



NEXT GENERATION

SCIENCE

STANDARDS

For States, By States



STEM Foundations

NGSS and CTE

STEM and the NGSS



- NGSS provide a solid foundation for STEM education
 - Integration of Science and Engineering Design
 - Focus on conceptual understanding and application to real world situations and problems
 - Use of mathematics and technical writing as evidence of understanding scientific concepts



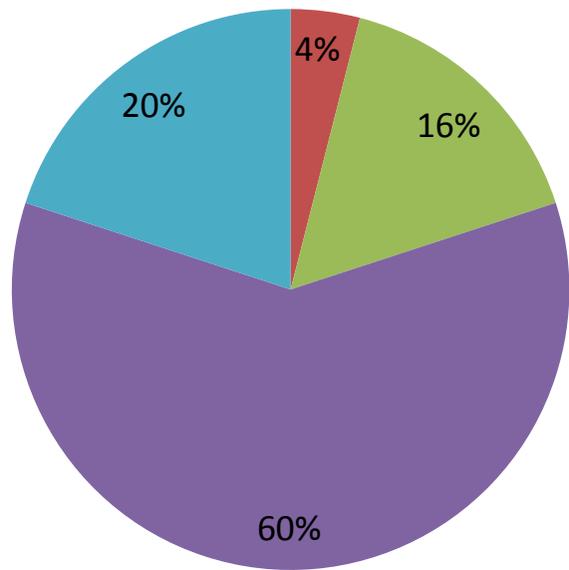
Science in “Bright Outlook” Careers

Trends in STEM careers using Department of Labor’s ONET database

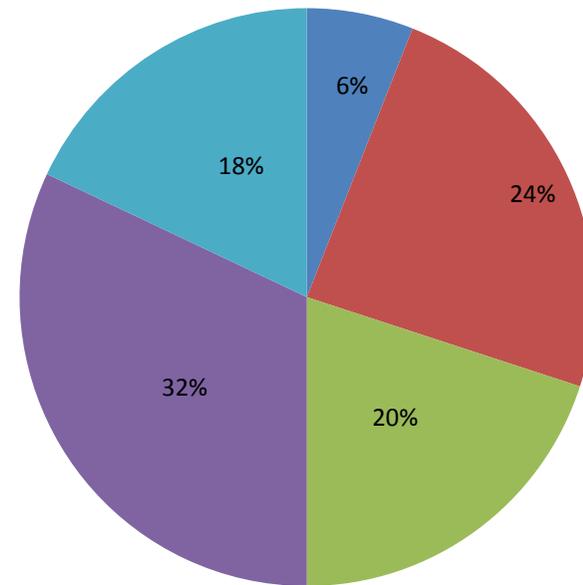
Zone Sample Selection



- A comparison of both STEM and non-STEM careers in our sample shows that STEM careers generally require higher levels of preparation than non-STEM careers.



Sample of *STEM* bright outlook careers in ONET zones



Sample of *non-STEM* bright outlook careers in ONET zones

Knowledge Needed for Bright Outlook STEM and Non-STEM Jobs



All Jobs in Sample	STEM Jobs	Non-STEM Jobs
1. English language	1. English language	1. English language
2. Mathematics	2. Mathematics	2. Customer & personal service
3. Customer & personal service	3. Computers & electronics	3. Administration & management
4. Computers & electronics	4. Engineering & technology	4. Mathematics
5. Admin & management	5. Administration & management	5. Computers & electronics
6. Engineering & technology	6. Design	6. Education & training
7. Education & training	7. Customer & personal service	7. Public Safety
8. Design	8. Biology	8. Psychology
9. Sales & marketing	9. Physics	9. Sales & marketing
10. Psychology	10. Production & processing	10. Clerical

Most Important Skills for Bright Outlook Jobs



All Jobs	STEM Jobs	Non-STEM Jobs
1. Active listening	1. Critical thinking	1. Active listening
2. Critical thinking	2. Active listening	2. Speaking
3. Speaking	3. Reading comprehension	3. Critical thinking
4. Reading comprehension	4. Complex problem-solving	4. Reading comprehension
5. Complex problem solving	5. Speaking	5. Social perceptiveness
6. Judgment & decision making	6. Judgment & decision making	6. Judgment & decision making
7. Monitoring	7. Active learning	7. Service orientation
8. Writing	8. Writing	8. Monitoring
9. Social perceptiveness	9. Science	9. Coordination
10. Service orientation	10. Mathematics	10. Writing

