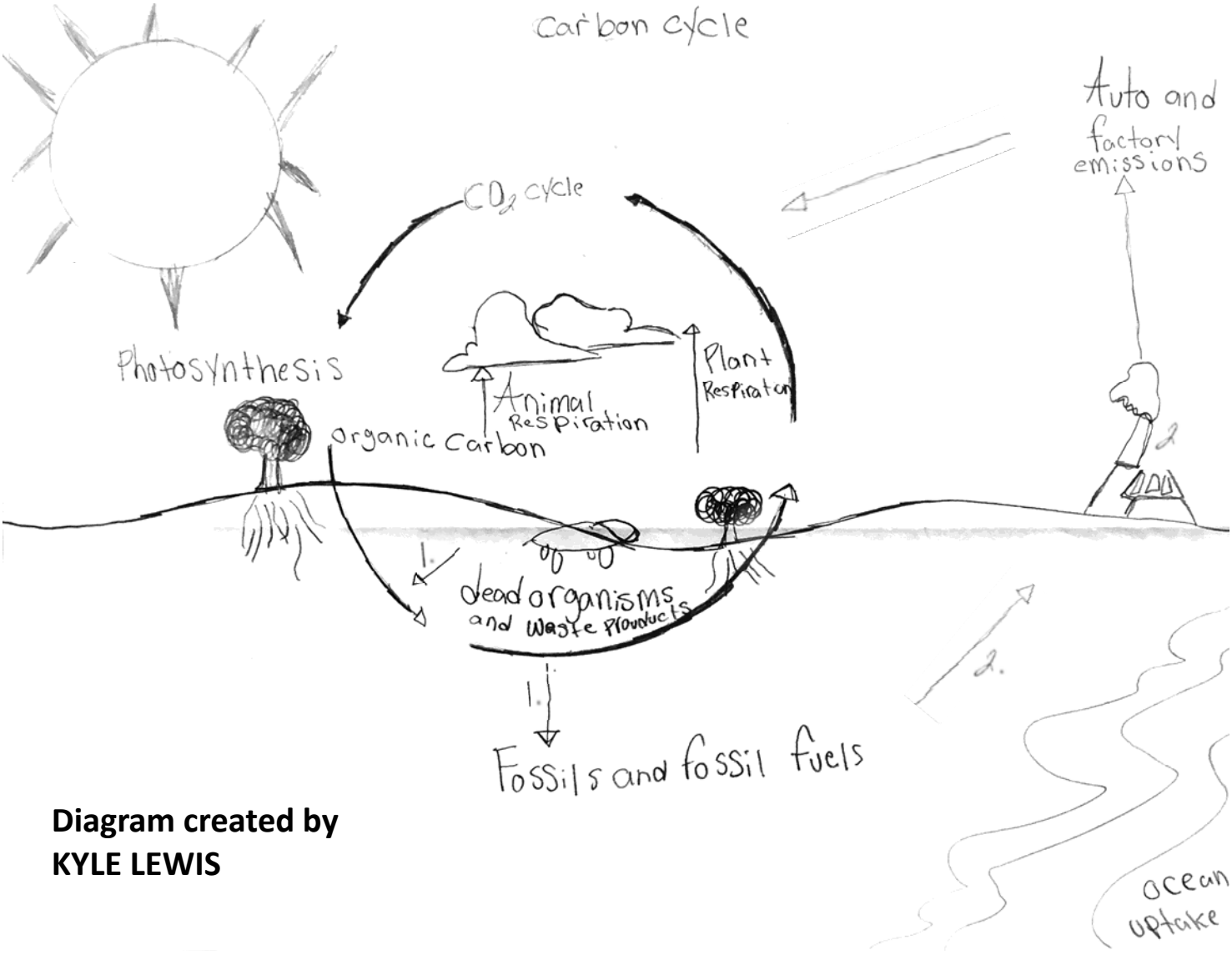


Diagram created by
KYLE LEWIS

1. The creation of fossil fuels from dead organisms is an extremely slow part of the carbon cycle. The fossil fuels underground today were slowly built up by dying organisms that were buried and compressed underground over a period of millions of years.

2. Until recently, the carbon trapped in fossil fuels mostly stayed trapped underground. In the last hundred years or so, however, we have been rapidly taking millions of years worth of stored carbon and shooting it up into our atmosphere in a matter of decades.

Climate Change: Causes and Solutions

by ANDREW BENSEN

Over the last hundred or so years, climate change has begun to be a more serious and apparent problem. It heats up the earth causing problems like an excess of disease carrying mosquitos, natural disasters such as droughts and hurricanes, and it has even made the golden toad, a species of toad, go extinct. Climate change is caused by the burning of fossil fuels and there are many possible solutions, including recycling and riding a bike.

Climate change is caused by the burning of fossil fuels. You probably know what it's like to feel heat coat you as you walk into a building in the middle of winter. Or maybe the joy of hopping in a taxi after walking three miles. In both of these scenarios, whether it's the kind warmth of your home or the relief of pain after using your legs for so long, fossil fuels are being used. In fact, the three main uses of fossil fuels in New Haven are heating, electricity, and transportation. Fossil fuels are the remnants of carbon-filled plants that died and sank into the earth millions of years ago. Carbohydrates are what we intake when we eat food. It's what our bodies burn in order to make energy. We then breathe out the broken down pieces of these carbon molecules as carbon dioxide (CO_2). When fossil fuels are burned in a car or at a power plant, it releases the same thing we release when we breathe, CO_2. Too much CO_2 in our atmosphere can cause an extreme greenhouse effect. This is when light from the sun passes through the atmosphere allowing us to see, however the "wall" of carbon dioxide that surrounds the earth traps heat in, warming up our planet.

A possible solution to climate change is riding a bike. When you drive a car, it emits a lot of carbon dioxide. According to earthonedge.com, "humans are responsible for dumping more than 30 billion tons of carbon dioxide into the atmosphere every year." If people decide to switch to riding a bike, it would cut down that number. A study by *Environmental Health Perspectives* shows, "if 30 million urban and suburban midwesterners replaced half of their short car trips with cycling during the warmest six months of the year, they could save approximately four trillion pounds of carbon dioxide emissions, 1,100 lives and $7 billion in mortality and health care costs for the region every year." These numbers not only show what the positive effects of riding a bike could be, but that people are literally dying because of all the fossil fuel emissions coming from cars. The idea of a large number of people being willing to ride bikes however, is very impractical and highly unlikely. Many people work and live in places that are far away.

