

Clues to accompany “The Mystery of the 3 Scary Numbers”

Note to teacher: Attach the “Keeling Curve” Mauna Loa Observatory graph to starred clue.

Two degrees Celsius is about 3.6 degrees Fahrenheit. In 2009, 167 countries signed on to the Copenhagen Accord. These 167 countries are the biggest polluters in the world, responsible for 87 percent of all greenhouse gas emissions. The Accord states that we cannot raise the Earth’s temperature more than **2 degrees Celsius**, without risking planetary disaster. All 167 countries, including the United States, pledged that: “We agree that deep cuts in global [greenhouse gas] emissions are required... so as to hold the increase in global temperature below **2 degrees Celsius**.”

Former NASA scientist James Hansen, the world’s most prominent climatologist, believes that the Copenhagen target of keeping global warming under **2 degrees Celsius** is not good enough. He says: “The target that has been talked about in international negotiations for 2 degrees of warming is actually a prescription for long-term disaster.”

At the 2009 Copenhagen climate summit, a spokesman for small island nations warned that many island nations would not survive if the planet warmed by **2 degrees Celsius**: “Some countries will flat-out disappear.”

Many scientists believe that allowing the Earth to warm by **2 degrees Celsius** could be a disaster. “Any number much above one degree involves a gamble,” writes Kerry Emanuel of MIT, the Massachusetts Institute of Technology, a leading authority on hurricanes, “and the odds become less and less favorable as the temperature goes up.” Thomas Lovejoy, once the World Bank’s chief biodiversity adviser, says this: “If we’re seeing what we’re seeing today at 0.8 degrees Celsius [for example, Superstorm Sandy], 2 degrees is simply too much.”

To prevent a planetary catastrophe—rising sea levels, melting glaciers, disrupted food production, a scarcity of fresh water, more violent and deadly storms, more frequent draughts, increased warfare over scarce resources, etc.—the climate may not be allowed to rise more than **2 degrees Celsius**. This is the *only* number that the vast majority of the world’s nations have agreed to about the climate.

Scientists estimate that humans can pour about **565** more **gigatons** of carbon dioxide into the atmosphere by 2050 and still have some hope of staying below 2 degrees Celsius. [A gigaton is one billion tons — that is, one thousand million tons.] The **565-gigaton** figure was derived from one of the most sophisticated computer-simulation models that have been built by climate scientists around the world over the past few decades.

Computer models calculate that even if we stopped all CO₂ (carbon dioxide) releases now, the temperature would likely still rise another 0.8 degrees Celsius, as previously released carbon continues to overheat the atmosphere. That means we're already three-quarters of the way to the **2-degree Celsius** limit—because we've already heated the planet 0.8 degrees Celsius.

In late May 2012, the International Energy Agency published its latest figures of how much carbon dioxide is being released into the atmosphere: CO₂ emissions in 2011 were 31.6 gigatons, up 3.2 percent from emissions the year before. [A gigaton is one billion tons—that is, one thousand million tons.] Study after study predicts that carbon emissions will keep growing by roughly three percent a year—and at that rate, we'll blow through our **565-gigaton** allowance in 16 years, around the time today's preschoolers will be graduating from high school.

Fossil-fuel companies—and countries like Venezuela or Kuwait that act like fossil-fuel companies—already have a huge amount of coal, oil, and natural gas in the ground that they own or have access to. The amount of these “reserves”—when burned for energy—would release an estimated **2,795 Gigatons** of carbon dioxide into the atmosphere. [A gigaton is one billion tons—that is, one thousand million tons.] That is the number calculated by the Carbon Tracker Initiative, a team of London financial analysts and environmentalists.

2,795 Gigatons—is higher than **565 Gigatons**. *Five* times higher.

If just two giant oil companies, Russia's Lukoil and the U.S. corporation ExxonMobil, burned all the fossil fuel that they own, *each* would release more than 40 gigatons of carbon dioxide into the atmosphere.

Energy corporations and big energy producing countries like Saudi Arabia and Kuwait, have estimated reserves of coal, oil and gas that—if burned for energy—would release **2,795 gigatons** of carbon emissions. John Fullerton, a former managing director at JP Morgan, who now runs the Capital Institute, calculates that at today's market value, the **2,795 gigatons** of carbon emissions are worth about \$27 trillion—that's 27 thousand billion dollars: \$27,000,000,000,000.

President Obama's Secretary of the Interior, Ken Salazar, has opened up a huge area of Wyoming for coal extraction. The total basin contains 67.5 gigatons worth of carbon, if all that coal is burned for energy.

According to NOAA, the National Oceanic and Atmospheric Administration, the average temperature in the lower 48 United States in 2012 was the hottest ever recorded. It was 55.3 degrees, one degree above the previous record and 3.2 degrees higher than the 20th-century average, scientists at the NOAA said.

According to James Hansen, former climatologist with NASA, the U.S. National Aeronautics and Space Administration, the "tar sands" of Alberta, Canada contain as much as 240 gigatons of carbon—which, if burned, would take up almost half of the available atmospheric space if we take the **565 gigatons of carbon** limit seriously. The company, TransCanada, has proposed that it build a pipeline from Canada through North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas to export oil around the world.

"Lots of companies do rotten things in the course of their business—pay terrible wages, make people work in sweatshops—and we pressure them to change those practices," according to writer and journalist Naomi Klein. "But **these [three] numbers** make clear that with the fossil-fuel industry [coal, oil, and natural gas], wrecking the planet is their business model. It's what they do."

If the oil reserves of just six companies—Exxon, BP, Chevron, ConocoPhillips, Shell, and the Russian firm Gazprom—were burned for energy, this would use up more than a quarter of the **565 gigatons of carbon** limit that is needed to keep the planet from warming over **2 degrees Celsius**. (Each of these companies continues to search for more oil.)

