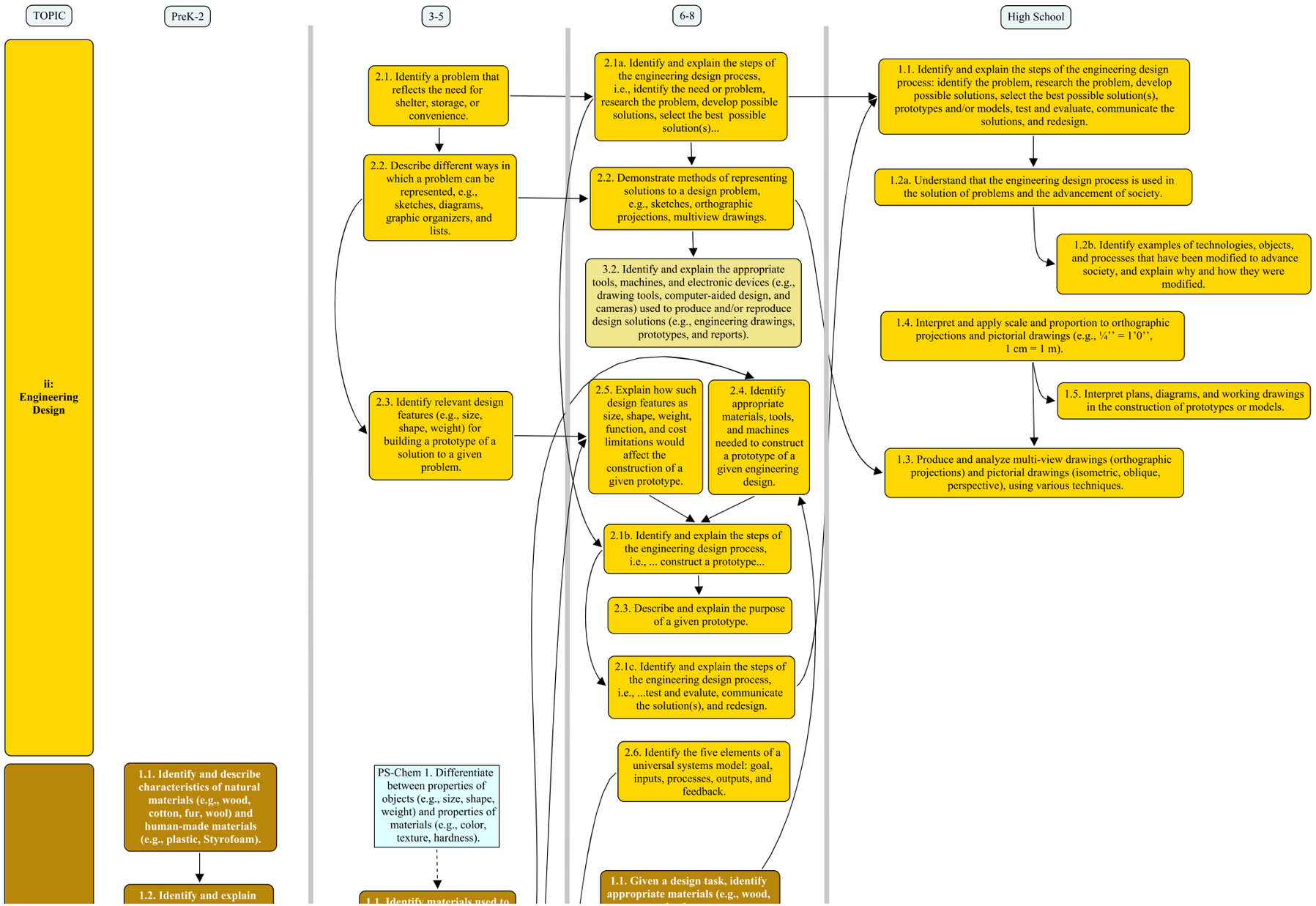
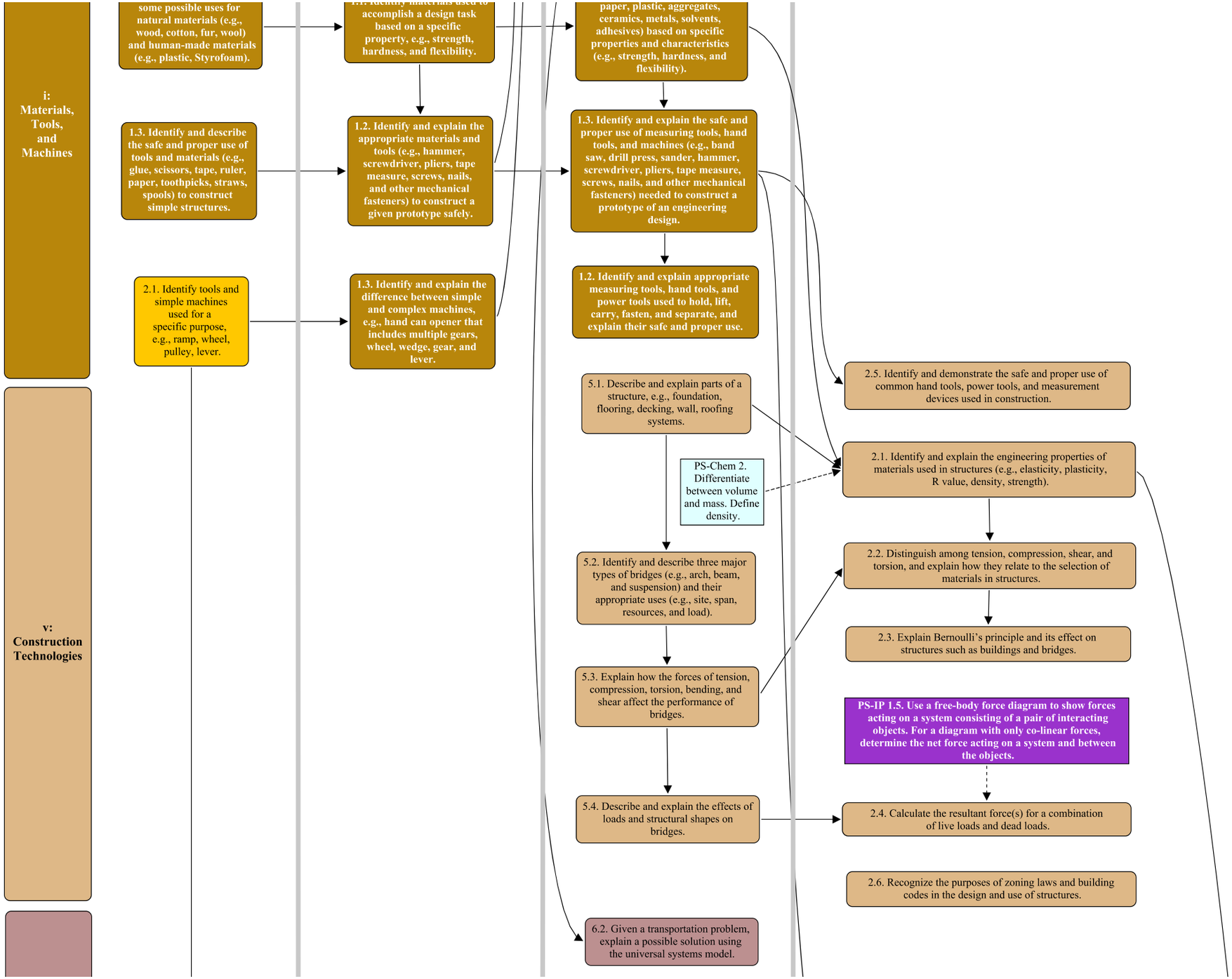
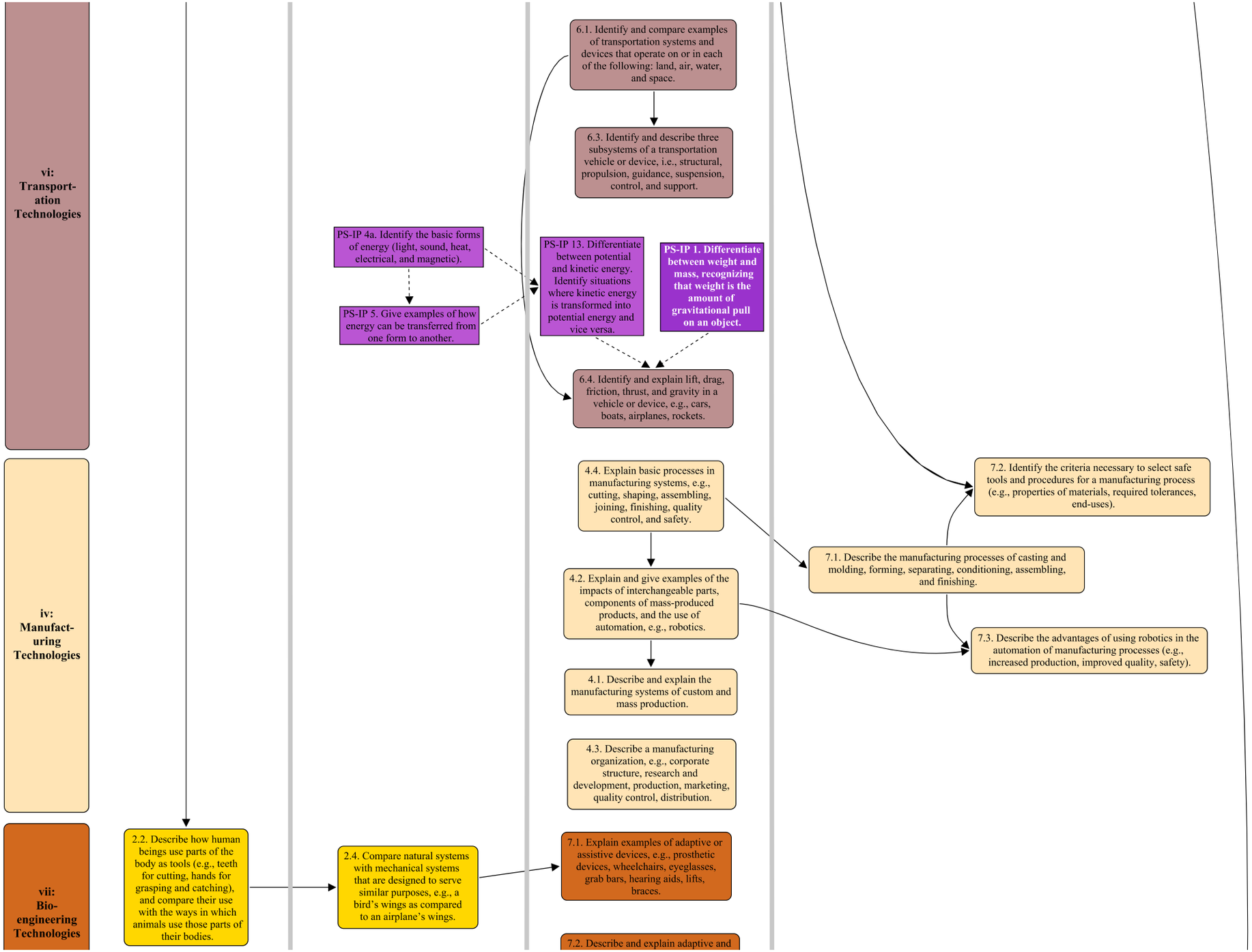
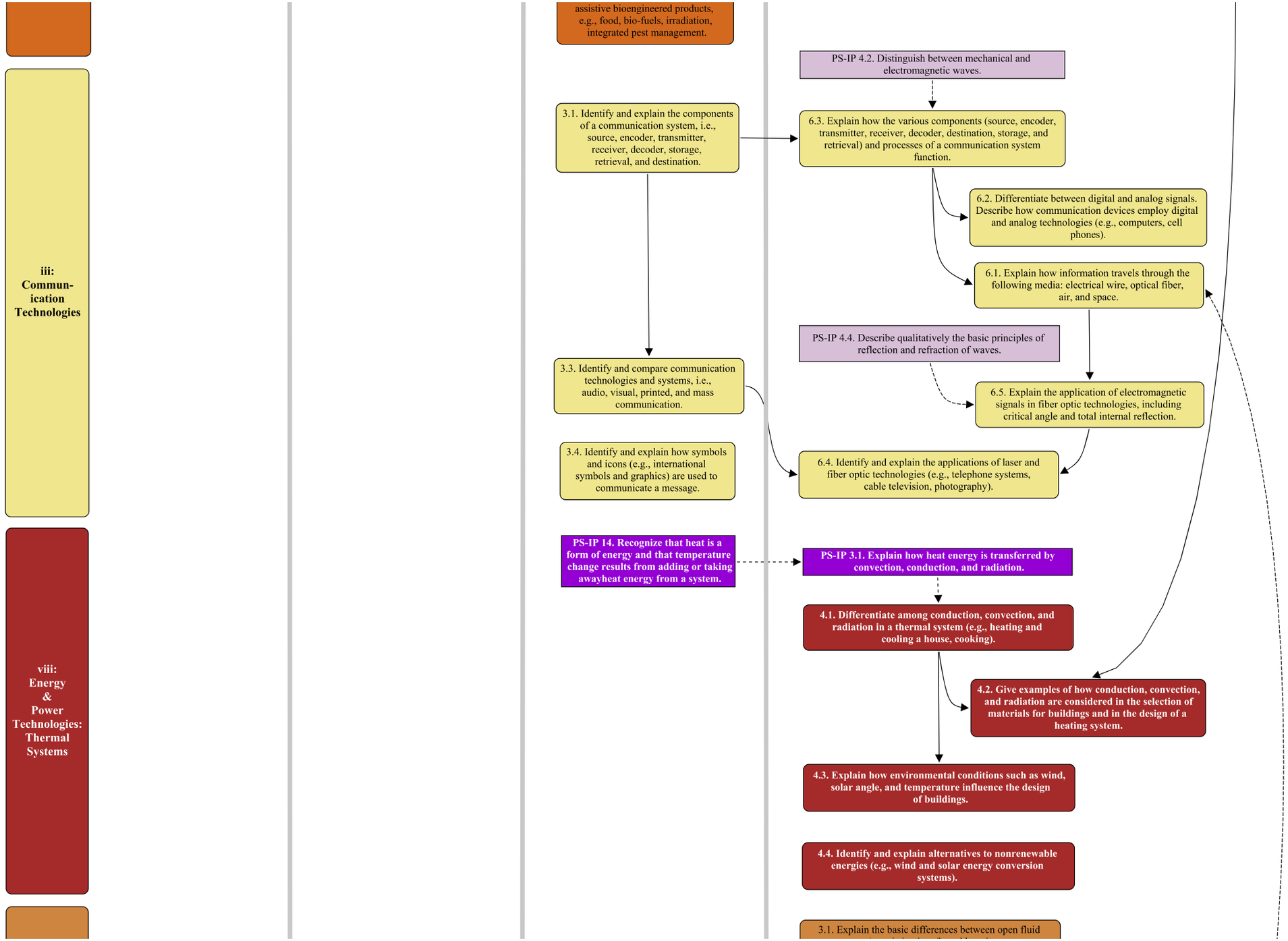
Technology/Engineering Strand Map

