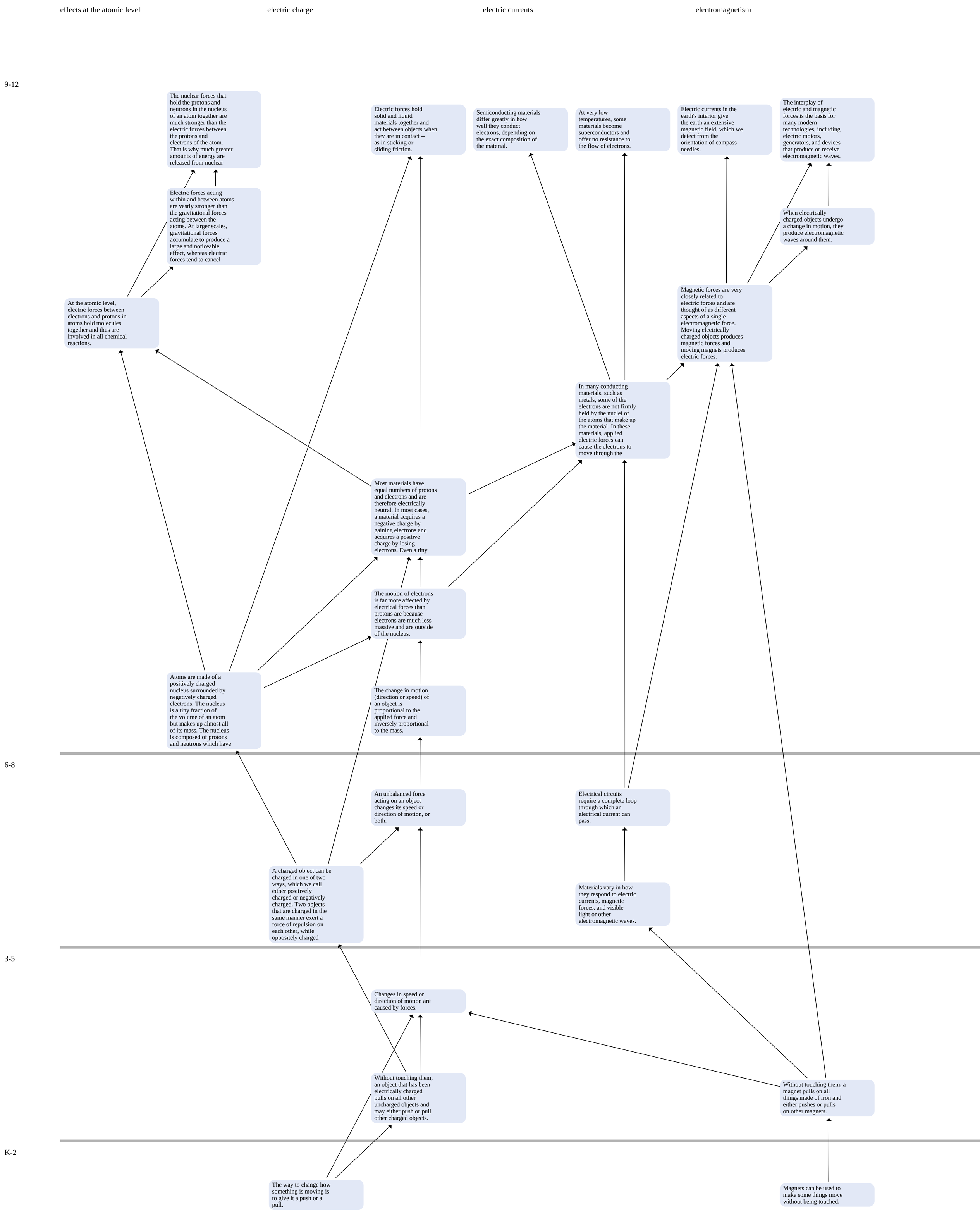
effects at the atomic level
electric charge
electric currents
electromagnetism
9-12
The nuclear forces that hold the protons and neutrons in the nucleus of an atom together are much stronger than the electric forces between the protons and electrons of the atom. That is why much greater amounts of energy are released from nuclear
Electric forces acting within and between atoms are vastly stronger than the gravitational forces acting between the atoms. At larger scales, gravitational forces accumulate to produce a large and noticeable effect, whereas electric forces tend to cancel
At the atomic level, electric forces between electrons and protons in atoms hold molecules together and thus are involved in all chemical reactions.
Electric forces hold solid and liquid materials together and act between objects when they are in contact -- as in sticking or sliding friction.
Semiconducting materials differ greatly in how well they conduct electrons, depending on the exact composition of the material.
At very low temperatures, some materials become superconductors and offer no resistance to the flow of electrons.
Electric currents in the earth's interior give the earth an extensive magnetic field, which we detect from the orientation of compass needles.
The interplay of electric and magnetic forces is the basis for many modern technologies, including electric motors, generators, and devices that produce or receive electromagnetic waves.
When electrically charged objects undergo a change in motion, they produce electromagnetic waves around them.
Magnetic forces are very closely related to electric forces and are thought of as different aspects of a single electromagnetic force. Moving electrically charged objects produces magnetic forces and moving magnets produces electric forces.
In many conducting materials, such as metals, some of the electrons are not firmly held by the nuclei of the atoms that make up the material. In these materials, applied electric forces can cause the electrons to move through the
Most materials have equal numbers of protons and electrons and are therefore electrically neutral. In most cases, a material acquires a negative charge by gaining electrons and acquires a positive charge by losing electrons. Even a tiny
The motion of electrons is far more affected by electrical forces than protons are because electrons are much less massive and are outside of the nucleus.
Atoms are made of a positively charged nucleus surrounded by negatively charged electrons. The nucleus is a tiny fraction of the volume of an atom but makes up almost all of its mass. The nucleus is composed of protons and neutrons which have
The change in motion (direction or speed) of an object is proportional to the applied force and inversely proportional to the mass.
6-8
An unbalanced force acting on an object changes its speed or direction of motion, or both.
Electrical circuits require a complete loop through which an electrical current can pass.
A charged object can be charged in one of two ways, which we call either positively charged or negatively charged. Two objects that are charged in the same manner exert a force of repulsion on each other, while oppositely charged
Materials vary in how they respond to electric currents, magnetic forces, and visible light or other electromagnetic waves.
3-5
Changes in speed or direction of motion are caused by forces.
Without touching them, an object that has been electrically charged pulls on all other uncharged objects and may either push or pull other charged objects.
Without touching them, a magnet pulls on all things made of iron and either pushes or pulls on other magnets.
K-2
The way to change how something is moving is to give it a push or a pull.
Magnets can be used to make some things move without being touched.