In early March 2012, Exxon CEO Rex Tillerson told Wall Street analysts that the company plans to spend \$37 billion a year through 2016 (about \$100 million *a day*) searching for *more* oil and gas.

Two-thirds of wheat grown in poor countries, and almost a quarter of the wheat grown in rich countries—nearly half the world's total crop—is at risk from global warming. In order to keep up with the world's growing population, global wheat production needs to rise 50 percent.

Around the world, the Earth's average temperature has risen more than 1 degree Fahrenheit (0.8 degrees Celsius) since 1880, and about twice that in parts of the Arctic. That may not sound like much, but we're already starting to see more intense rainstorms; severe droughts and heat waves are becoming more frequent. Rising seas are damaging homes near the water. Some populations of animals are starting to die out.

There is overwhelming evidence that our climate is warming due to pollution from human activities. That's the conclusion reached by 97 percent of climate scientists and every major National Academy of Science in the world. When we burn dirty fossil fuels like oil and coal, and when we cut down forests that store carbon, we pollute our atmosphere with greenhouse gases and warm our planet. This is not controversial among scientists.

*This graph shows the increase over time of the carbon dioxide concentration in the atmosphere. Every major scientific organization in the world, and 97 percent of climate scientists, attribute this increase to human causes—mostly burning fossil fuels like coal, oil, and natural gas. The higher the concentration of carbon dioxide in the atmosphere, the warmer the planet becomes. [See attached "Keeling Curve" graph.]

Over the past 30 years, permanent Arctic sea ice has shrunk to half its previous area and thickness. As it diminishes, global warming increases. This is due to several things, including release of the potent greenhouse gas methane trapped under nearby permafrost, and because ice reflects the sun's energy whereas oceans absorb it. Oil companies see the disappearance of Arctic ice as an opportunity to make more profit by drilling for more oil—which will create even more global warming. For example, Royal Dutch Shell has spent \$4.5 billion preparing to drill in the Arctic. One of the world's leading environmentalists, David Suzuki, calls this "insane."

Because of global warming, the world's glaciers are melting. All scientific organizations and the vast majority of climate scientists, (97 percent) believe that global warming is caused by human activity. Here is how *National Geographic* magazine describes it: "Everywhere on Earth ice is changing. The famed snows of Kilimanjaro have melted more than 80 percent since 1912. Glaciers in the Garhwal Himalaya in India are retreating so fast that researchers believe that most central and eastern Himalayan glaciers could virtually disappear by 2035. Arctic sea ice has thinned significantly over the past half century, and its extent has declined by about 10 percent in the past 30 years. NASA's repeated laser altimeter readings show the edges of Greenland's ice sheet shrinking. Spring freshwater ice breakup in the Northern Hemisphere now occurs nine days earlier than it did 150 years ago, and autumn freeze-up 10 days later. Thawing permafrost has caused the ground to subside more than 15 feet (4.6 meters) in parts of Alaska. From the Arctic to Peru, from Switzerland to the equatorial glaciers of Man Jaya in Indonesia, massive ice fields, monstrous glaciers, and sea ice are disappearing, fast." The results include rising sea levels and putting at risk the fresh water supply of billions of people.

The U.S. Department of Defense has said that global warming will create more instability and warfare around the world. Global warming is already creating more violent storms, drought, lack of food and water, mass migration, and the spread of disease. All these will create tension between people around the world and lead to increased military conflict. According to *The New York Times*, Secretary of State John Kerry (then a U.S. senator) has argued that the continuing conflict in southern Sudan, which has killed and displaced *tens of thousands* of people, is a result of drought and expansion of deserts in the north. "That is going to be repeated many times over and on a much larger scale," he said. Global warming is killing people in many different ways.

Scientists are not certain, but if the planet warms by more than an average of **two degrees Celsius**, the climate could hit a point of no return. The future becomes truly scary. For example, the collapse of the Greenland ice sheet and the Antarctic ice shelf will produce sea-level rises of 25 meters, inundating coastal cities and placing large areas of land far underwater. Coral reefs will be dead from ocean acidification. Fish stocks will plunge due to acidity and decreased dissolved oxygen as oceans warm. Searing heat, the extreme violence of "hypercanes" caused by warmer oceans, and flash floods will make growing crops impossible across large areas of formally fertile continents. Southern Europe, the southern United States, and Central America, along with Central Asia and Africa and the whole of Australia could become deserts. All of these changes will occur far too rapidly to allow for adaptation on the part of perhaps 90 percent of plant and animal species, which will cease to exist.

According to an estimate of the Congressional Budget Office in 2007, the top 20 percent of the wealthiest people in the country are responsible for consumption that releases three times the carbon dioxide—the main greenhouse gas—as the bottom 20 percent of the population.

According to climate scientists at Oxford University in Great Britain, humanity could probably keep the Earth's average temperature rise below **2 degrees Celsius** in the future if we cut carbon emissions every year by 2.4 percent. For true safety, scientists estimate that humanity would need to cut carbon emissions by twice that rate.

There are currently several proposals to export coal through the Columbia River Gorge to Asia. The Sightline Institute, an environmental think tank in Seattle, estimated that if just *two* of these coal export terminal proposals were approved—in Longview and Bellingham, Washington—it would add 199 million tons of carbon dioxide to the atmosphere, every single year. And this includes just the actual burning of the coal: not the “mining, processing, rail shipping, storing, maritime shipping, constructing new port or rail facilities, or any other related activities.” Over 10 years, the coal burned in Asia from the coal exports would be equal two gigatons of carbon dioxide. [A gigaton is a billion tons.]