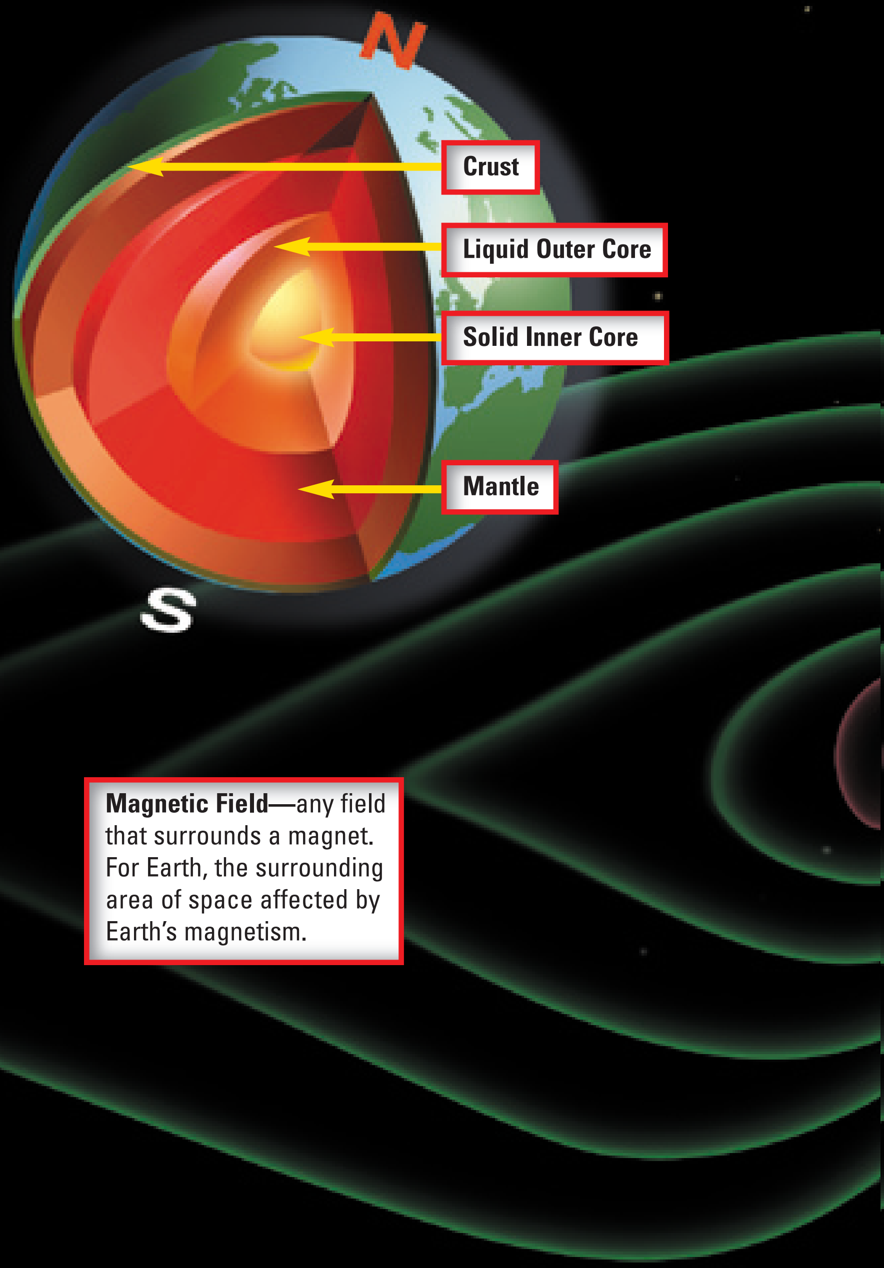
AT-A-GLANCE Magnetism

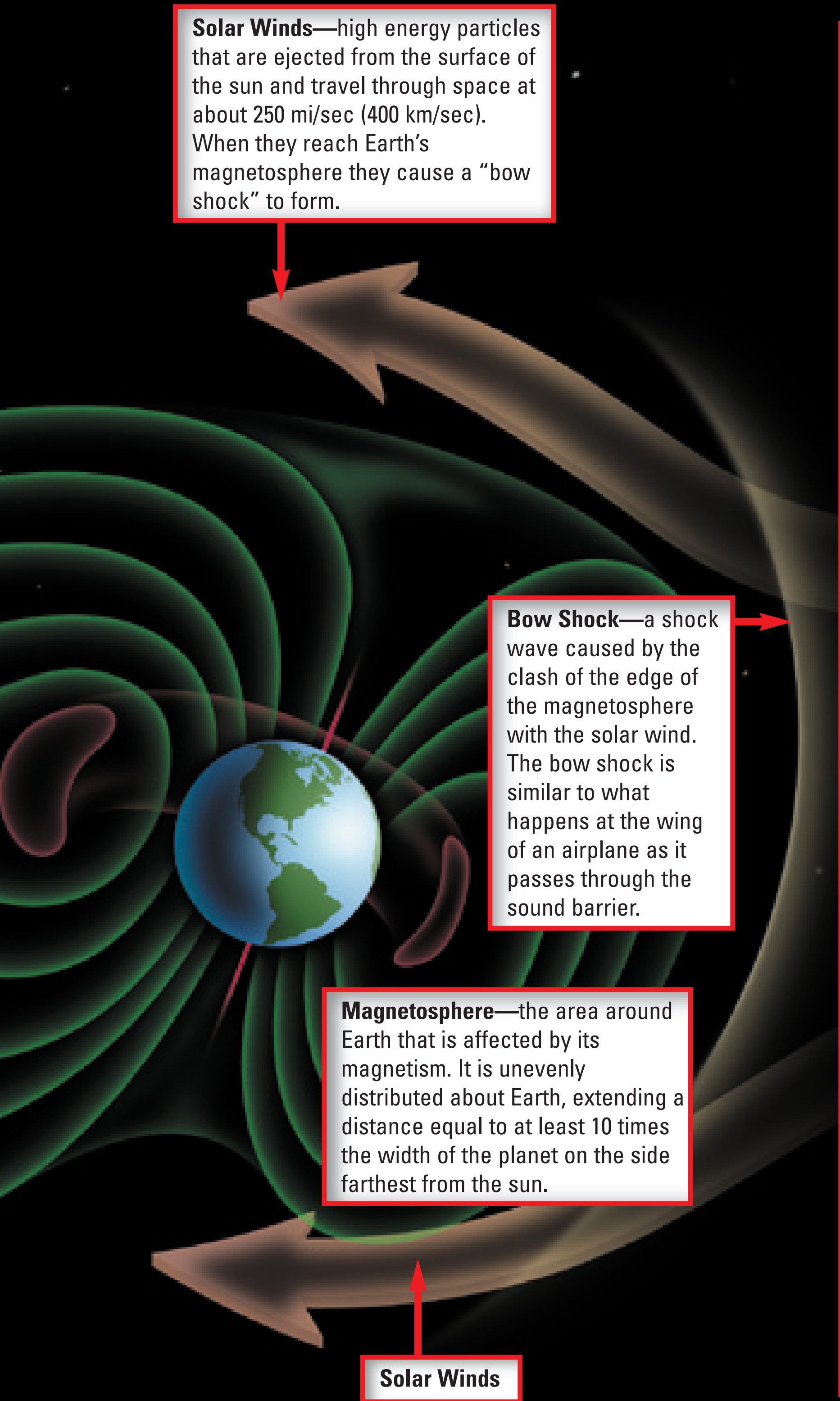
Have you ever felt the push or pull between two magnets? You may already know that every magnet has a north pole and a south pole, and opposite poles attract while similar poles repel. But do you know why? It's all because of magnetism, which, like gravity, is part of one of the fundamental forces of nature. Unlike gravity, magnetism does not show up equally in all types of matter. It most often occurs in substances containing the elements such as iron, nickel, and cobalt, and it gets its start right at the heart of the matter—in the very atoms that make up those elements.

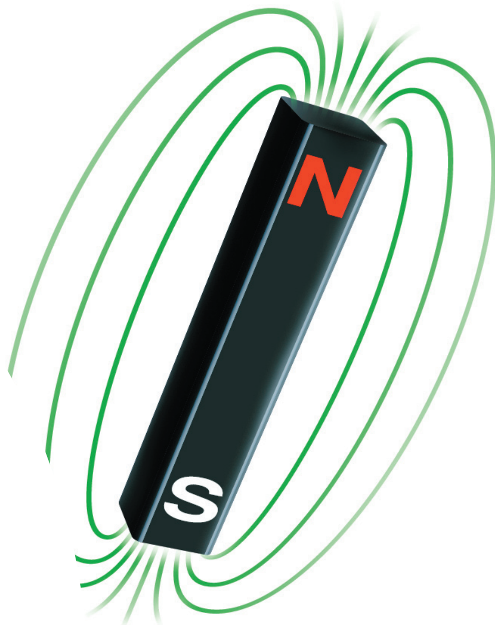
Even though you can't see them, all atoms are in constant motion and they're composed of different parts. At their center, in the nucleus, atoms have particles called protons and neutrons. Moving around the outside of atoms are tiny negatively charged particles called electrons, which, as their name suggests, are also involved in electricity. These electrons don't just move around the nucleus of the atom. They spin as well. While spinning, they create a tiny electric current that creates a small magnetic field around each and every electron. A magnetic field is an invisible area around an object which can interact with the magnetic field around another object.

