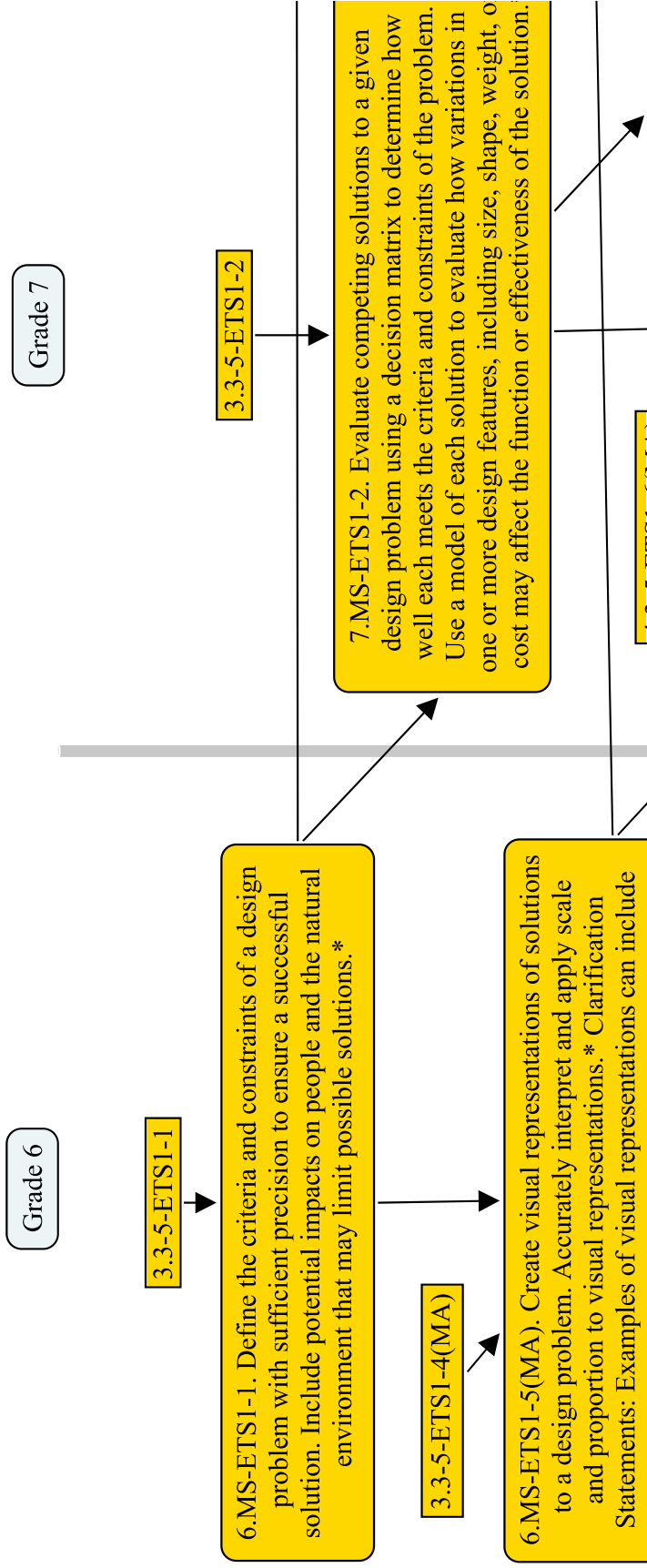


2016 MA STE MS-HS Technology

Please direct comments, suggested edits, and questions to: ste@doe.mass.gov
The standards and strand maps are available at: doe.mass.gov/ste/standards
(*) denotes integration of technology/engineering



Engineering Strand Map (April 2016)

Questions to: mathsciencetech@doe.mass.edu.
or at: www.doe.mass.edu/stem/review.html
Engineering through a practice or core idea.

Grade 8

Technology/Engineering (Grade 9-10)