Another possible solution to climate change is recycling. When you recycle, you help reduce the amount of greenhouse gas emissions. This is because when making new products from recycled materials it reduces the need for new materials. A lot of carbon dioxide emissions are released when mining or extracting new materials. "When U.S. recycling levels reach 75% it will be the environmental and CO_2 equivalent of removing 55 million cars from U.S. roads each year," says recycleacrossamerica.org. Another way you can cut down on the amount of new materials being collected is by reusing a water bottle. When you do this, you're not buying a new plastic water bottle every time you need a drink. You reduce the amount of plastic you use and waste if not recycled.

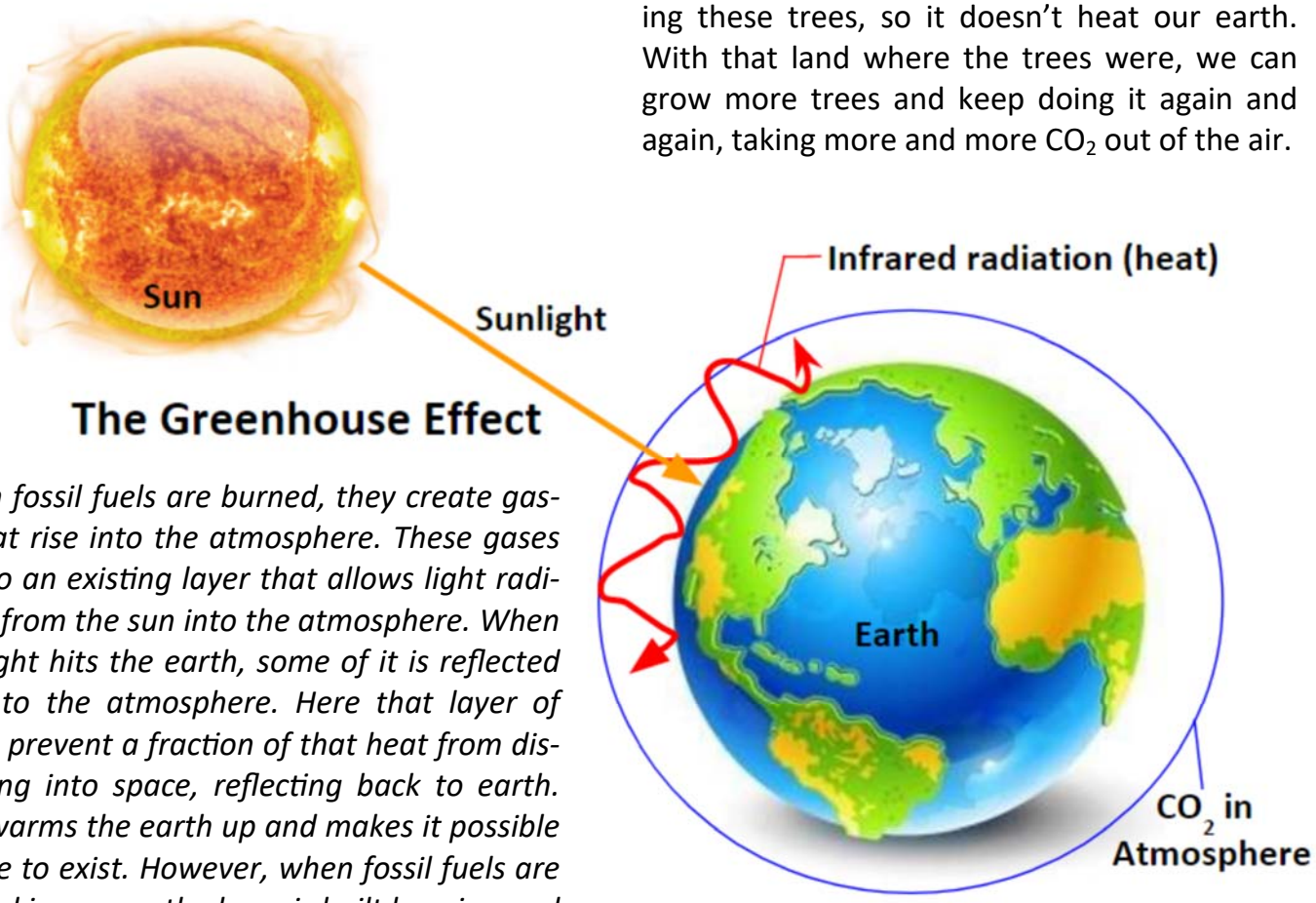
Climate change has become a problem with many negative effects that needs to be addressed. If there is no real change soon, there may be little hope for the health of our planet. However, as we saw there are many ways we can all contribute to help solve this problem. We can do things like ride bikes, recycle, or use a reusable water bottle rather than purchasing a new one every time we need water.

An Unconventional Solution to Climate Change: Grow, Cut Down, and Bury Trees (then Repeat)

by ANGELA FERNANDEZ-AYALA

Carbon dioxide is part of a "blanket" of gases around earth. Normally sunlight passes through the blanket and heats earth and much of the heat bounces back into space. Certain gases like CO_2 trap the heat and hold it. This helps control the earth's temperature. Burning fossil fuels and burning forests puts more and more CO_2 into Earth's blanket every year. It traps more heat and warms the land and seas more and more, causing lots of different problems.

We should be aware of climate change and do something about it. To prevent our fossil fuels from running out and our Earth from heating up, we could use methods to power our stuff that don't involve fossil fuels. We can use other kinds of energy like solar energy, biofuels, or geothermal energy. We should use these renewable resources to power our stuff. We could even cut down some trees and bury them to reduce the amount of CO_2 in the air. It will help because when carbon is in air it heats the earth and trees take carbon out of the air. So, we can take all that carbon from the air and store it underground by cutting down and burying these trees, so it doesn't heat our earth. With that land where the trees were, we can grow more trees and keep doing it again and again, taking more and more CO_2 out of the air.