Because of the forces of attraction and repulsion, different atoms of a substance align their magnetic fields with each other to create larger magnetized regions called domains. In most materials, these magnetic domains are randomly organized so that their north and south poles don't line up with each other. As a result, the material is not magnetic. However, in materials containing elements like iron, cobalt and nickel, the different magnetic domains have the ability to line up. If enough of them line up, you've got a magnet. So, the bottom line is that the magnets on your refrigerator stick because of the spin of electrons in their atoms!



Magnetic Field—any field that surrounds a magnet. For Earth, the surrounding area of space affected by Earth's magnetism.





Anyone who has ever used a magnetic compass to find their direction outdoors knows that there is a connection between our Earth and magnets. Back in 1600, a British doctor named William Gilbert proved that compasses work because our Earth itself behaves like a giant bar magnet with two magnetic poles near the true North and South poles. Originally, he thought that there was a giant magnet buried deep inside the Earth, but today, most scientists agree that the truth is far more complex.

Deep inside Earth, there are two different cores. The inner core is a solid mass of iron and nickel. It is surrounded by a molten outer core made up of liquid iron and nickel. As the world turns, these two cores spin at different rates. The difference in the motion in these two highly conductive cores generates an electrical current. Just like the spinning of electrons in atoms, this electrical current produces a magnetic field that affects the entire planet. This magnetic field not only is at work on the surface of the planet, but it extends thousands of miles into space. This area is called the magnetosphere.