ASET Science & Engineering Practice (SEP) Tool: Designing Solutions

Name or ID:
Lesson/Unit Title:
Intended Grade:

Directions for use

Indicate if a component is present using Y (yes) or N (no) and then, if it is present, fill in the right 2 columns.
A single lesson will most likely not address each of the components below.
The numbering of these components is not meant to indicate they should be used in sequence, they are simply for reference.

SEP 6	**Constructing Explanations and Designing Solutions:** The end-products of science are **explanations** of natural phenomena and the end-products of engineering are solutions to design problems. **a. Constructing Explanations:** The goal of science is the construction of theories that provide explanatory accounts of the world. A theory becomes accepted when it has multiple lines of empirical evidence and greater explanatory power than previous theories. **b. Designing Solutions:** The goal of engineering design is to find a solution to problems that is based on scientific knowledge and models of the material world. During the design process models or prototypes are systematically tested, and iteratively revised based on performance. Each proposed solution results from a process of balancing competing criteria of desired functions, technical feasibility, cost, safety, aesthetics, and compliance with legal requirements. The optimal choice depends on how well the proposed solutions meet criteria and constraints.

SEP 6b. Designing Solutions

Components of SEP **In this lesson/unit plan, it is clear that *students* have a structured opportunity to:**	Present? **Y/N**	**What teacher actions were taken to facilitate this component for students?**	**What are the students doing?**
1) **Describe criteria** and **constraints** of a design problem, including quantification when appropriate			
2) **Apply scientific knowledge** to **generate** a design plan that includes consideration for the criteria and constraints			
3) Build, t**est,** and evaluate the design of an object, tool, process, or system			
4) **Refine and/or optimize** the design solution based on performance during testing and consideration of the criteria and constraints			

 Project Next Gen ASET was supported by a grant to the California State University East Bay by the National Science Foundation Discovery Research K12, Award No. DRL-1418440. PI: michele.korb@csueastbay.edu or contact corinne.lardy@csus.edu, michelle.sinapuelas@csueastbay.edu

ASET Grade Band Criteria *(Grade Bands: K-2, 3-5)*

Science & Engineering Practices		
SEP 6b: Designing Solutions: Designing solutions in K-2 builds on prior experiences and progresses to the use of evidence and ideas in designing solutions. In 3-5 they build on K-2 experiences and progresses to the use of evidence in designing multiple solutions to design problems.		
*By the end of the grade band **students** will have had a structured opportunity to develop an understanding of each of these. Individual lessons or units should include opportunities for **students** to practice one or more of the following components ……*		
	K-2 Grade Band	**3–5 Grade Band**
1) **Describe criteria** and **constraints** of a design problem, including quantification when appropriate	Students will describe a given problem including: • The criteria or specific features needed in the solution, including quantification when appropriate • The materials or tool available for use in the solution	Students will describe a given problem including: • The criteria or specific features needed in the solution, including quantification when appropriate • The materials available for use in the solution • Any safety considerations that are needed
2) **Apply scientific knowledge** to **generate** a design plan that includes consideration for the criteria and constraints	With guidance, students apply scientific ideas to design a solution to the problem. This could include designing an object/tool, process, or system.	Students will apply scientific ideas to collaboratively design a solution (or multiple solutions) to a problem. This could include designing an object/tool, process, or system.
3) Build, t**est,** and evaluate the design of an object, tool, process, or system	With guidance, students: a. use tools and/or materials to build a device that solves a specific problem or a solution to a specific problem. b. evaluate potential solutions by describing whether the design solution meets the expectations (solves the problem). This may include generating and or comparing multiple solutions to a problem.	Students: a. build a device based on their design solution b. evaluate the proposed solution according to how well it meets the specified criteria and constraints of the problem. In some cases students will generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution
4) **Refine and/or optimize** the design solution based on performance during testing and consideration of the criteria and constraints	Students will make suggestions for how to revise or improve the solution to better solve the problem If time allows students will revise their device and evaluate	Modify the design solution based on the results of tests to address problems in the design or improve its functioning or compare the proposed solutions (if multiple) based on how well each meets the criteria and constraints given

 Project Next Gen ASET was supported by a grant to the California State University East Bay by the National Science Foundation Discovery Research K12, Award No. DRL-1418440. PI: michele.korb@csueastbay.edu or contact corinne.lardy@csus.edu, michelle.sinapuelas@csueastbay.edu