The Greenhouse Effect

When fossil fuels are burned, they create gases that rise into the atmosphere. These gases add to an existing layer that allows light radiation from the sun into the atmosphere. When the light hits the earth, some of it is reflected back to the atmosphere. Here that layer of gases prevent a fraction of that heat from dissipating into space, reflecting back to earth. This warms the earth up and makes it possible for life to exist. However, when fossil fuels are burned in excess, the layer is built heavier, and more infrared radiation is reflected back to the earth. Because of this, the earth might warm up to a dangerous extent.

Diagram created by
JOHHAN ALVERENGA-SALINAS

Description by GABRIEL REED

Why Is It that Carbon Dioxide Causes Earth to Heat Up Anyway?

by WILL BROMAGE

To understand why CO_2 (carbon dioxide) causes climate change, let's use an analogy of a warm hand in a plastic fishbowl. Now, let's think of the hand as the Earth, and the bowl as the atmosphere. You can see in the picture on the left that my hand is fully glowing. When my hand, representing the Earth, goes into the fishbowl, representing the atmosphere, the heat stays trapped inside, as seen in the picture on the right. When heat tries to leave the Earth, it gets trapped in the atmosphere by carbon dioxide a lot like what you see with my hand. Light can pass through but heat can't escape, so it will make the fishbowl hotter over time, just like the Earth is getting hotter over time because of extra CO_2.

Photographs by ISAIAH HALLOWAY

The Deadliest Animal on Earth

by GABRIEL FORTES

Mosquitos have been shown to be one of the most deadly animals on earth right now. Mosquitos carry tons of deadly disease that kill more than thousands of people every year. One of the most dangerous diseases they carry is named malaria. Malaria is a disease caused by parasites that could potentially kill those affected by it. People who get malaria are typically very sick with high fevers, shaking chills, and flu-like illness.

How Malaria Will Get Worse as a Result of Our Changing Climate

by ALFIA ANSARI

Malaria and climate change. You may never think about how those two things could ever be related to each other, but they are. Malaria is a vector born disease (which means it is transferred by infected insects) and affects red blood cells which are needed to deliver oxygen to the body. Malaria is transmitted through mosquitoes. The same mosquitos that give you those red itchy bumps during the summer can also infect you with a deadly disease that may not have a cure. Since mosquitoes thrive in warm, wet areas, the rising issue of climate change can cause the deadly insect to spread to new places and therefore bring malaria all around the world.

A mosquito will become infected with the malaria parasite and then will bite a human. The parasites are microorganisms and naturally affect mosquitoes. Mosquitos then transfers the disease into a human, and the cycle keeps going. Other mosquitoes will come and suck the blood of the infected person and bite others so they will also get infected.

Currently, the malaria crisis is occurring in warmer climates such as those in parts of Africa, Asia, and Latin America, but that doesn't mean we can ignore it. It is killing thousands of people and climate change is only making it worse. Climate change is causing the planet to warm up by trapping carbon dioxide into the atmosphere. This is caused by the overuse of fossil fuels which emit heat-trapping CO_2 into the air. Mosquitoes thrive in warmer climates, since it allows them to mature faster and allows the malaria parasite to mature faster too. Wet climates also attract these deadly mosquitoes because warm wet puddles is where mosquitoes lay their eggs. As shown on the map on the next page, if the earth keeps getting warmer, mosquitoes will be able to spread and infect people in places that didn't have the disease before, it may also make those counties that already have the disease even worse off.

How the Malaria Parasite Spreads Itself

Malaria is a disease caused by a plasmodium parasite transmitted by the bite of infected mosquitoes (1). When you're bitten by a malaria-infected mosquito, the parasites that cause malaria are released into your blood and infect your liver cells (2). The parasite reproduces in the liver cells, eventually getting into red blood cells, where it then reproduces so much that the cells burst open (3). This allows thousands of parasites to spread throughout the bloodstream where they can be picked up by a new mosquito bite to find another human host.