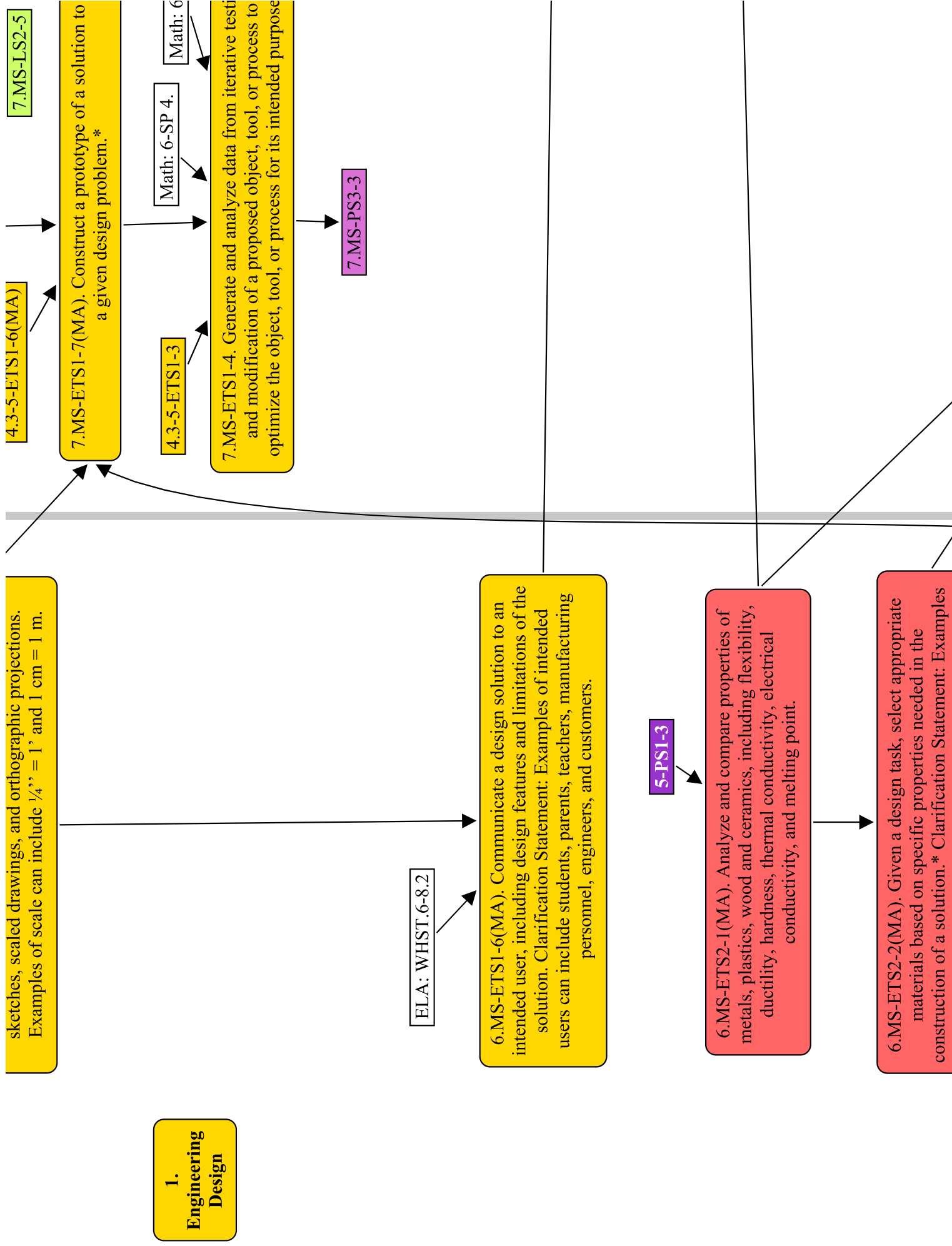
Math: G-MG 3.

