Department of Defense Civil-Military Programs

Civil-Military Programs

ASD M&RA (DASD(RI))

Vision Statement

To raise the interest and improve the knowledge and skills of at-risk youth in science, technology, engineering, and mathematics, which will provide for a highly educated and skilled American workforce that can meet the advanced technological requirements of the Department of Defense.

Mission Statement

By exposing youth to the technological environments and positive role models found on military bases and installations, we will provide 25-hours of exemplary instruction, using the DoD curriculum that meets or exceeds the National Standards. We will nurture a winning network of collaborators and build mutual loyalty.

Our Goal

Provide an outstanding, unforgettable Science, Technology, Engineering, and Mathematics (STEM) educational opportunity for students and teachers in a hands-on, hi-tech, alternative, discovery/inquiry-based environment on a military installation.

Academies

- Five day, 25-hour curriculum - non-residential
- Five hours per day, approximately 9:00 am to 2:00 pm
- School year: Extended over five consecutive weeks and teachers enroll the entire classroom – other option would be Monday – Friday
- Summer: 25-hour curriculum, Monday – Friday and Parents/guardians enroll individual students
- STARBASE provides all materials
- Schools and/or parents provide a bag lunch/drink and transportation to and from facility

General Information

- Created at Selfridge ANGB, MI in 1991 as Project Stars with a grant from W.K. Kellogg Foundation.
- Officially authorized as a DoD program through congress in FY93 (10 USC 2193b).
- 82 locations including Puerto Rico, Guam and Native American reservation outreach programs.
- Hosted by US Army, Army National Guard, US Air Force, Air National Guard, Air Force Reserve, US Navy and US Space Force.
- ~110,000 students participate annually.
- Average Program cost are around $450,000.

DoD STARBASE is a premier educational program, sponsored by the Office of the Assistant Secretary of Defense for Manpower and Reserve Affairs. At DoD STARBASE students participate in challenging "hands-on, minds-on" activities in Science, Technology, Engineering, and Mathematics (STEM). They interact with military personnel to explore careers and observe STEM applications in the "real world."

DoD STARBASE
CURRICULUM

SCIENCE
- A. Science Fundamentals
- B. Characteristic Properties
- C. Motion & Force
- D. Science Explorations

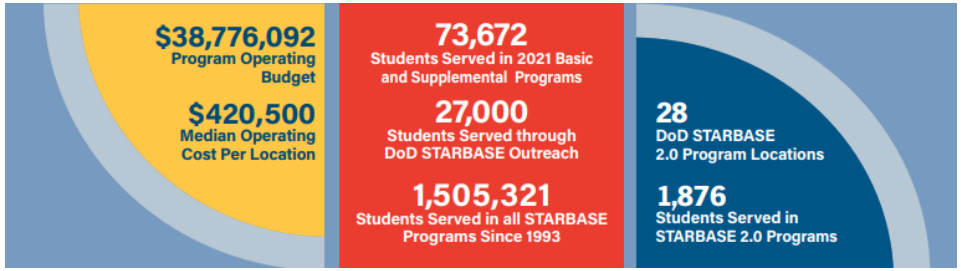
TECHNOLOGY
- A. Applying Technology

ENGINEERING
- A. Engineering Design Process
- B. 3-D Computer Aided Design

MATHEMATICS
- A. Number Relationships
- B. Measurement
- C. Geometry
- D. Data Analysis

SCIENCE, TECHNOLOGY, ENGINEERING, & MATHEMATICS (STEM) CAREERS
- A. STEM Careers on Military Facilities
- B. Personal Investigations