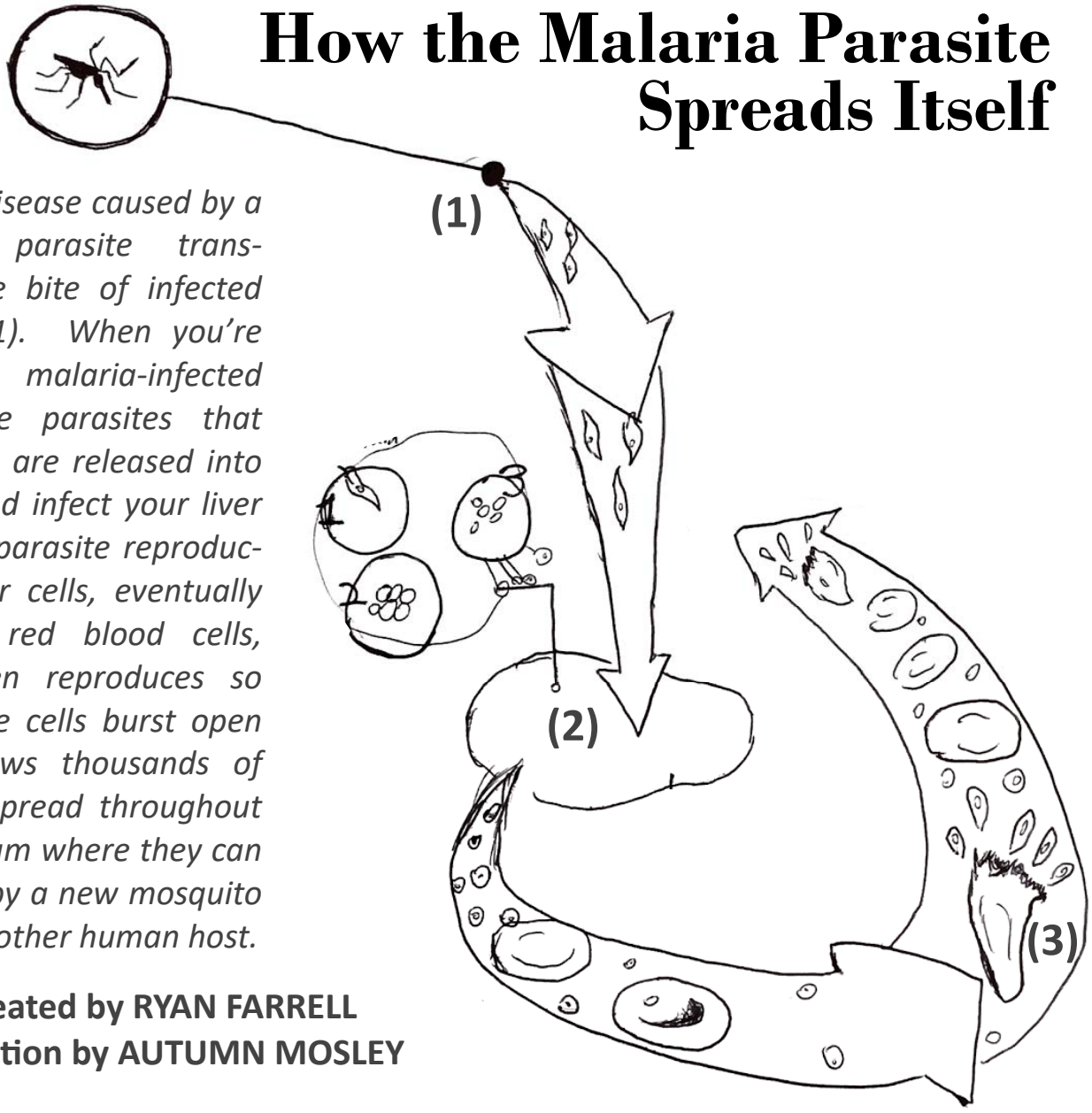
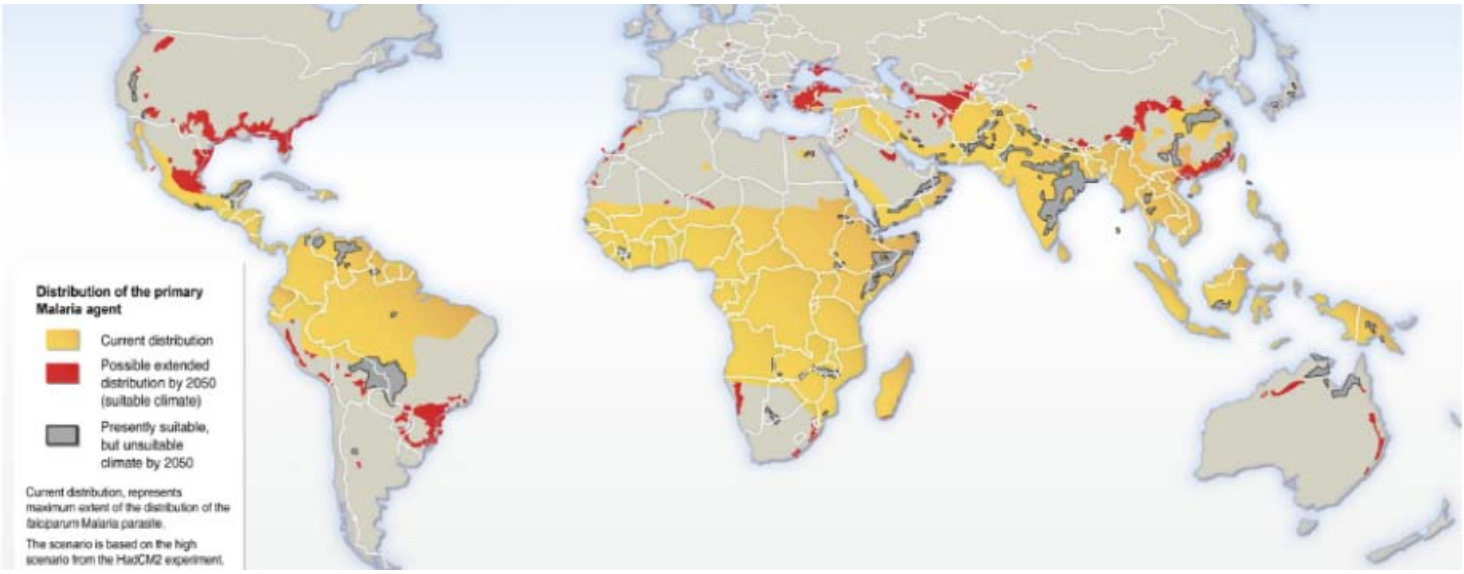


Diagram created by RYAN FARRELL and description by AUTUMN MOSLEY



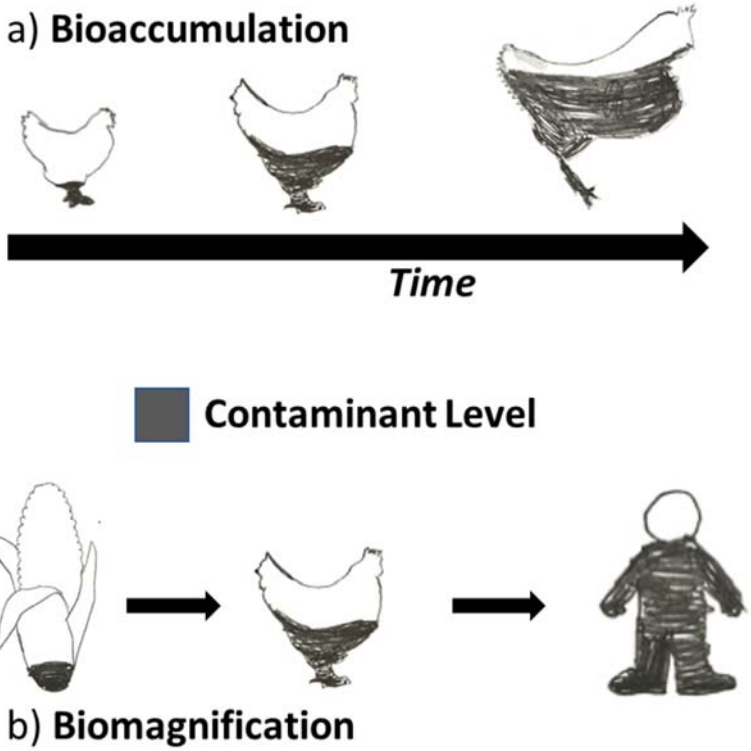
Source: www.sciencemag.org

The Spread of Malaria after DDT Was Banned

by EVA ZSIGMOND

DDT, a toxic chemical known as the most powerful pesticide in the world, was being sprayed everywhere from spider webs in people's homes, to front yards, to being sprayed in giant clouds over people. Due to this, DDT caused many health effects such as birth defects, premature births, and infant deaths, along with the deaths of animals and wildlife. Rachel Carson, a conservationist, wrote a book called *Silent Spring* which advanced the global environmental movement, exposed the hazards of DDT, and eventually got DDT banned.

