Ask an Expert Samples

Why do you have to stay away from tall objects when there is a lightning storm and how come when batteries fall in water why does it not electrocute you?

Lightning: You should stay away from tall objects like trees or power poles during a lightning storm because lightning bolts strike at the highest point in the area. The lightning bolt carries so much energy that even if it doesn't strike you directly, the electrical field surrounding it can shock you or burn you severely. Also, a powerful bolt can partly shatter or even split trees or poles, and if you're standing very near or beneath one, you could be struck by falling debris.

Batteries: It depends on the size (and voltage) of the battery and the volume and saltiness of the water. If you mean the small batteries that power things like flashlights or electric screwdrivers, and you're sitting in a bathtub in water they fall into—let alone something bigger like a swimming pool—the answer is that they don't generate enough energy to give you a shock. If you were sitting in that bathtub and someone dropped a car battery into it, you might get a shock, probably not enough to kill you. (Water doesn't actually conduct electricity all that well unless it has salt in it.) If you were floating in a pool or a lake, though, you wouldn't get a shock—the current would have nowhere to ground.

What is a series circuit?

Imagine an electrical circuit as a loop of wire with both ends connected to a source of power, like the + and - poles of a battery or the points inside a plug in a wall outlet. Connected to the loop is the thing you want to power—the current passes through it and makes it work. In a series circuit, all the things powered through the circuit are on that one loop. An everyday example is a string of holiday lights. When one light burns out, it blocks the current in the whole circuit and the bulb or LED has to be replaced. That's a disadvantage of series circuits as opposed to parallel ones, where each thing needing power is on its own loop from the power source.

When in the world do you think there will be solar power everywhere???

There already is solar power everywhere, in the sense that solar power is being used in pretty much every country today as part of a mix that also includes wind power, coal, natural gas, oil, hydroelectric, and nuclear fission. The percentage of electricity generated by solar power worldwide is growing very fast, but faster in some places than others. Solar and wind power together currently generate about 0.5 percent of the world's energy. It's been estimated that solar energy could produce 2.5 percent of the world's electricity by 2025 at current growth rates—though following the recent Paris Conference on climate change, many countries are pledging to increase those rates. If we're going to follow the recommendation of leading climate scientists and move completely off coal, natural gas, and oil by 2050 to avoid much worse climate change, solar and wind energy will certainly need to grow a lot faster.

Why do larger wind turbines rotate slower than smaller wind turbines?

To understand the answer, it helps to know the basics of how a wind turbine works and why those blades are usually so big in the first place. The blades turn a shaft, and at the far end of that shaft inside the housing is the actual electric generator. Between the blades and the generator is a gear system that converts the slow rotation of those huge blades into a much faster spin. It's like the opposite of when you're in low gear going up a hill on your bike, and you're pedaling super fast just to make the wheels go slowly. The bigger the blades, the more power they generate. That's because bigger blades have more surface area that's getting pushed by the wind and turned into rotation force or torque. (For much the same reason, bigger sails on sailboats make the boats move faster.) But because that same wind energy is moving longer, heavier blades—think of how far the tip of each blade has to travel in each rotation—they turn more slowly than smaller ones.

If lightning hits your car and the car is still running, what happens when you get out?

The answer is: so long as you get out of the car after the lightning strike is over, nothing. The car's body is made of metal, and it will have conducted the electrical charge from the lightning into the ground. It makes no difference to your safety whether the engine is running or not. But the voltage of the lightning is so high that it may have damaged the outside of the car—scorching paint, fusing side mirrors. In newer vehicles, the computer chips in the engine control systems may be destroyed. Also, safety experts recommend that if you're caught driving in a thunderstorm, you should pull over to the side of the road and sit with your hands in your lap, not touching door or window handles, radio dials, the gearshift, or the steering wheel—all things that contain metal and are connected to the outside of the car. That way you're sure not to get electrocuted if the car does take a hit.

What is a California Condor?

The California condor is the biggest bird native to North America, with a nearly ten-foot wingspan—and one of the rarest. Currently, there are only about 400 of them left in the world. And there are only that many because the last 27 of them alive were captured in 1987, and then they were bred at the San Diego Zoo Safari Park and the Los Angeles Zoo. The condors had died off because of poaching—hunters killing them illegally—from the loss of the wild places where they lived, and from lead poisoning from eating dead animals with lead bullets in them. Condors are a kind of vulture and they only eat animals that are already dead (carrion). Like other vulture species, they have mostly bald heads and down-curving beaks. Their feathers are mostly black, with white patches on the undersides of the wings. So they're impressive, but not exactly pretty. In 1991, 425 California Condors were released back into the wild in coastal California, Arizona, and northern Utah. They're surviving, but they are still very few. If you see one, you're lucky.

How do energy and matter relate? [longer version]

The great twentieth-century scientist Albert Einstein showed that matter is basically organized energy. All matter is made of atoms, which consist of incredibly tiny little bits of energy called quanta. (One of them is called a quantum.) Every atom has a nucleus at its center, which includes two kinds of quanta, protons and neutrons. Around this nucleus are spinning even tinier quanta called electrons. The nucleus is held together by a kind of energy called the strong force, but what keeps the electrons spinning round the nucleus is electromagnetism, because protons have a positive charge and electrons have a negative one. (When you play with two bar magnets, you'll notice that if you try to push together either the two positive or the two negative ends of the magnets, they repel each other, but if you put the positive end of one near the negative end of the other, they attract each other.)

Here's one way we know that matter is made of energy: quanta sometimes behave like particles, like when electrons jump from one atom to another to create electric current, but sometimes like waves—that's what electrons are like when they're going around an atomic nucleus. You can't say an electron is in any one place at any one time, so scientists call the area around the nucleus occupied by one or more electron waves a "shell." The same is true of light. Einstein showed that light is made of quanta called photons—but a stream of photons also behaves like a wave. If you point a beam of light at two little slits close together in the side of a cardboard box, the pattern made on the inside back of the box by the split beam of light coming through the two slits is like the one you get from two sets of water ripples crossing. Scientists can create waves of protons or neutrons too.

But the most powerful proof we have that matter is made of energy is a nuclear reactor—or a nuclear bomb. Relatively huge atoms like Uranium 235 (called that because it has 235 particles in its nucleus) are often unstable. When one of these atoms flies apart, it releases a humongous amount of energy. That amount is described in Einstein's famous equation $E = mc_2$. It means that the energy in a given amount of matter is the mass (roughly, the weight) of that matter multiplied by the square of the speed of light: 186,000 miles per second. Square that and you get 34,596,000,000. That's a *lot* of energy. Can you imagine how much energy you're made of?

How do energy and matter relate? [short version]

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Here's one way we know that matter is made of energy: quanta sometimes behave like particles, like when electrons jump from one atom to another to create electric current, but sometimes like waves—that's what electrons are like when they're zipping around an atomic nucleus. The same is true of light. Einstein showed that light is made of quanta called photons—but light also behaves like a wave. Radio waves and X-rays are just kinds of light you can't see. Everything is made of tiny bits of energy, including you.