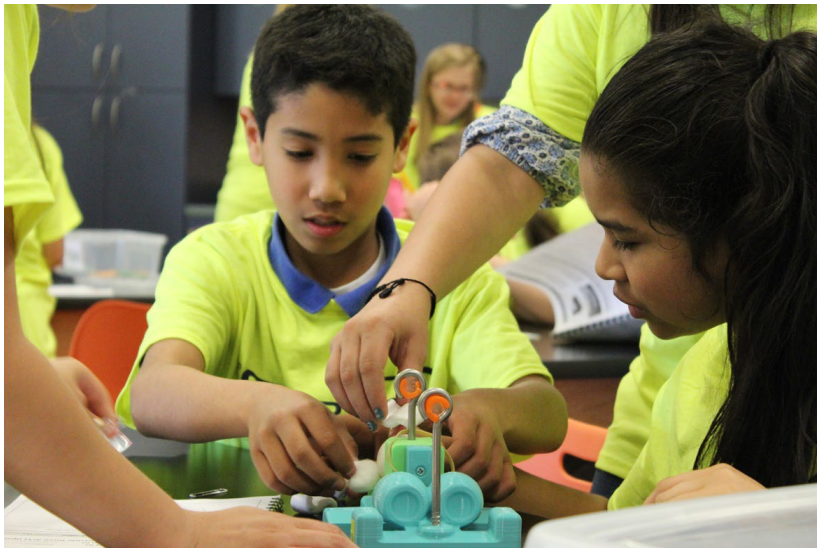
FY21 Annual Program Overview



DoD STARBASE
A Department of Defense Youth Program

Curriculum Subjects

- **Science:**
  - Motion & Force
  - Science Fundamentals
  - Characteristics of Properties
  - Science Explorations
- **Technology:**
  - Applying Technology
- **Engineering:**
  - Engineering Design Process
  - 3D Computer Aided Design
- **Mathematics:**
  - Number & Number Relationships
  - Measurement
  - Geometry
  - Data Analysis
- **STEM Careers:**
  - STEM Careers
  - Personal Investigations



Sample of Curriculum Lessons

- Building Blocks of Matter
- Energy Explorations
- 3D PTC CREO 4.0
- Physics
- Chemistry
- Buoyancy & Solutions
- Rocketry & Newton
- Circuitry
- GPS
- Coding
- Robotics
- Simulations
- Spheros'
- Atmospheric Ratios
- Measurement
- Geometry
- PTC Onshape
- Fluids
- Data Analysis

Over 90 lesson plans

Core	Sub-Categories	Approved Lessons	Time (minutes)	# of Objectives	Objectives Met				STARBASE KEY CONCEPTS
					1	2	3	4	
1. Science	A. Science Fundamentals	Creating and Building Molecular Models	60	4	●				Structure of Matter, Periodic Table of Elements, Chemical Formula
		Energy Explorations	See Activity			●			Potential Energy, Kinetic Energy, Transfer of Energy, Conservation of Energy
		States of Matter Experiments	See Activity				●		Physical Change, Matter, States of Matter, Kinetic Energy
		Physical and Chemical Changes Experiments	See Activity					●	Chemical Change, Physical Change, Matter, States of Matter, Transfer of Energy, Chemical Reactions, Standard Tools and Units of Measurement
		Double Bubble Trouble	45-60				●	●	Chemical Change, Physical Change, Matter, States of Matter, Transfer of Energy, Chemical Reactions, Standard Tools and Units of Measurement
	B. Characteristic Properties	Introduction to Fluid Mechanics (Parent)	10-20	2					Parent LP must be followed with an Approved Appendix
		A. Fluid Characteristics	40-50		●	●			Characteristic Properties of Matter, Fluid Mechanics, Standard Tools and Units of Measurement
		B. Buoyancy Activities	40			●			Characteristic Properties of Matter, Fluid Mechanics, Force
		Chromatography	60			●			Characteristic Properties of Matter, Polar Molecules
		Characteristic Properties	30			●			Characteristic Properties of Matter
		What's the Solution	15			●			Characteristic Properties of Matter
	C. Motion & Force	Introduction to Motion & Force (Parent)	10-20	3					Parent LP must be followed with an Approved Appendix
		A. Newton's Activities	See Activity		●	●	●		Newton's Laws of Motion, Standard Tools and Units of Measurement, Variable
		B. CO_2 Rockets Dragsters	45-60		●	●	●		Rocketry, Newton's Laws of Motion, Standard Tools and Units of Measurement, Variable
		C. Straw Rockets	40-60		●	●	●		Rocketry, Newton's Laws of Motion, Standard Tools and Units of Measurement, Variable
		D. Water Rockets	25-30		●	●	●		Rocketry, Newton's Laws of Motion, Standard Tools and Units of Measurement, Variable
		E. Solid Propellent Rockets	45-60		●	●	●		Rocketry, Newton's Laws of Motion, Standard Tools and Units of Measurement, Variable
	D. Science Explorations	Bernoulli's Principle Experiments	See Activity	1	●				Characteristic Properties of Matter, Fluid Mechanics
		Nanotechnology: Miniscule Matters	60		●				Structure of Matter, Standard Units of Measurement, Characteristic Properties of Matter, Nanotechnology
		Introduction to Circuitry (Parent)	??						Activity In development
		A. littleBits of Energy	45-60		●				Circuitry, Structure of Matter, Electricity, Engineering Design Process

