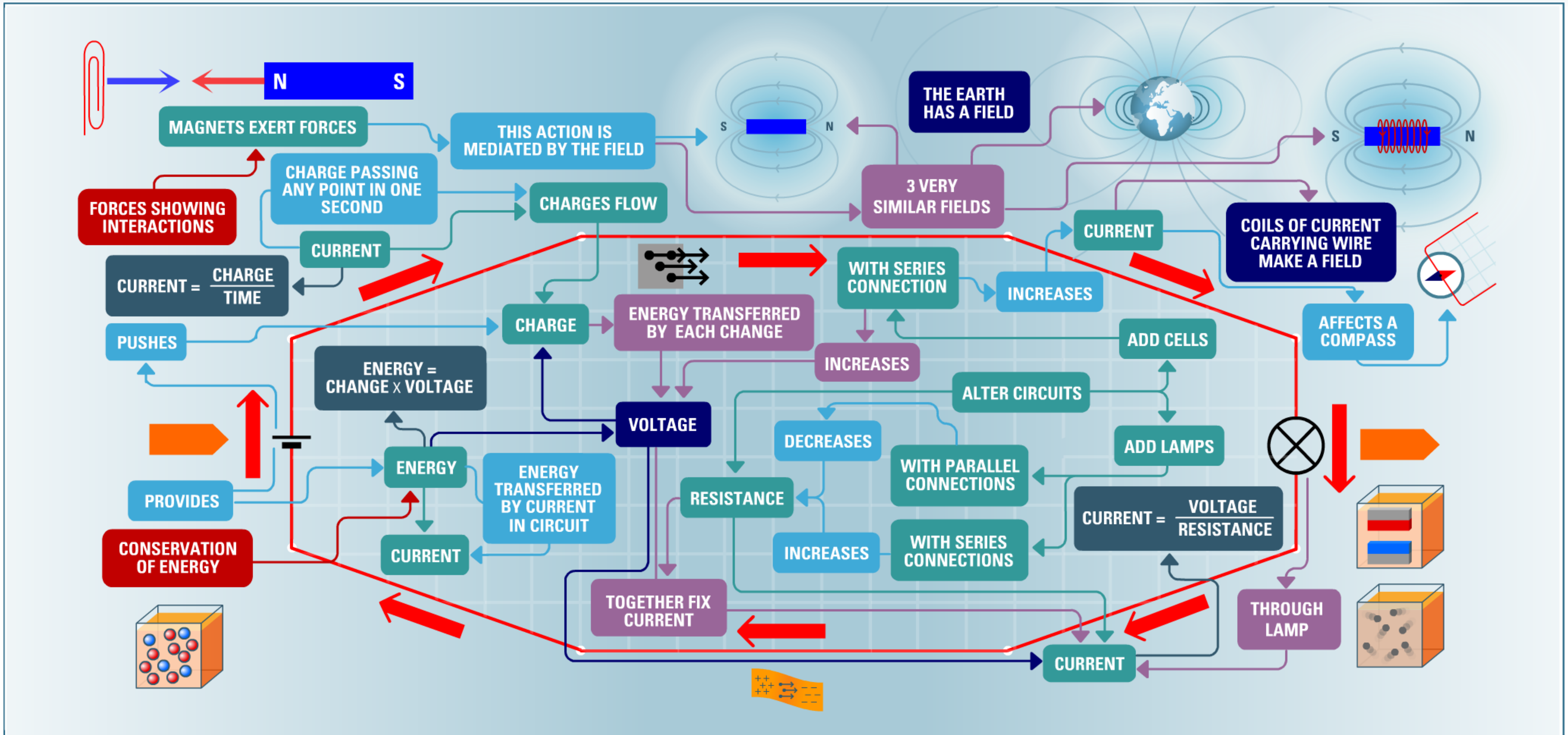


KEY IDEAS | MAIN IDEAS | LINKING | EXTENSION IDEAS | FURTHER LINKING | RELATIONSHIPS



IOP Institute of Physics
Supporting Physics Teaching: 11-14

Electric circuits are omnipresent because they are a very convenient and controllable way of shifting energy from one place to another. So an important distinction is between something that flows around the circuit, being conserved (the electric charge) and something that is shifted, whilst still being conserved (energy is shifted from one place to another). In a simple circuit of a bulb and battery, the charge, which is already present all around the circuit, is set in motion by the battery. Where the resistance is greatest, in the filament of the bulb, there the flow of charge does most working, warming the filament, which heats the surroundings by convection and radiation. Energy is shifted from the chemical store of the battery to the thermal store of the surroundings. This continues until the chemical store is depleted and the battery is “flat”. Then charge is no longer set in motion.
Adding another battery with series connection doubles the forces applied to the charges, resulting in a greater steady flow, and more working in the filament.
So energy is shifted more rapidly. Adding another bulb with series connections increases the resistance, reducing the flow, resulting in energy being shifted more slowly. Adding a bulb with parallel connections to a circuit with one bulb and one battery results in two loops operating independently. In each there is the same push and pull on the charges and the same resistance as in the original circuit. So the bulb in each loop glows as one bulb by itself. But you don’t get something for nothing, the chemical store of the battery is emptied twice as quickly.

All of this semi-quantitative reasoning can be formalised, yielding some very densely interconnected relationships, so that the quantity of energy shifted each second (the power) can be worked out, given the circuit. The core relationships are (power = energy / time, energy = charge voltage, charge = current time, current = voltage / resistance). To use these relationships successfully one has to have a very clear idea of the underlying reasoning, and to be very careful about the quantities which one is representing by the terms in the relationships.

Magnetic fields exist in volumes of space around either permanent magnets or current carrying wires. They represent volumes of space where placing a magnetic material will result in a force acting on that object, exerted by the source of the magnetic field. So fields are the medium by which action at a distance is supported: one might see them as the way in which the magnet reaches out and touches the magnetic material. As these forces are large enough to feel with objects that you can manipulate (unlike the other two examples of non-contact forces: gravity and electrical) a detailed study of the shapes of the fields and the resulting forces is a good place to come to understand non-contact forces. Such a detailed study is carried out using techniques to reveal the shape of the field: compasses and iron filings. Some technological exploitations of these non-contact forces make the effects seem more real: the bell, relay and motor are amongst the most common.

Specific Timeline
General Timeline

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