**Physical Science—Chapter 16 Study Guide**

**Electronics**

1. Foundations to electronics
   1. Definition of electronics: study of the behavior and motion of electrons in a vacuum or special materials such as semiconductors
   2. Vacuum tube—general term for any “vacuumized” glass tube with containing electrodes; because the tube does not contain air, electrons are able to flow from one electrode to the other when voltage is applied to them
      1. Cathode—negative electrode
      2. Anode—positive electrode
   3. Special types of vacuum tubes
      1. Cathode-ray tube—any simple vacuum tube designed so that electrons would flow through the vacuum when voltage is applied
         1. Crookes Tube—the earliest version of this tube—Crookes coated the inside of the tube with a substance that glowed when the electrons struck it
         2. Picture tube—a more advance version of the Crookes tube which allowed the beam of electrons to be directed in such a way to produce a picture on the side of the tube where the electrons strike
         3. X-ray tube— a vacuum tube with extra high voltage so that x-rays are produces when the electrons strike the anode
      2. Diode—a vacuum tube which contains a filament which serves as the cathode and a plate which serves as the anode
         1. Thermionic emission—the flow of electrons which have been knocked off the filament to the plate
         2. Diodes are useful because they can convert AC to DC
      3. Triode—a vacuum tube containing a chargeable grid between the cathode and anode
         1. Can be used as a switch, to cut off the flow of electrons
         2. Can be used to amplify or lessen the flow of electrons
2. Semiconductors
   1. Semiconductors are materials that are neither a good conductor nor a good insulator
   2. The most common are silicon and germanium
   3. Doping—process of adding another material to a semiconductor to change its behavior
      1. N-type semiconductor—semiconductor with extra electrons (negative charge)
      2. P-type semiconductor—semiconductor with a deficiency of electrons (positive charge)
   4. Using semiconductors—devices made with semiconductors are called solid-state devices
      1. Diodes—a p-n junction serves as a one-valve for electricity; it is much more compact and efficient than the vacuum tube diode
      2. Transistor—a device that controls the flow of electrons; it largely replaced the triode
      3. Photo-voltaic cells—two layers of semiconductors are placed next to one another in such a way that light striking them produces a current
      4. Light-emitting diodes (LED)—a solid-state device which emits light when electrons pass from one type of semiconductor to another
      5. Lasers—similar to a LED but the light produced is in the form of a low-power laser
   5. Integrated circuits—this was the next advancement in electronics; semiconductors are still used in this device but it incorporates many different devices and pathways into one chip
      1. Made from a silicon wafer with many parts inlaid into it
      2. Benefits of integrated circuits
         1. Much cheaper to produce than a bunch of individual components
         2. More reliable
         3. Small size
      3. ICs are used in all handheld electronics and computers
   6. Micromachines—extremely small but functional machines made from microscopic components
3. Computers—devices which processes information (called “data”—pieces of information) using electronic circuits (chips)
   1. History of computers
      1. ENIAC—1946—first general purpose electronic computer; was able to perform mathematical calculations but filled up a large room and took as much power to operate as a small city
      2. UNIVAC I—America’s first mass-produced computer
      3. Incredibly rapid advance of technology since these computers
   2. Information in computers
      1. Analog vs. digital—picture a watch with hands vs. a digital watch or an old radio tuner with knobs vs. a button; analog data can have any possible value within a specified range and digital only has certain values within a range; computer use digital data
      2. Computers represent data using the binary system, which only uses 1s and 0s; the computer uses an electric pulse for 1 and no current for a 0;
         1. Bit—an individual piece of information
         2. Byte—smallest directly accessible unit of date, a group of eight bits
   3. Hardware in computers
      1. Processing information
         1. CPU (central processing unit)—serves as the “brain” of the computer
         2. Microprocessor—a single chip that contains a complete CPU
      2. Storing information—(called memory or storage)
         1. RAM—temporary memory in a computer
         2. Hard disk drive—permanent memory that uses disks containing many microscopic magnetizable spots
         3. Optical disks—disks with pits and lands that are created and read with a laser
            1. CD-ROM
            2. DVD-ROM
         4. Flash memory
            1. Flash drives
            2. SD cards
      3. Input/Output devices
         1. Input—keyboard, mouse, touchscreen, scanners, cameras, microphones
         2. Output—monitor, speakers, printers, digital projector
      4. Motherboard—this circuit board is the interface for all of the other components of a computer to communicate and work together
   4. Software—the instructions that direct the computer to perform certain tasks; a single piece of software designed to perform a certain task is a program
      1. System software—comes preinstalled on a computer and directs the basic functions of the computer; this would include the operating system (Windows, Mac or Linux)
      2. Application software—programs designed to do specific tasks
   5. Computer networks
      1. LAN (local area networks)—networks within a home, school, or business
      2. Internet—a worldwide network of computers
         1. World Wide Web
         2. Email
         3. Chat
         4. Cloud computing
   6. Types of modern computers
      1. General purpose computers—programmable to perform a variety of processing tasks
         1. PCs (personal computers)—desktops and laptops
         2. Tablets and PDAs
         3. Servers—a computer that can be accessed by many users
         4. Mainframes—large computers designed to store and retrieve vast amounts of information
         5. Supercomputers—extremely powerful computers designed to perform very complex calculations
      2. Special purpose computers—
         1. designed to perform only a few specialized instructions
         2. examples: ignition, fuel, and braking systems in cars, traffic lights, wristwatches, flight-control systems,
      3. Robotics—a versatile, computer-driven machine that can be programmed to do different tasks
         1. Industrial applications—welding, painting, packaging, etc.
         2. Scientific research—space, oceans, and skies
         3. Military and other