Major Points to Take Away



- The ONET database points out the overlap between the knowledge and skill areas that are deemed important for career success and the content knowledge/skills/practices embedded in the NGSS.
- The NGSS supports what research has made clear: Students need to engage in science and engineering practices as they learn content. The high-level thinking skills, communication skills, and argumentation from evidence practices within the NGSS align well with the skills requirements needed for bright outlook careers as defined by ONET.



Key Innovations in the NGSS

Innovations in the NGSS



1. Three-Dimensional Learning
2. The NGSS allow for coherent instruction and assessment
3. Engineering is integrated into science
4. Science is connected to math and literacy
5. All three dimensions build from K to 12 in learning progressions

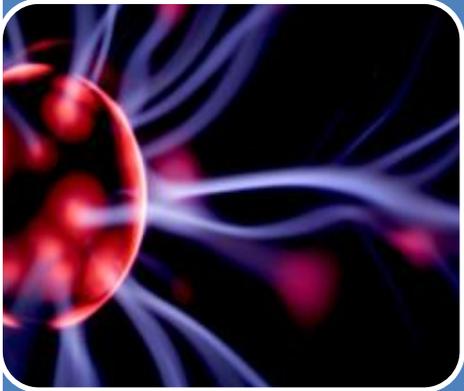


Disciplinary Core Ideas

Disciplinary Core Ideas



Physical Science



- PS1: Matter and Its Interactions
- PS2: Motion and Stability: Forces and Interactions
- PS3: Energy
- PS4: Waves and Their Applications in Technologies for Information Transfer

Life Science



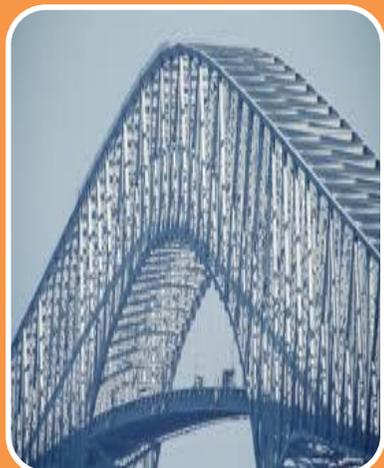
- LS1: From Molecules to Organisms: Structure and Processes
- LS2: Ecosystems: Interactions, Energy, and Dynamics
- LS3: Heredity: Inheritance and Variation of Traits
- LS4: Biological Evolution: Unity and Diversity

Disciplinary Core Ideas (cont.)



Earth and Space Science

- ESS1: Earth's Place in the Universe
- ESS2: Earth's Systems
- ESS3: Earth and Human Activity