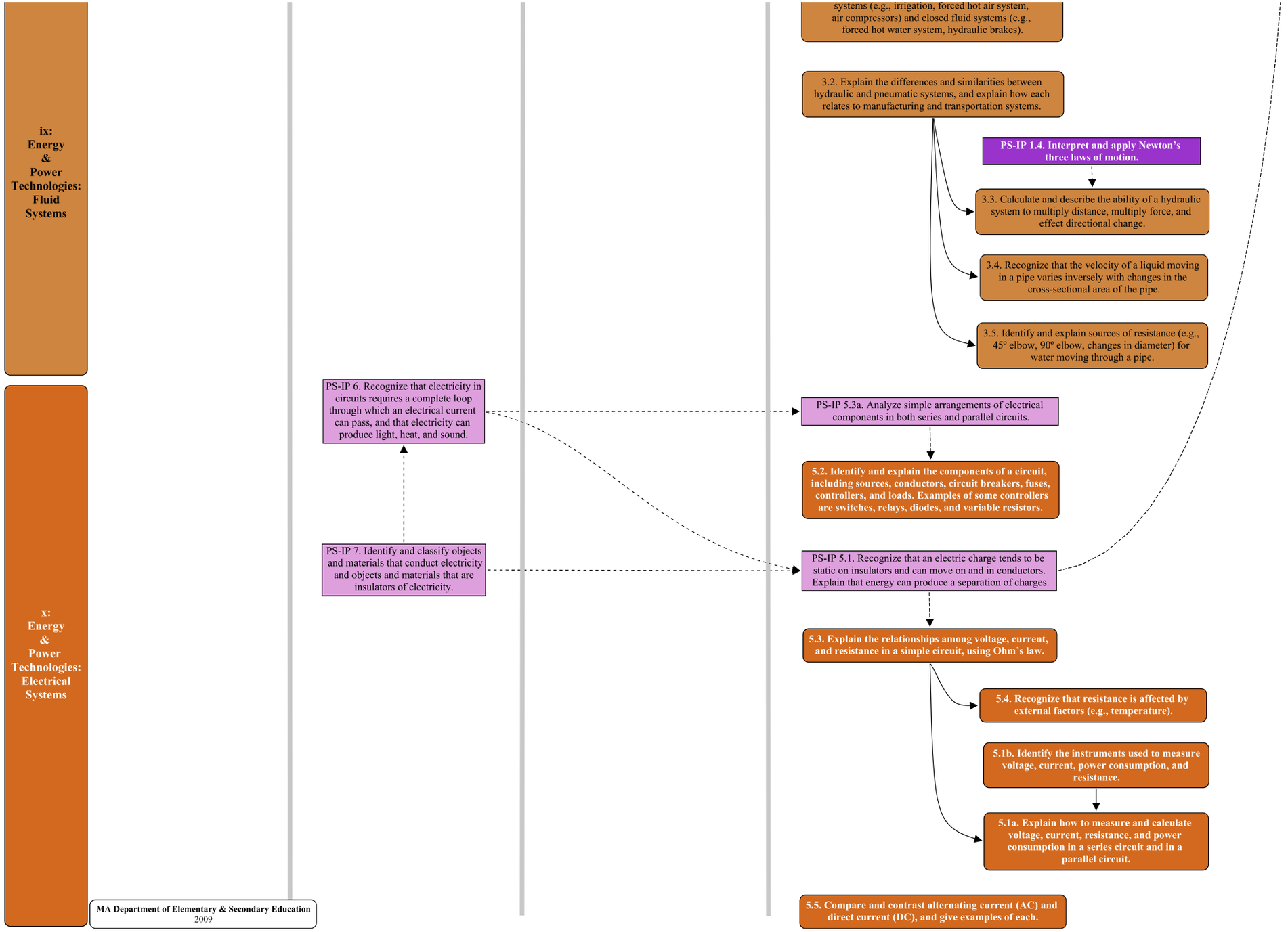
MA Department of Elementary & Secondary Education
2009




i: Materials, Tools, and Machines
some possible uses for natural materials (e.g., wood, cotton, fur, wool) and human-made materials (e.g., plastic, Styrofoam).
1.3. Identify and describe the safe and proper use of tools and materials (e.g., glue, scissors, tape, ruler, paper, toothpicks, straws, spools) to construct simple structures.
2.1. Identify tools and simple machines used for a specific purpose, e.g., ramp, wheel, pulley, lever.
accomplish a design task based on a specific property, e.g., strength, hardness, and flexibility.
1.2. Identify and explain the appropriate materials and tools (e.g., hammer, screwdriver, pliers, tape measure, screws, nails, and other mechanical fasteners) to construct a given prototype safely.
