Engineering and Technology Progression

This progression describes key elements in the engineering design process. The design process is a systematic approach to problem solving, utilizing many different practices. Thus, the progression defines *process,* and the *context* for design is left to the discretion of the teacher. However, it might be prudent to choose a context for a design problem that could be initiated in elementary grades, and further developed in middle and high school.

In elementary grades, students learn that humans change the natural world for various reasons, including satisfying basic wants and needs. They learn that there can be many solutions to a specific problem that humans want to solve (criteria), but that some solutions may be limited based on available materials and resources (constraints).

In middle school students learn that the more precisely the criteria and constraints can be defined, the more likely the designed solution will be successful. In addition, they learn to evaluate various solutions systematically relative to how well they meet the defined criteria and constraints.

In high school the criteria and constraints include more complexity, by considering things like cost, safety, reliability, and aesthetics, as well as social, cultural and environmental impacts.

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Grade 4:

Alternate KSA Aligned to KCAS for Science:

Define a simple design problem reflecting a need or a want with criteria for success and constraints (limits) on materials, time, or cost.

3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time or cost.

SEP (Science and Engineering Practices)	DCI (Disciplinary Core Ideas)	CC (Crosscutting Concepts)
Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time or cost.	Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	People's needs and wants change over time, as do their demands for new and improved technologies.

Grade 7:

Alternate KSA Aligned to KCAS for Science:

Define the criteria and constraints of a design problem to ensure a successful solution, and potential impacts on people and the environment that may limit possible solutions.

MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

SEP (Science and Engineering Practices)	DCI (Disciplinary Core Ideas)	CC (Crosscutting Concepts)
Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.	The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.	The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources and economic conditions.

Grade 11:

Alternate KSA Aligned to KCAS for Science:

Evaluate a solution to a real-world problem based on criteria and trade-offs that account for a range of constraints including cost, safety, reliability as well as social and environmental impacts.

HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural and environmental impacts.

SEP (Science and Engineering Practices)	DCI (Disciplinary Core Ideas)	CC (Crosscutting Concepts)
Analyze complex real-world problems by specifying criteria and constraints for successful solutions.	When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural and environmental impacts.	New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.