Sub-Categories	Approved Lessons	Time (minutes)	# of Objectives	Objectives Met				STARBASE KEY CONCEPTS
				1	2	3	4	
	B. STARBITS Simple Circuits	??		●				Activity In development
	Small Will Help All	60-75		●				Engineering Design Process, Standard Tools and Units of Measurement, Characteristic Properties of Matter, Structure of Matter
	Introduction to Navigation and Mapping (Parent)	10-15						Parent LP must be followed with an Approved Appendix
ence Explorations	A. Top Secret Mission	45	1	●				Geographic Coordinate Systems, Navigation Instruments, Standard Tools and Units of Measurement, Map Fundamentals
	B. Search and Rescue on the Big Island of HI	45-60		●				Geographic Coordinate Systems, Navigation Instruments, Standard Tools and Units of Measurement, Map Fundamentals
	C. Global Positioning Systems	See Activity		●				Geographic Coordinate Systems, Navigation Instruments, Geocaching, Map Fundamentals
	Coding the Road	45-60		●	●			Robot, Robotics Programming, Coding, Geometry
	Guided Coding Experience	30-40						Coding
	Introduction to Robotics (Parent)	30						Parent LP must be followed with an Approved Appendix
	A: Programming Logic and Math Reasoning	50		●	●			Robot, Robotics Programming , Standard Tools and Units of Measurement.
	B: Robotics Challenge Activities	See Activity		●	●			Robot, Robotics Programming, Standard Tools and Units of Measurement, Geometry
plying Technology	C. Robo Loops	50	2	●	●			Robot, Robotics Programming, Standard Tools and Units of Measurement, Engineering Design Process,
	Introduction to Simulation (Parent)	10-15						Activity In development
	A. *Simulation--Imitating Life*			●	●			Activity In development
	Introduction to Renewable Resources	--						Activity In development
	A. Wind Energy			●	●			Activity In development
	B. Fuel Cells			●	●			Activity In development
	C. Solar Energy			●	●			Activity In development
	Introduction to the Engineering Design Process (Parent)	10-15						Parent LP must be followed with an Approved Appendix
gineering Design ess	A. Eggbert	40-60	2	●	●			Engineering Design Process, Newton's Laws of Motion, Force, Potential and Kinetic Energy, Mathematical Operations, Standard Tools and Units of Measurement
	B. Operation Bridge Quest	60		●	●			Engineering Design Process

Core	Sub-Categories	Approved Lessons	Time (minutes)	# of Objectives	Objectives Met				STARBASE KEY CONCEPTS
					1	2	3	4	
3. Engineering	A. Engineering Design Process	C. Contraption Action!	45-60	2	●	●			Engineering Design Process, Potential Energy, Kinetic Energy, Transformation of Energy, Conservation of Energy
		D. Sphero Solutions	50-60		●	●			Engineering Design Process, Robotic Programming, Coding, Standard Tools and Units of Measurement, Friction, Characteristic Properties of Matter
	B. 3-D Computer Aided Design	DoD Mandatory PTC Modules	180-240	4	●	●	●	●	Computer Aided Design, Engineering Drawing, Geometry Standard Tools and Units of Measurement
4. Mathematics	A. Number and Number Relationships	Figure That	20	1	●				Numerical Representation, Mathematical Operations, Graphing
		Finding the Percentage	15		●				Numerical Representation, Mathematical Operations, Standard Tools and Units of Measurement, Characteristic Properties of Matter
		Fingerprint Analysis	45		●				Numerical Representation, Graphing, Standard Tools and Units of Measurement, Mathematical Operations, Biometrics
		Eggbert Extension Activities	See Activity		●				Numerical Representation, Mathematical Operations, Standard Tools and Units of Measurement, Graphing
		Atmospheric Ratios	10-15		●				Numerical Representation, Graphing, Structure of Matter, Characteristic Properties of Matter
		My Ratio Is Sinking	30		●				Characteristic Properties of Matter, Standard Tools and Units of Measurement, Numerical Representation, Mathematical Operations
	B. Measurement	Basic Measurement - Length*	10-30	3	●				Standard Tools and Units of Measurement, Mathematical Operations
		Basic Measurement - Liquid Volume*	10-30			●			Standard Tools and Units of Measurement
		Basic Measurement - Mass*	10-30				●		Standard Tools and Units of Measurement
		Engineering Measurement Training	20-30		●		●		Standard Tools and Units of Measurement, Mathematical Operations
		Pop Goes the Fizz	45		●	●	●		Standard Tools and Units of Measurement, Graphing
		STEM Time Capsule	45		●				Standard Tools and Units of Measurement, Geometry, Mathematical Operations
	C. Geometry	Basic Geometry		1	●				Activity In development
		What's My Angle	60		●				Geometry, Rocketry, Newton's Laws of Motion, Graphing, Mathematical Operations,
		What's Up Dock	30-45		●				Geometry, Standard Tools and Units of Measurement, Mathematical Operations