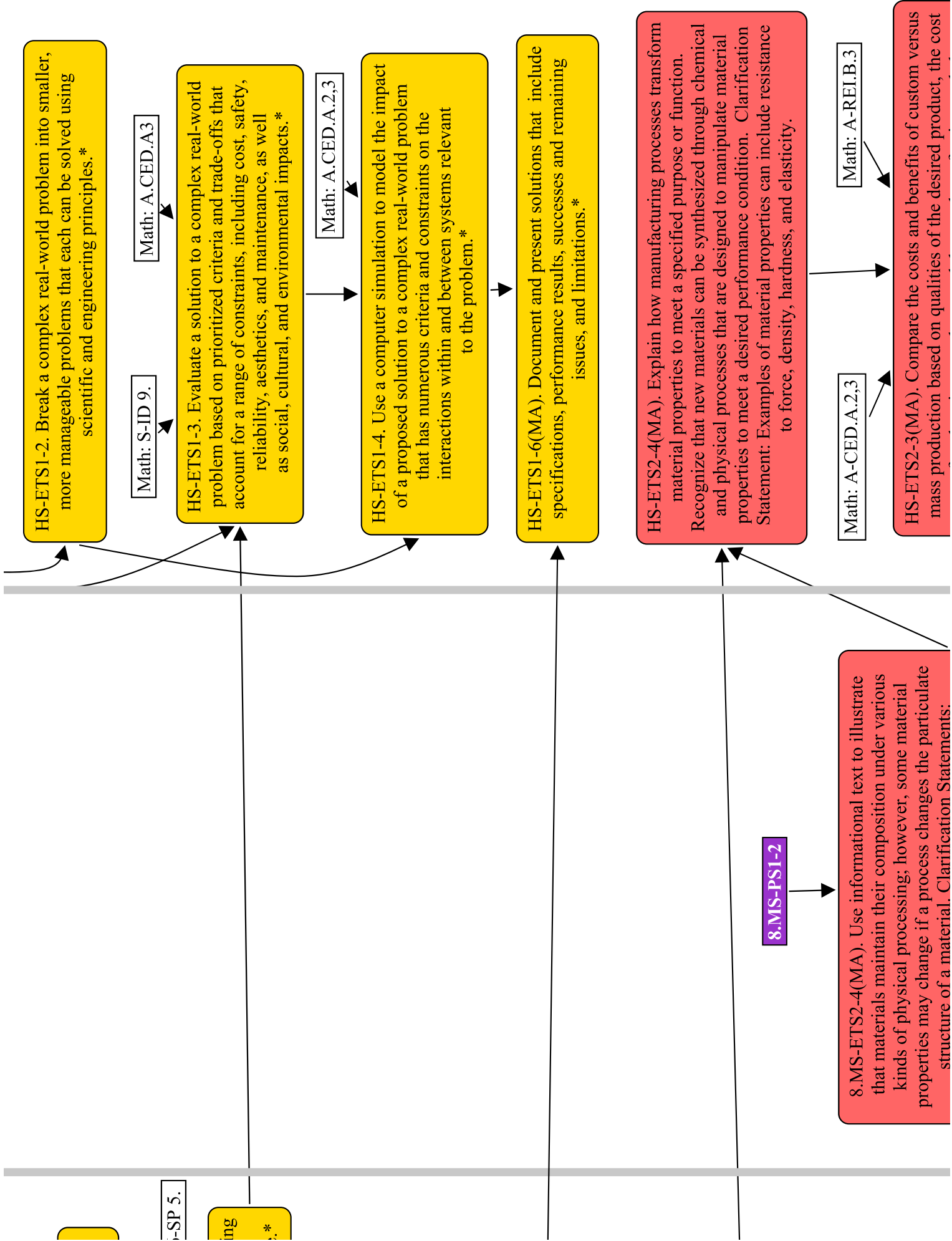
HS-ETS1-1. Analyze a major global challenge to specify a design problem that can be improved. Determine necessary qualitative and quantitative criteria and constraints for solutions, including any requirements set by society.* Clarification Statement: Examples of societal requirements can include risk mitigation, aesthetics, ethical considerations, and long-term maintenance costs.

Math: G-GMD 4.

Math: G-SRT.1

HS-ETS1-5(MA). Plan a prototype or design solution using orthographic projections and isometric drawings, using proper scales and proportions.*





2. Materials, Tools & Manufact- uring

of materials can include metals, plastic, wood, and ceramics.

HS-PS2-6

Math: 3-MD 4.

6.MS-ETS2-3(MA). Choose and safely use the appropriate measuring tools, hand tools, fasteners, and common hand-held power tools used to construct a prototype. Clarification Statements: Examples of measuring tools include a tape measure, meter stick, and a ruler. Examples of hand tools include a hammer, a screwdriver, a wrench, and pliers. Examples of fasteners include nails, screws, nuts and bolts, staples, glue, and tape. Examples of common power tools include jigsaw, drill, and sander.

5.3-5-ETS3-1

7.MS-ETS3-5(MA). Use the concept of systems engineering to model inputs, processes, outputs, and feedback among components of a transportation, structural, or communication system.

5.3-5-ETS3-2

7.MS-ETS3-4(MA). Show how the components of a structural system work together to serve a structural function or maintain an environment for a particular human use. Provide examples of physical structures and relate their design to their intended use. Clarification Statements: Examples of components of a structural system could include foundation, decking, wall, and roofing. Evaluations of function should include identification

Examples of physical processing can include cutting, forming, extruding, and sanding. Examples of changes in material properties can include a non-magnetic iron material becoming magnetic after hammering and a plastic material becoming rigid (less elastic) after heat treatment.

8.MS-ETS2-5(MA). Present information that illustrates how a product can be created using basic processes in manufacturing systems, including forming, separating, conditioning, assembling, finishing, quality control, and safety. Compare the advantages and disadvantages of human vs. computer control of these processes.

of each unit to produce, and the number of units needed.

HS-ETS2-1(MA). Determine the best application of manufacturing processes to create parts of desired shape, size, and finish based on available resources and safety. Clarification Statement: Examples of processes can include forming (molding of plastics, casting of metals, shaping, rolling, forging, and stamping), machining (cutting and milling), conditioning (thermal, mechanical and chemical processes), and finishing. State Assessment Boundary: Specific manufacturing machines are not expected in state assessment.