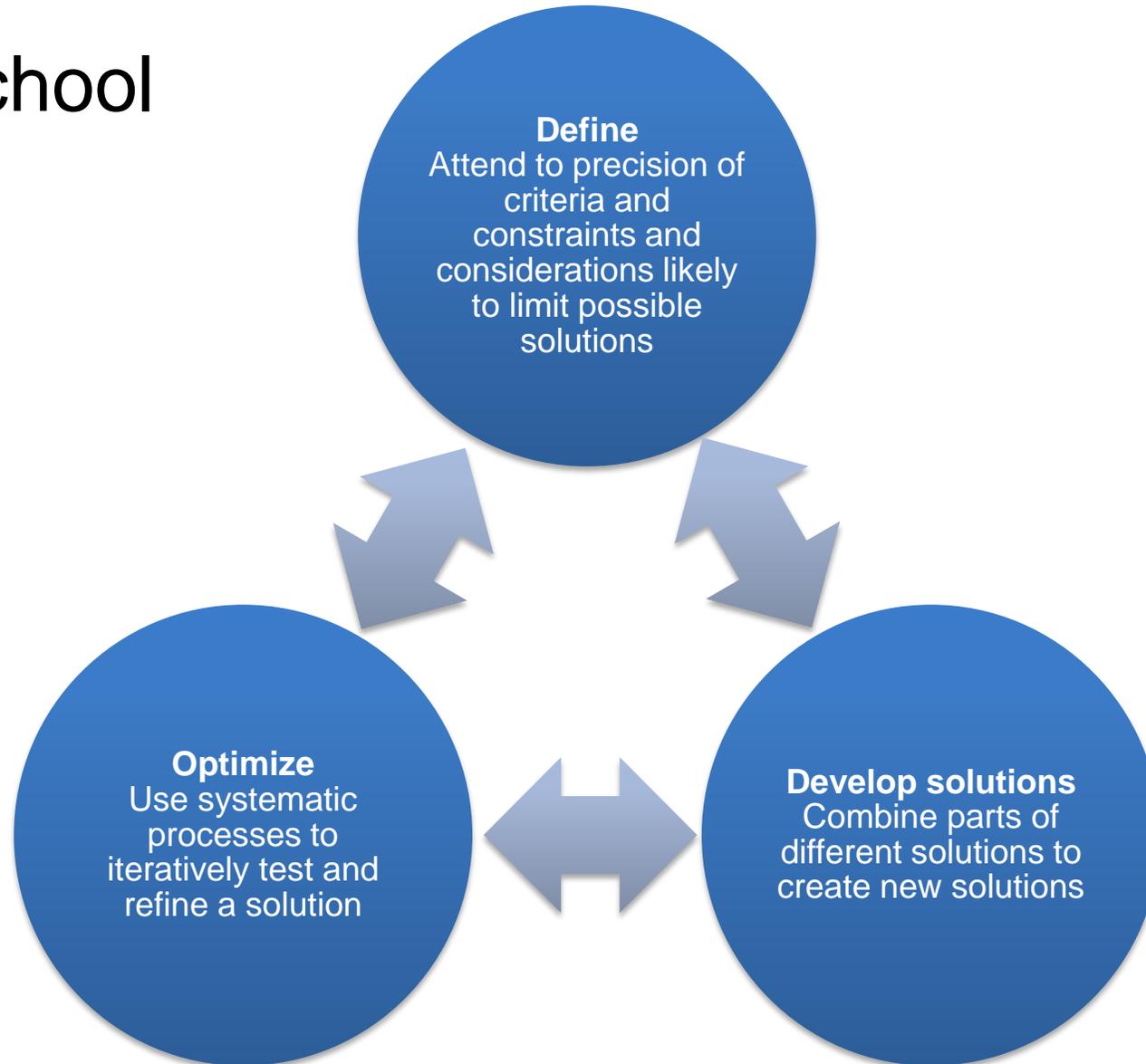
Engineering, Technology, and Applications of Science

- ETS1: Engineering Design
- ETS2: Links Among Engineering, Technology, Science, and Society