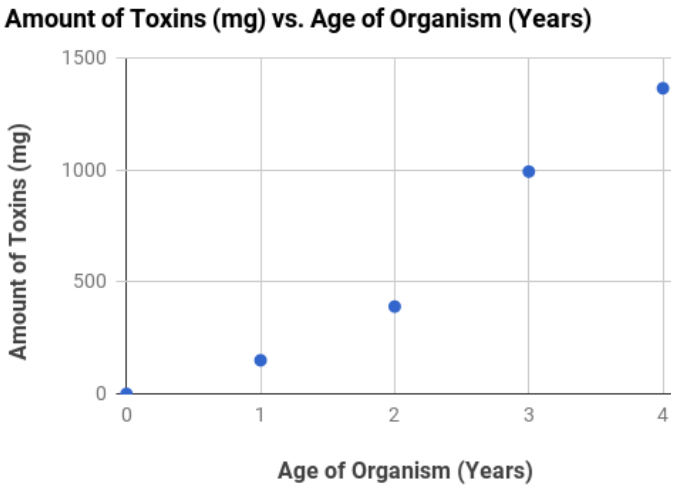
Unfortunately once DDT was banned, cases of malaria broke out, spreading like wildfire.



a) The top diagram shows how DDT bioaccumulation works. It shows an organism (a chicken) becoming more contaminated over time as it grows and ingests a chemical that its body is unable to process or remove.

b) The bottom diagram shows how DDT biomagnification works. It shows how when an organism eats another organism it takes in that living thing's entire lifetime worth of pollution in one meal, adding significantly it to its own contaminant level.

The graphs below show another way to visualize these two processes.



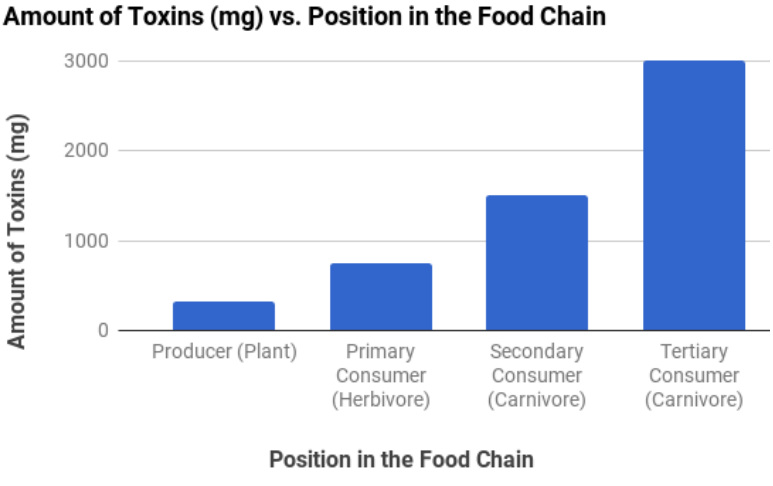


Diagram created by IMANI HARRISON, graphs by MATTHEW BARNES, and description by ANDREW BENSEN

Carson Not to Blame for Malaria's Return

by BRANDI OCASIO

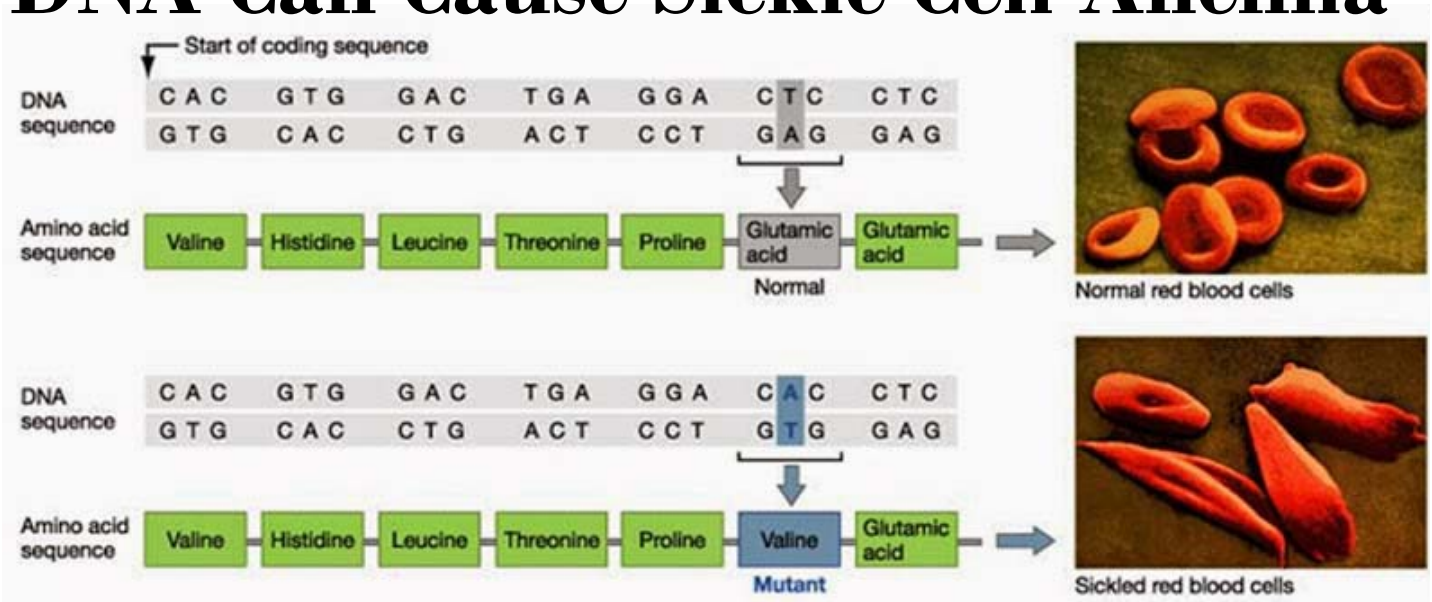
"For the first time in the history of the world, every human being is now subjected to contact with dangerous chemicals, from the moment of conception until death," wrote Rachel Carson in her award winning book *Silent Spring* in 1962. In recent years, many conservatives and some doctors have attacked Rachel Carson for the banning of DDT. The book talked about the dangers of DDT and how it has and will have a drastic effect on the environment and human health. This book was very controversial, but effective. It resulted in the banning of DDT in the United States.