HS-ETS2-2(MA). Explain how computers and robots can be used at different stages of a manufacturing system, typically for jobs that are repetitive, very small, or very dangerous. Clarification Statement: Examples of stages include design, testing, production, and quality control.

HS-ETS3-1(MA). Model a technological system in which the output of one subsystem becomes the input to other subsystems.

6.MS-PS4-3

6.MS-PS4-2

HS-ETS3-2(MA). Use a model to explain how information transmitted via digital and analog signals travels through the following media: electrical wire, optical fiber, air, and space. Analyze a communication problem and determine the best mode of delivery for the communication(s).

8.MS-PS2-2

Math: 7-EE 3.

HS-ETS3-3(MA). Explain the importance of considering both live loads and dead loads when constructing structures. Calculate the resultant force(s) for a combination of live loads and dead loads for various situations. Clarification Statements: Examples of

3. Technological Systems

Explanations of tension should include identification of live vs. dead loads and forces of tension, torsion, compression, and shear. Examples of uses include carrying loads and forces across a span (such as a bridge), providing livable space (such as a house or office building), and providing specific environmental conditions (such as a greenhouse or cold storage). State Assessment Boundary: Calculations of magnitude or direction of loads or forces are not expected in state assessment.

6.MS-PS4-3

7.MS-ETS3-1(MA). Explain the function of a communication system and the role of its components, including a source, encoder, transmitter, receiver, decoder, and storage.

7.MS-ETS3-2(MA). Compare the benefits and drawbacks of different communication systems. Clarification Statement: Examples of communication systems can include radio, television, print, and Internet. Examples of benefits and drawbacks can include speed of communication, distance or range, number of people reached, audio only vs. audio and visual, and one-way vs. two-way communication.

ELA: WHST.6-8.9

7.MS-ETS3-3(MA). Research and communicate information about how transportation systems are designed to move people and goods using a variety of vehicles and devices. Identify and describe subsystems of a transportation vehicle including structural, propulsion, guidance, suspension, and control subsystems. Clarification Statements: Examples of design elements include vehicle shape to maximize cargo or passenger capacity, terminals, travel lanes, and communications/controls. Examples of vehicles can include a car, sailboat, and small airplane.

structures can include buildings, decks, and bridges. Examples of loads and forces include live load, dead load, total load, tension, shear, compression, and torsion.

7.MS-PS3-6

HS-ETS3-5(MA). Analyze how the design of a building is influenced by thermal conditions such as wind, solar angle, and temperature. 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.

HS-ETS3-4(MA). Use a model to illustrate how the forces of tension, compression, torsion, and shear affect the performance of a structure. Analyze situations that involve these forces and justify the selection of materials for the given situation based on their properties. Clarification Statements: Examples of structures include bridges, houses, and skyscrapers. Examples of material properties can include elasticity, plasticity, thermal conductivity, density, and resistance to force.

8.MS-PS2-2

HS-ETS3-6(MA). Use informational text to illustrate how a vehicle or device can be modified to produce a change in lift, drag, friction, thrust, and weight. Clarification Statements: Examples of vehicles can include cars, boats, airplanes, and rockets. Considerations of lift require consideration of Bernoulli's principle.

ELA: WHST.9-10.7

HS-ETS4-1(MA). Research and describe various ways that humans use energy and power systems to harness resources to accomplish tasks effectively and efficiently. Clarification Statement: Examples of energy and power systems can include fluid systems such as hydraulics and pneumatics, thermal systems such as heating and cooling, and electrical systems such as electronic devices and residential wiring.

**4.
Energy
&
Power
Technologies**

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HS-ETS4-2(MA). Use a model to explain differences between open fluid systems and closed fluid systems. Determine when it is more or less appropriate to use one type of system instead of the other. Clarification Statements: Examples of open systems can include irrigation, forced hot air system, and air compressors. Examples of closed systems can include forced hot water system and hydraulic brakes.

Math: A-CED 4.

Math: 7-RP.A.2c.

HS-ETS4-4(MA). Calculate and describe the ability of a hydraulic system to multiply distance, multiply force, and effect directional change. Clarification Statement: Emphasis is on the ratio of piston sizes (cross-sectional area) as represented in Pascal's law.

HS-ETS4-3(MA). Explain how differences and similarities between hydraulic and pneumatic systems lead to different applications of each in technologies.

7.MS-PS3-1

8.MS-PS2-2

HS-ETS4-5. Explain how a machine converts energy, through mechanical means, to do work. Collect and analyze data to determine the efficiency of simple and complex machines.