Engineering Design and the NGSSS



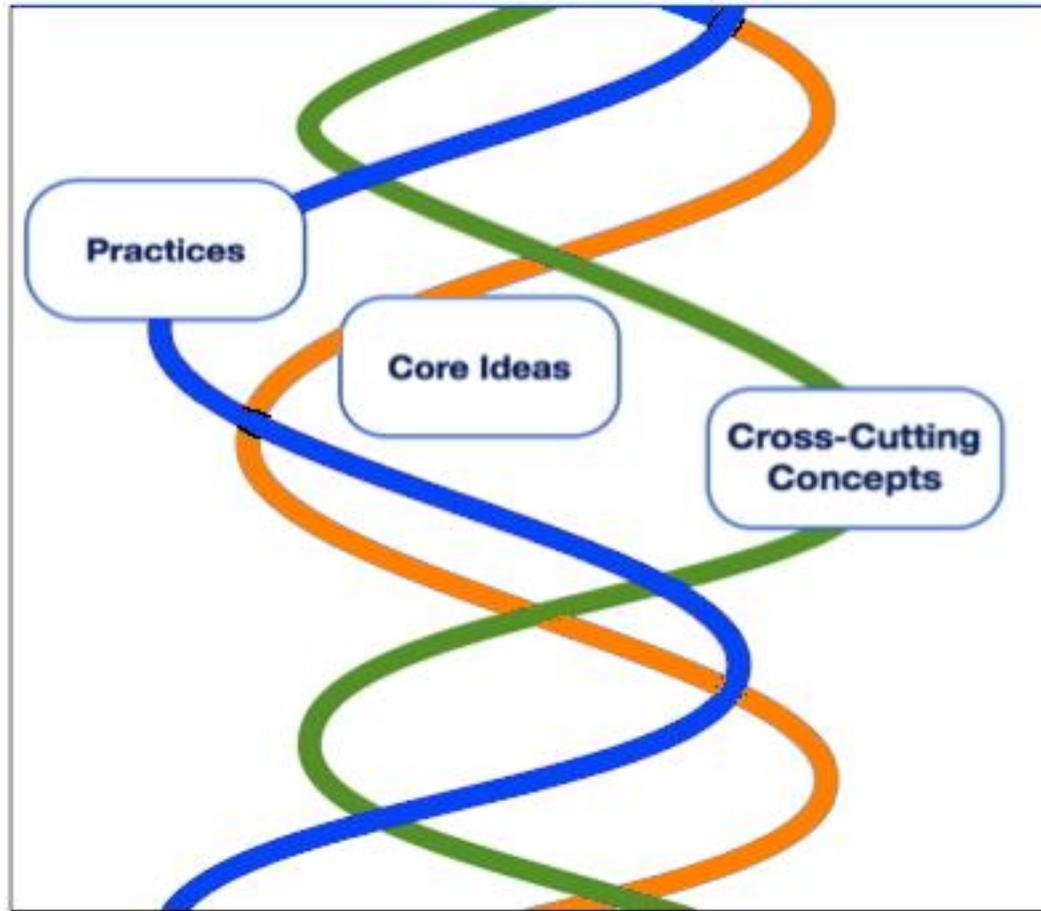
Middle School





What's Different about the Next Generation Science Standards?

Three Dimensional Learning



- Performance Expectations
- The Framework requires contextual application of the three dimensions by students.
- Focus is on how and why as well as what



Giant African Land Snail

Bundling Math and Science

Construct and compare linear, quadratic, and exponential models and solve problems.

Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

For exponential models, express as a logarithm the solution to $ab^{ct}=d$ where a , c , and d are numbers and the base b is 2, 10, or e ; evaluate the logarithm using technology.

NGSS LS2: Ecosystems

1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*

NGSS LS4: Biological Evolution

2. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*

Giant African Land Snail



In 1966, a Miami boy smuggled three Giant African Land Snails into the country. His grandmother eventually released them into the garden, and in seven years there were approximately 18,000 of them. The snails are very destructive and had to be eradicated. They consume over 500 different types of plants, lay over 1,200 eggs per year, and have been shown to cause indigenous snails' populations to decrease over time. According to the USDA, it took 10 years and cost \$1 million to eradicate them. Now, Dade County, Florida faces the same infestation.

Giant African Land Snail



- a. Assuming the snail population grows exponentially, write an expression for the population, P , in terms of the number, t , of years since their release in 1966.
- b. How long does it take for the population to double?
- c. Assuming the cost of eradicating the snails is proportional to the population, how much would it have cost to eradicate them if
 - i. The Florida Department of Agriculture (FDA) had started the eradication program a year earlier?
 - ii. The FDA had let the population grow unchecked for another year?

Giant African Land Snail



- d. Using information from online sources develop a model of a possible food web for current day Dade County. The web should include at least one indigenous snail, the wolf snail and at least three indigenous plants. Be sure to include mathematical or computational representations about the current carrying capacity of the ecosystem as well as the energy dissipation as energy is transferred from organism to organism.
- e. Given the population growth and the nature of the Land Snails, insert the Land Snails into the previously constructed food web. Using your previous representation, construct an argument based on the competitive relationships and the mathematical comparisons between a normally functioning ecosystem versus one with the Land Snails . The argument should also include the Land Snails effect on other organisms within the food web.

Giant African Land Snail



- f. Apply concepts of statistics and probability to develop evidence that the Land Snail has an advantageous heritable trait and tend to increase in proportion to wolf snails.
- g. In Hawaii, a new species of snail was introduced to combat the Land Snails. While it showed some progress, there was an extinction of some indigenous snails as a result of the new species. Construct a possible alternative to eradicating the Land Snails and the new species. The plan should include clear discussions regarding the criteria, trade-offs, and the plan for the mitigation of human intervention.

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