1.3. Identify and explain the difference between simple and complex machines, e.g., hand can opener that includes multiple gears, wheel, wedge, gear, and lever.
paper, plastic, aggregates, ceramics, metals, solvents, adhesives) based on specific properties and characteristics (e.g., strength, hardness, and flexibility).
1.3. Identify and explain the safe and proper use of measuring tools, hand tools, and machines (e.g., band saw, drill press, sander, hammer, screwdriver, pliers, tape measure, screws, nails, and other mechanical fasteners) needed to construct a prototype of an engineering design.
1.2. Identify and explain appropriate measuring tools, hand tools, and power tools used to hold, lift, carry, fasten, and separate, and explain their safe and proper use.
v: Construction Technologies
5.1. Describe and explain parts of a structure, e.g., foundation, flooring, decking, wall, roofing systems.
PS-Chem 2. Differentiate between volume and mass. Define density.
5.2. Identify and describe three major types of bridges (e.g., arch, beam, and suspension) and their appropriate uses (e.g., site, span, resources, and load).
5.3. Explain how the forces of tension, compression, torsion, bending, and shear affect the performance of bridges.
5.4. Describe and explain the effects of loads and structural shapes on bridges.
6.2. Given a transportation problem, explain a possible solution using the universal systems model.
2.5. Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.
2.1. Identify and explain the engineering properties of materials used in structures (e.g., elasticity, plasticity, R value, density, strength).
2.2. Distinguish among tension, compression, shear, and torsion, and explain how they relate to the selection of materials in structures.
2.3. Explain Bernoulli's principle and its effect on structures such as buildings and bridges.
PS-IP 1.5. Use a free-body force diagram to show forces acting on a system consisting of a pair of interacting objects. For a diagram with only co-linear forces, determine the net force acting on a system and between the objects.
2.4. Calculate the resultant force(s) for a combination of live loads and dead loads.
2.6. Recognize the purposes of zoning laws and building codes in the design and use of structures.


vi: Transport-ation Technologies
iv: Manufact-uring Technologies
vii: Bio-engineering Technologies
6.1. Identify and compare examples of transportation systems and devices that operate on or in each of the following: land, air, water, and space.
6.3. Identify and describe three subsystems of a transportation vehicle or device, i.e., structural, propulsion, guidance, suspension, control, and support.
PS-IP 4a. Identify the basic forms of energy (light, sound, heat, electrical, and magnetic).
PS-IP 5. Give examples of how energy can be transferred from one form to another.
PS-IP 13. Differentiate between potential and kinetic energy. Identify situations where kinetic energy is transformed into potential energy and vice versa.
PS-IP 1. Differentiate between weight and mass, recognizing that weight is the amount of gravitational pull on an object.
6.4. Identify and explain lift, drag, friction, thrust, and gravity in a vehicle or device, e.g., cars, boats, airplanes, rockets.
4.4. Explain basic processes in manufacturing systems, e.g., cutting, shaping, assembling, joining, finishing, quality control, and safety.
7.2. Identify the criteria necessary to select safe tools and procedures for a manufacturing process (e.g., properties of materials, required tolerances, end-uses).
7.1. Describe the manufacturing processes of casting and molding, forming, separating, conditioning, assembling, and finishing.
4.2. Explain and give examples of the impacts of interchangeable parts, components of mass-produced products, and the use of automation, e.g., robotics.
7.3. Describe the advantages of using robotics in the automation of manufacturing processes (e.g., increased production, improved quality, safety).
4.1. Describe and explain the manufacturing systems of custom and mass production.
4.3. Describe a manufacturing organization, e.g., corporate structure, research and development, production, marketing, quality control, distribution.
2.2. Describe how human beings use parts of the body as tools (e.g., teeth for cutting, hands for grasping and catching), and compare their use with the ways in which animals use those parts of their bodies.
2.4. Compare natural systems with mechanical systems that are designed to serve similar purposes, e.g., a bird's wings as compared to an airplane's wings.