DDT causes great harm to the central nervous system by interfering with nerve impulses. DDT is toxic. According to the National Pesticide Information Center, "DDT is slightly to moderately acutely toxic to mammals, including people, if eaten. DDT is poorly absorbed through mammalian skin, but it is easily absorbed through an insect's outer covering known as an exoskeleton. Laboratory animals exposed to DDT develop hyperexcitability, tremors, incoordination, and convulsions." The NPIC also stated, "people exposed to DDT while working with the chemical or by accidental exposure report a prickling sensation of the mouth, nausea, dizziness, confusion, headache, lethargy, incoordination, vomiting, fatigue, and tremors." The Center for Sustainable Nanotechnology spoke on this also, claiming that, "the persistence of DDT in the environment and the bioaccumulation and biomagnification of this compound has led to serious health effects in many organisms." The Center for Sustainable Nanotechnology continues with, "if a larger organism consumes many of these small organisms, the dose (or concentration) of DDT that it experiences becomes larger than it was in the smaller organisms. This process is called biomagnification, and it takes place when organisms higher in the food chain eat many of the smaller organisms that have bioaccumulated the chemical from the environment." DDT is still affecting our food supply and the natural balance of nature. All generations alive today, including millennials, have DDT in their systems, even if they didn't live through a time when it was widely used.

This topic causes debate and arguments even today. Some people claim that the banning of DDT resulted in a dire outbreak of malaria. This, however, is not the case. Places in the world where DDT was never banned and is still used today actually have statistically *higher* numbers of malaria cases.

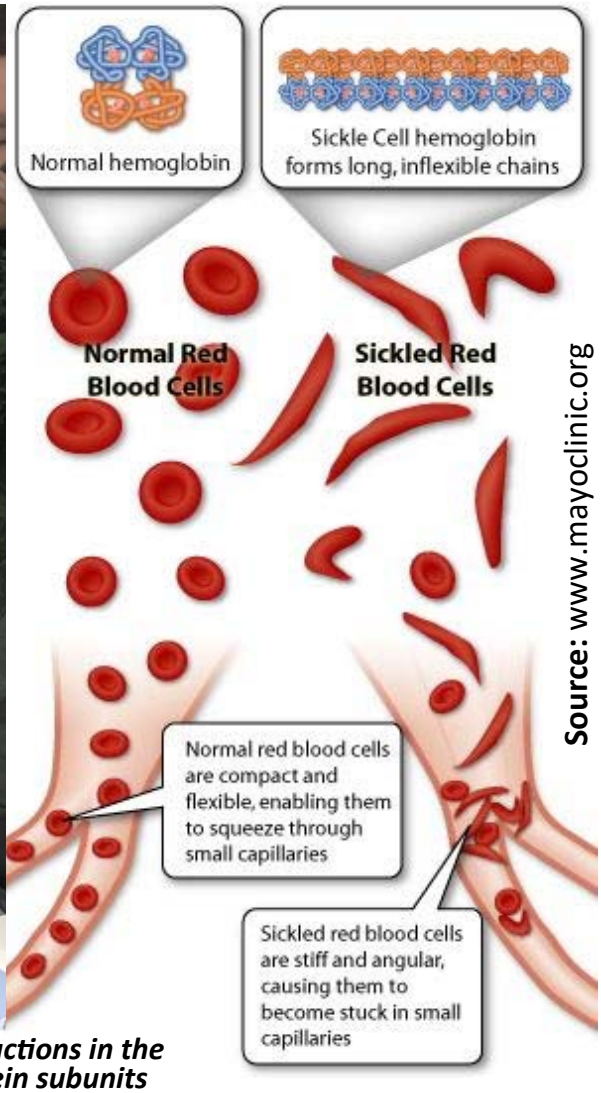
Why is this the case? If these places still have access to DDT, a very powerful chemical that kills the mosquitoes that carry malaria, why do they have the worst cases in the modern world? Well, that's obvious. The chemical *was* effective. No one can deny that. But it was only effective to an extent. These chemicals stopped working due to the overuse of it. The overuse caused the populations of bugs to slowly become immune to DDT. DDT never had the ability to kill a select few mosquitoes with particular DNA sequences that made them naturally immune. After spraying, these mosquitoes were the only ones left and were able to pass this trait down to their many offspring. According to BioMed Central, "scientists used a wide range of methods to narrow down how the resistance works, finding a single mutation in the *GSTe2* gene, which makes insects break down DDT so it's no longer toxic." By increasing survival and reproduction, the few initial copies of this *GSTe2* gene were able to greatly increase in number in the rapidly recovering mosquito populations. The cycle continued and is continuing today—which is why there's such a large number of malaria outbreaks. Mosquito populations are no longer affected by DDT.

A Change in One Single "Letter" of DNA Can Cause Sickle Cell Anemia



The change in amino acid sequence causes hemoglobin molecules to crystallize when oxygen levels in the blood are low. As a result, red blood cells sickle and get stuck in small blood vessels.

