Engineering Solutions for Global Health

Next Generation Science Standards Connections

The activities in the Engineering Solutions for Global Health Kit were designed to support three-dimensional learning as described by the National Research Council in *A Framework for K-12 Science Education* (2012, Washington, DC: National Academies Press).

The following table lists the Next Generation Science Performance Expectations as well as the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts that are addressed by the activities in the kit. The table also provides details about the connections of the activities to those elements.

Standards	Description	Engineering Solutions for Global Health Connections	Lessons 1	Lessons 2	Lessons 3	Post-Investigation Questions
Performance Expectation			✓	✓	✓	✓
HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.	Students define and analyze the global issue of world hunger and malnutrition. Students then design a solution with an initial treatment proposal that meets given quantitative requirements for RDA and protein concentration and qualitative and quantitative constraints.	✓	✓	✓	
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	Students focus on one aspect of world hunger, protein-energy undernutrition, and design a treatment solution for it.		✓	✓	✓
HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.	Students use simulated outcomes to validate their initial treatment proposal and test its effectiveness, and then make revisions to the proposal as appropriate. The final treatment proposal takes into account constraints and trade-offs and considers social, environmental, and economic factors.			✓	✓
Science and Engineering Practices			✓	✓	✓	✓
Asking Questions and Defining Problems	Define a design problem that involves the development of a process with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations.	Students use resources to collect information to ask questions in order to define the problem of world hunger. They use the information to design a solution in the form of a treatment proposal that meets requirements and constraints.	✓		✓	

General Biology: Curriculum Connections

Standards	Description	Engineering Solutions for Global Health Connections	Lessons 1	2	3	Post-Investigation Questions
Science and Engineering Practices			✓	✓	✓	✓
Constructing Explanations and Designing Solutions	Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	Students design a treatment proposal to address protein-energy undernutrition using evidence from an experiment to test protein liquids using Bradford reagent; students consider appropriate constraints and tradeoffs to create a final treatment proposal	✓	✓	✓	
Using Mathematics and Computational Thinking	Students use algebraic thinking and analysis to represent data.	Students calculate the RDA of protein for a patient. Students calculate the volume of protein liquid to include in the treatment proposal for the patient.		✓	✓	✓
Disciplinary Core Ideas			✓	✓	✓	✓
ETS1.A	Humanity faces major global challenges today, such as the need for supplies of food which can be addressed through engineering. These global challenges also may have manifestations in local communities.	Students ask questions in order to define the problem of world hunger, which can include food insecurity in the United States. They use the information to design a solution in the form of a treatment proposal.	✓	✓	✓	✓
ETS1.B	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.	Students design a treatment proposal that takes into account product and user constraints, and considers social, environmental, and economic factors.	✓	✓	✓	
ETS1.C	Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed.	Students are given one constraint to consider after creating an initial treatment proposal solution for protein-energy undernutrition. Then students are given one or more additional constraints and must take into account the possible tradeoffs of considering multiple constraints as they continue to revise the proposal to reach a final proposal.		✓	✓	
Crosscutting Concept			✓	✓	✓	
Cause and Effect	Students understand that empirical evidence is required to make claims about causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems.	Students practice using the concept of cause and effect as it relates to nutrition: a deficiency in nutrients such as protein can cause physical effects including stunting and wasting. Students see that nutrition treatments can lead to patient outcomes of improvement, no improvement, or death, depending on the treatments' design and effectiveness. Students also think about cause and effect during the Bradford assay: the binding of certain amino acids to the Bradford reagent causes a brown to blue color change in the reagent.	✓	✓	✓	