7.1. Explain examples of adaptive or assistive devices, e.g., prosthetic devices, wheelchairs, eyeglasses, grab bars, hearing aids, lifts, braces.
7.2. Describe and explain adaptive and


assistive bioengineered products, e.g., food, bio-fuels, irradiation, integrated pest management.
iii: Commun-ication Technologies
viii: Energy & Power Technologies: Thermal Systems
PS-IP 4.2. Distinguish between mechanical and electromagnetic waves.
3.1. Identify and explain the components of a communication system, i.e., source, encoder, transmitter, receiver, decoder, storage, retrieval, and destination.
6.3. Explain how the various components (source, encoder, transmitter, receiver, decoder, destination, storage, and retrieval) and processes of a communication system function.
6.2. Differentiate between digital and analog signals. Describe how communication devices employ digital and analog technologies (e.g., computers, cell phones).
6.1. Explain how information travels through the following media: electrical wire, optical fiber, air, and space.
PS-IP 4.4. Describe qualitatively the basic principles of reflection and refraction of waves.
3.3. Identify and compare communication technologies and systems, i.e., audio, visual, printed, and mass communication.
6.5. Explain the application of electromagnetic signals in fiber optic technologies, including critical angle and total internal reflection.
3.4. Identify and explain how symbols and icons (e.g., international symbols and graphics) are used to communicate a message.
6.4. Identify and explain the applications of laser and fiber optic technologies (e.g., telephone systems, cable television, photography).
PS-IP 14. Recognize that heat is a form of energy and that temperature change results from adding or taking awayheat energy from a system.
PS-IP 3.1. Explain how heat energy is transferred by convection, conduction, and radiation.
4.1. Differentiate among conduction, convection, and radiation in a thermal system (e.g., heating and cooling a house, cooking).
4.2. Give examples of how conduction, convection, and radiation are considered in the selection of materials for buildings and in the design of a heating system.
4.3. Explain how environmental conditions such as wind, solar angle, and temperature influence the design of buildings.
4.4. Identify and explain alternatives to nonrenewable energies (e.g., wind and solar energy conversion systems).
3.1. Explain the basic differences between open fluid


ix: Energy & Power Technologies: Fluid Systems
x: Energy & Power Technologies: Electrical Systems
systems (e.g., irrigation, forced hot air system, air compressors) and closed fluid systems (e.g., forced hot water system, hydraulic brakes).
3.2. Explain the differences and similarities between hydraulic and pneumatic systems, and explain how each relates to manufacturing and transportation systems.
PS-IP 1.4. Interpret and apply Newton's three laws of motion.
3.3. Calculate and describe the ability of a hydraulic system to multiply distance, multiply force, and effect directional change.
3.4. Recognize that the velocity of a liquid moving in a pipe varies inversely with changes in the cross-sectional area of the pipe.
3.5. Identify and explain sources of resistance (e.g., 45º elbow, 90º elbow, changes in diameter) for water moving through a pipe.
PS-IP 6. Recognize that electricity in circuits requires a complete loop through which an electrical current can pass, and that electricity can produce light, heat, and sound.
PS-IP 5.3a. Analyze simple arrangements of electrical components in both series and parallel circuits.
5.2. Identify and explain the components of a circuit, including sources, conductors, circuit breakers, fuses, controllers, and loads. Examples of some controllers are switches, relays, diodes, and variable resistors.
PS-IP 7. Identify and classify objects and materials that conduct electricity and objects and materials that are insulators of electricity.
PS-IP 5.1. Recognize that an electric charge tends to be static on insulators and can move on and in conductors. Explain that energy can produce a separation of charges.
5.3. Explain the relationships among voltage, current, and resistance in a simple circuit, using Ohm's law.
5.4. Recognize that resistance is affected by external factors (e.g., temperature).
5.1b. Identify the instruments used to measure voltage, current, power consumption, and resistance.
5.1a. Explain how to measure and calculate voltage, current, resistance, and power consumption in a series circuit and in a parallel circuit.
5.5. Compare and contrast alternating current (AC) and direct current (DC), and give examples of each.
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