Core	Sub-Categories	Approved Lessons	Time (minutes)	# of Objectives	Objectives Met				STARBASE KEY CONCEPTS
					1	2	3	4	
4. Mathematics	C. Geometry	Fly on the Ceiling	45	1	●				Geometry
		Robo Putt-Putt	45-55		●				Geometry, Robotic Programming, Standards Tools and Units of Measurement
		Does Your Robot Measure Up?	45		●				Geometry, Mathematical Operations, Engineering Drawing, Standard Tools and Units of Measurement,
	D. Data Analysis	Basic Graphing*	15	3	●	●	●		Graphing
		Warm Ups and Cool Downs	15		●	●	●		Graphing, Physical Change, Chemical Change, Variables, Standard Tools and Units of Measurement, Chemical Reactions
		Rocket Launch	45-50		●	●	●		Graphing, Rocketry, Variables, Newton's Laws of Motion, Force
5. STEM Careers	A. STEM Careers on Military Facilities	No Lessons to Approve (Site-Specific)	50-60	1					N/A
	B. Personal Investigations	No Lessons to Approve (Site-Specific)	50-60	1					N/A

Mandatory: This lesson and the chosen hands-on activity are required as an introduction to teach this concept.

STARBASE Places Emphasis on:

Understanding Scientific Concepts
Developing abilities of inquiry
Integrating all aspects of science
Multiple process skills
Management of information
Troubleshooting systems and applications
Understanding connections
Asking questions and defining problems
Construction explanations
Designing solutions
Implementing designs
Communicating
Applying metric measurement
Analyzing data – statistical methods
Date, tables, and graphs
Understanding equivalent numbers
Cartesian Coordinates Systems in navigation
Using estimations

And many more topics

Program Justification

- 7,000 students drop out of school every day nationwide. †
- 1 in 10 male high school dropouts is in jail or juvenile detention. † †
- 1 in 4 African-American dropouts are incarcerated or institutionalized. † †
- Female dropouts are nine times more likely to become single mothers. † †
- Possible to identify as early as 6th grade up to half the students who won't graduate. † † †
- Cutting dropout rate in half would yield $45 billion annually in tax revenue or cost savings. †
- U.S. Department of Labor estimates 90% of new high-growth, high-wage jobs will require some level of postsecondary education.

† Committee on Education & Labor (12 May 2009)
† † The New York Times (8 October 2009)
† † † "Keeping Middle Grades Students On Track to Graduation," Robert Balfanz, Liza Herzog (May 2006)

Program Efficacy

- 35% gain in knowledge (nationwide pre/post test comparison)
- Attitudes of participants shift dramatically toward the positive
- Youth leave with a sense of empowerment

"One student … wanted to come so badly that his entire family chose to stay in Detroit rather than vacation in Mexico…." – Teacher

"I have noticed less struggle getting my child up and ready for school on days he attends DoD STARBASE." – Parent

"I liked… learning things that I thought I wouldn't ever learn in my life." – Student

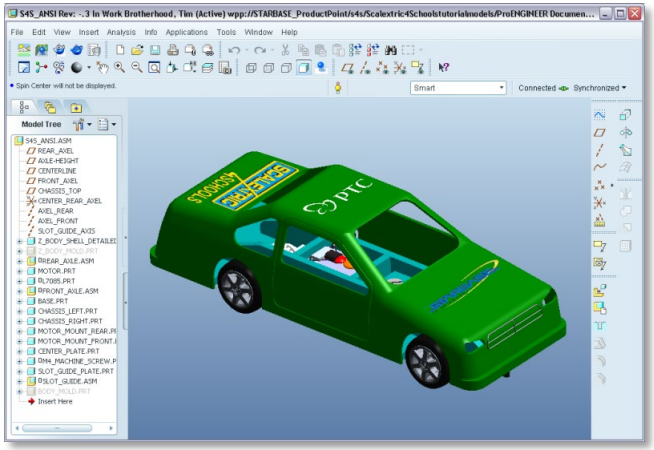
"The strength at DoD STARBASE is definitely teamwork." –Teacher

"There is a young man in my [class] who comes from… a VERY ROUGH school. This has been life changing for him. To see that school and learning can be a safe and enjoyable experience." – Teacher