Source: www.miami.edu



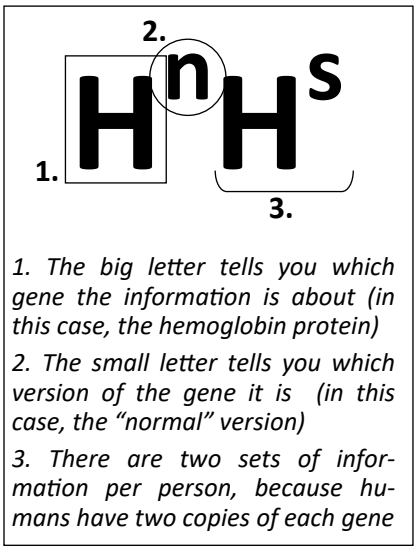
Source: www.mayoclinic.org

Robert Logan (left) and Matthew Torres (right) follow the instructions in the DNA sequence to create normal and mutated hemoglobin protein subunits

How Sickle Cell Anemia and Malaria Resistance Are Inherited

by TYRON KNIGHT

A Punnett square is a diagram that is used to predict the outcomes of sexual reproduction. Genes are the fundamental physical and functional unit of heredity, or how traits are passed down. Punnett squares help us track which alleles, or versions of genes, the children of a particular reproduction may get. Each parent has two copies of every gene (one from their mom and one from their dad), so it is a 50-50 chance which they will pass on to any given child. The Punnett square below shows all the different possible genetic outcomes for the children of two parents who are both "carriers" for sickle cell.



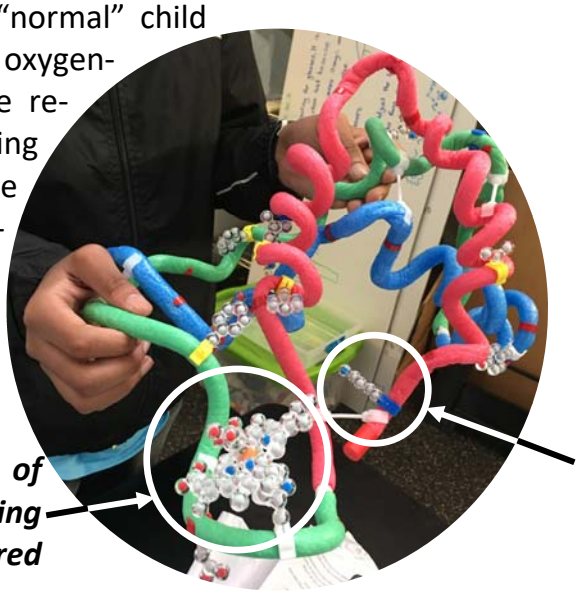
1. The big letter tells you which gene the information is about (in this case, the hemoglobin protein)

2. The small letter tells you which version of the gene it is (in this case, the "normal" version)

3. There are two sets of information per person, because humans have two copies of each gene

Parent #2 (H^nH^S) \ Parent #1 (H^nH^S)	H^n "Normal" version of hemoglobin protein	H^S "Sickled" version of hemoglobin protein
H^n "Normal" version of hemoglobin protein	H^nH^n	H^nH^S
H^S "Sickled" version of hemoglobin protein	H^nH^S	H^SH^S

For this combination, there is a 50% chance to have a child that is a carrier for sickle cell (H^nH^S), a 25% chance to have a child with sickle cell disease (H^SH^S), and a 25% chance to have a child with completely "normal" hemoglobin. An H^nH^n "normal" child would be vulnerable to malaria but have 100% oxygen-carrying ability. An H^nH^S "carrier" child would be resistant to malaria and have about 90% oxygen-carrying ability and an H^SH^S "sickle cell disease" child would be resistant to malaria and have about 50% oxygen-carrying ability. Because of the costs and benefits, the sickle cell trait only evolved in places with lots of malaria around where protection from malaria was worth the cost of loss in ability to carry oxygen.



The shape and chemical properties of this part of the hemoglobin protein are just right for attracting and holding onto the oxygen molecules your red blood cells carry all throughout your body.

A change in one amino acid (the building blocks of protein) at this location is responsible for the "sickle cell" trait.

Sickle Cell Anemia: A "Racial" Disease?

by NOAH WALLER-SLISZ

Race is a factor in the underfunding of sickle cell research. I read an article by Shaun King about the sickle cell disease that opened with the question, "Did you know that sickle cell anemia is the single most common life-threatening genetic disease in the United States?" I found out that it can shorten a person's lifespan to about 40 to 45 years old. And that "over 100,000 Americans suffer from the sickle cell disease." It is said to primarily affect African Americans. I kept reading and found out that there is another common genetic disease called cystic fibrosis. Similar to the sickle cell disease, the cystic fibrosis disease can lower someone's lifespan to about 37 years old. This disease affects far fewer Americans than sickle cell, but is said to mostly affect Caucasians. In 2011, foundations for cystic fibrosis had about $176 million while sickle cell funding was at just $1 million. Also, "from 2009 to 2011, researchers published twice as many papers on cystic fibrosis as they did on sickle cell."

This brings up the question of whether or not race is even real in a biological sense or if it is only real in a social sense. Well, from this article it seems that it is in a biological sense. But after reading this article, I watched this video where a mixture of high school students were doing DNA tests. Before they did the tests, they were asked who they thought they would have the most similarities with. All of the students picked someone of their matching race or culture. After the tests came in, the students found out that they had no special similarities with their same race at all. All of the students had just as much or more similarities with people of different "races." By seeing this video, people would say that race real is not real in a biological sense but only in a social sense. But by seeing both the video and reading the article, I have to say that I have no clue what sense race is real by.

Regardless of whether it is biologically real or not, with the evidence given in the article, I have concluded that race is a factor in the underfunding of sickle cell research. In other words, I am basically saying that people are underfunding and under-researching the sickle cell disease because it is seen as mostly affecting African American people and that because cystic fibrosis is thought to be suffered mostly by Caucasians, it is unfairly given more funding and attention.

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by WILLIAM SAPP

For many years medical and premedical students have been taught that sickle cell anemia is an African American disease. On their exams, they're taught to answer questions relating to sickle cell by "just circling African-American." This is a major problem being that studies have shown that race is a social construct that is not related to genetics. One doctor who is also a sociologist has been writing papers explaining why sickle cell anemia isn't a racial disease. She explains the main reason people were misdiagnosed with sickle cell anemia was because both skin color and the disease are both inherited and have a small correlation. That has led many to believe that race is validated as a biological thing and that this disease is connected to being African American, but that isn't true because not only have blacks gotten this disease but so have whites. In the past 100+ years, races have been defined as medical categories and these have been affecting the patient's experiences, but race isn't related to health because of genetics. Race is very important to health because racism impacts our health.

Funding Disparities between Sickle Cell Anemia and Cystic Fibrosis

by NATALIE LEONFFU

Ever think about the way things are funded? If there's ever a battle for funds? Or if things are being mis-funded? One clear example of this is sickle cell anemia and cystic fibrosis' funding difference based on the public's view of them.

Sickle cell disease (SCD) is a condition that results from an altered protein called hemoglobin that carries oxygen through the bloodstream. SCD misshapes red blood cells into the shape of a crescent (or sickle). The purpose of red blood cells and the hemoglobin they contain is to carry oxygen to tissues. Normal red blood cells are able to pass through the bloodstream without a problem, but the sickle cells get caught in the passages. Sickle cells build up in the veins and block the blood flow. The positive benefit is that having sickle cell anemia significantly decreases your chance of getting malaria.

Malaria is a deadly disease that's spread by infected mosquitos. It has been found in Africa, Central America, South America, Asia, and parts of Europe. People in regions with high malaria risk have evolved through many generations sickle cell anemia. Those who had this disease were less likely to get malaria and therefore more likely to have children, passing on this unique trait. The way the sickle cells are shaped prevents the disease from entering a red blood cell and getting to the whole body.

Sickle cell anemia vs. cystic fibrosis. Each is a life-threatening condition. According to Centers for Disease Control and Prevention, "Sickle Cell Disease (SCD) affects approximately 100,000 Americans. SCD occurs among about 1 out of every 365 Black or African-American births. SCD occurs among about 1 out of every 16,300 Hispanic-American births. About 1 in 13 Black or African-American babies is born with sickle cell trait." Yet, sickle cell anemia is usually identified as an exclusively African-American genetic disease. Meanwhile, cystic fibrosis (CF) is generally identified as a white genetic disease. According to the Cystic Fibrosis Foundation, "more than 30,000 people are living with cystic fibrosis in the United States (and more than 70,000 worldwide) with approximately 1,000 new cases of CF each year." Cystic fibrosis has much more funding than sickle cell anemia. This is a race problem. Medical schools are no help either as they teach that diseases are directly linked to racial biology. This of course isn't true. Biologically, we are all similar. Two African-American people can be more different from one another than from a white person. They only difference is the pigment of our skin, hair, and eyes. Both of the diseases (SCD and CF) can be found in other races then the one they're generally identified with. Sickle cell anemia, for example, can be found in European countries that had malaria, such as those in the Mediterranean.

Sickle Cell Anemia needs just as much funding as Cystic Fibrosis. It is only because of the way these diseases are perceived that funding unfairly differs. The funding determines the research in each field as well. Less will be known about sickle cell anemia simply because of racism.

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BREAKING Trump Pulls U.S. out of International Climate Agreement

by BRANDI OCASIO

On June 1st, 2017, President Donald Trump pulled out of the Paris climate accord. Mr. Trump said that he'd be willingly to renegotiate aspects on the agreement, but will not be part of it until further notice. He claims that the current agreement is not "fair" to the United States.

The Paris climate accord is an agreement between all the countries in the world, excluding Nicaragua and Syria (and soon the United States), dealing with greenhouse gas emission mitigation, adaptation, and finance starting in the year 2020. Its main goal is to prevent and regulate global warming.

Syria has been involved in a Civil War for 6 years. It's understandable why they are not apart of the agreement - they have other issues. Nicaragua is not part of the agreement because they feel the accord does not go far enough and feels it is inevitably useless.

Joshua Busby at the University of Texas answers the big questions: What does this mean, and what's next? He writes, "Under the normal rules of the agreement, the United States cannot withdraw until November 2020," but, "there is a nuclear option." The "nuclear option" he's referring to would allow the U.S. to leave the Paris climate accord by early 2018. However, this would mean the United States must withdraw from the United Nations Framework Convention on Climate Change, a treaty that started this entire process.

President Trump argues that this deal will and has done nothing to improve the environment. He claims it "hamstrings" the US economy, especially in the fossil fuel department. It "hurts American workers," and "empowers the polluters" who pollute the air and water almost as much as the US.

"The bottom line is that the Paris agreement is very unfair, at the highest level, to the United States," Trump said. He stated that the agreement would impose "draconian financial and economic burdens," costing America $3 trillion in domestic economic activity and 6.5 million industrial and manufacturing jobs. "I was elected to represent the citizens of Pittsburgh, not Paris," he said. The mayor of Pittsburg, Bill Peduto, spoke out against this, saying, "the city of Pittsburgh voted for Hillary Clinton with nearly 80% of the vote...we don't know what he's talking about."

President Trump has made several conflicting comments on the record about Climate change over the years. On February 6, 2009 Donald Trump wrote a letter to President Obama claiming, "we support your effort to ensure meaningful and effective measures to control climate change, an immediate challenge facing the United States and the world today," and continues on with, "If we fail to act now, it is scientifically irrefutable that there will be catastrophic and irreversible consequences for humanity and our planet." President Trump, three of his children and dozens of business leaders signed this letter calling for a global climate deal. However, on February 14, 2010 he changed his mind and decided, "with the coldest winter ever recorded, with snow setting record levels up and down the coast, the Nobel committee should take the Nobel Prize back from Al Gore," He continued to call Climate change a "hoax" in an interview on Fox news on January 6, 2014 stating, **"**this winter is brutal," adding that climate change is a myth perpetrated by "scientists [who] are having a lot of fun." Donald Trump then donated $5000 in 2014 to Protect Our Winters, a group that fights climate change. Trump has continued to bounce from side to side on this issue and even as of early June refused to answer a question from CNN asking if he still believed that climate change was a "hoax".

There are cities and states in the United States that are implementing their own laws and regulations to fight climate change. "The federal government is really important — there's no doubt about it — but a lot of aspects of climate policy involve local and state and regional decisions, and that's happening," said Jessica Green, assistant professor of environmental studies at NYU. Mayor Jackie Biskupski, of Salt Lake City, said "her administration had recently brokered an agreement with the local utility to power the city with 100 percent renewable energy by 2032." In California, considered the leading state in tackling climate change, the state senate just passed a law to go to 50 percent renewable electricity by 2026 and 100 percent by 2045. Another example is Washington, who has, "adopted a cap on carbon pollution and invested in growing clean energy jobs and subsidizes electric vehicle purchases and charging stations." Our own Governor Malloy said in a statement, "In the absence of leadership from the White House in addressing climate change, it is incumbent upon the states to take action in order to protect their residents."