"STARBASE was the best trip ever in my whole life. I will find a way back!!!!!" – Student

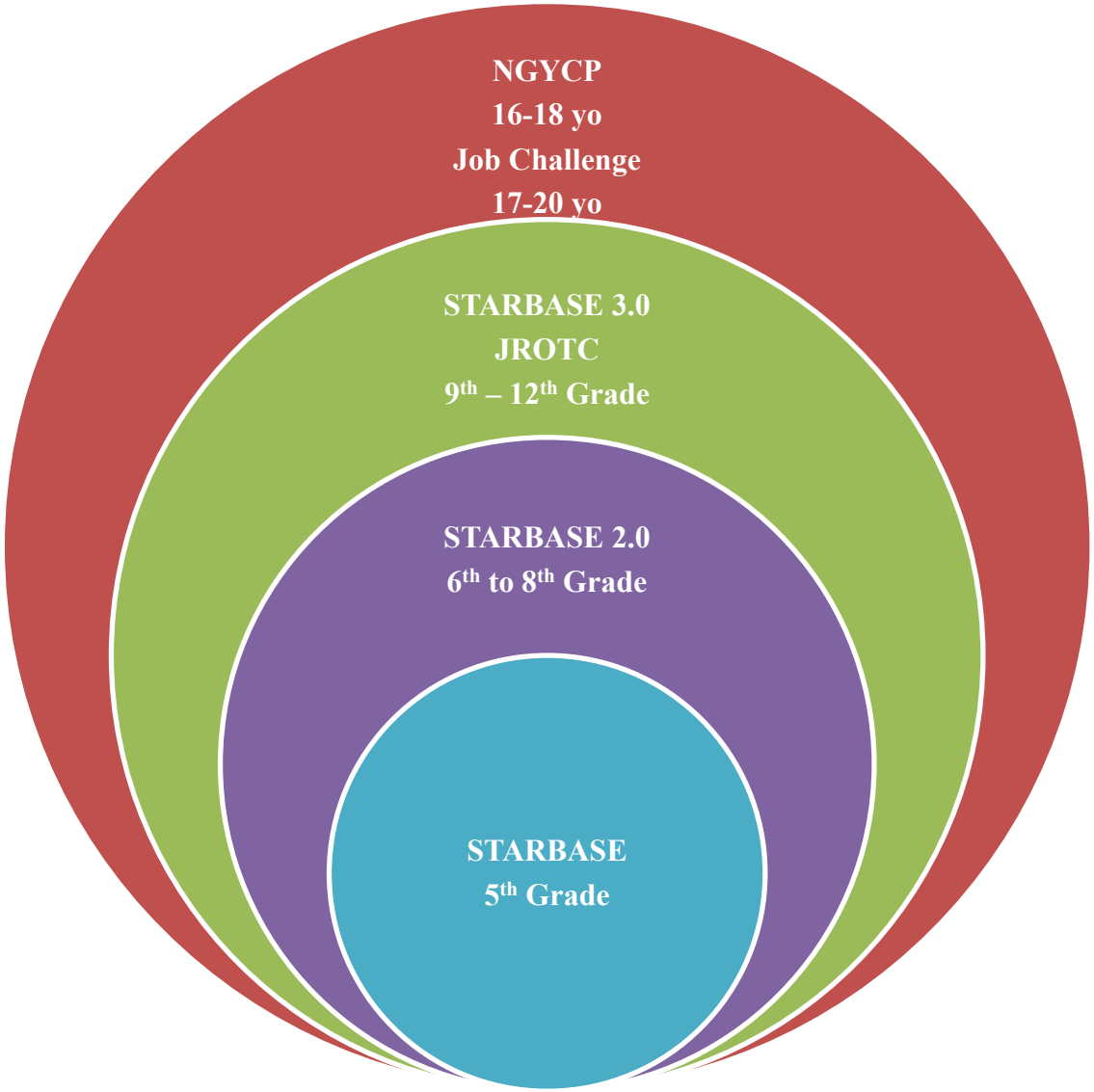
STARBASE 2.0

- After school mentoring initiative (middle school levels).
- Meetings conducted at school. Meetings are weekly or bi-monthly with a STEM Coach.
- STARBASE helps to provide STEM Coaches for a school, coordinates STEM Coach training, and develops STEM activities.
- Each sites decides their own STEM activities.
- One activity was where students design, make and race their own slot cars using PTC Creo 3D CAD and Product Point software, budgeting, marketing, shipping, and logistics and manufacturing.



Civil Military Programs

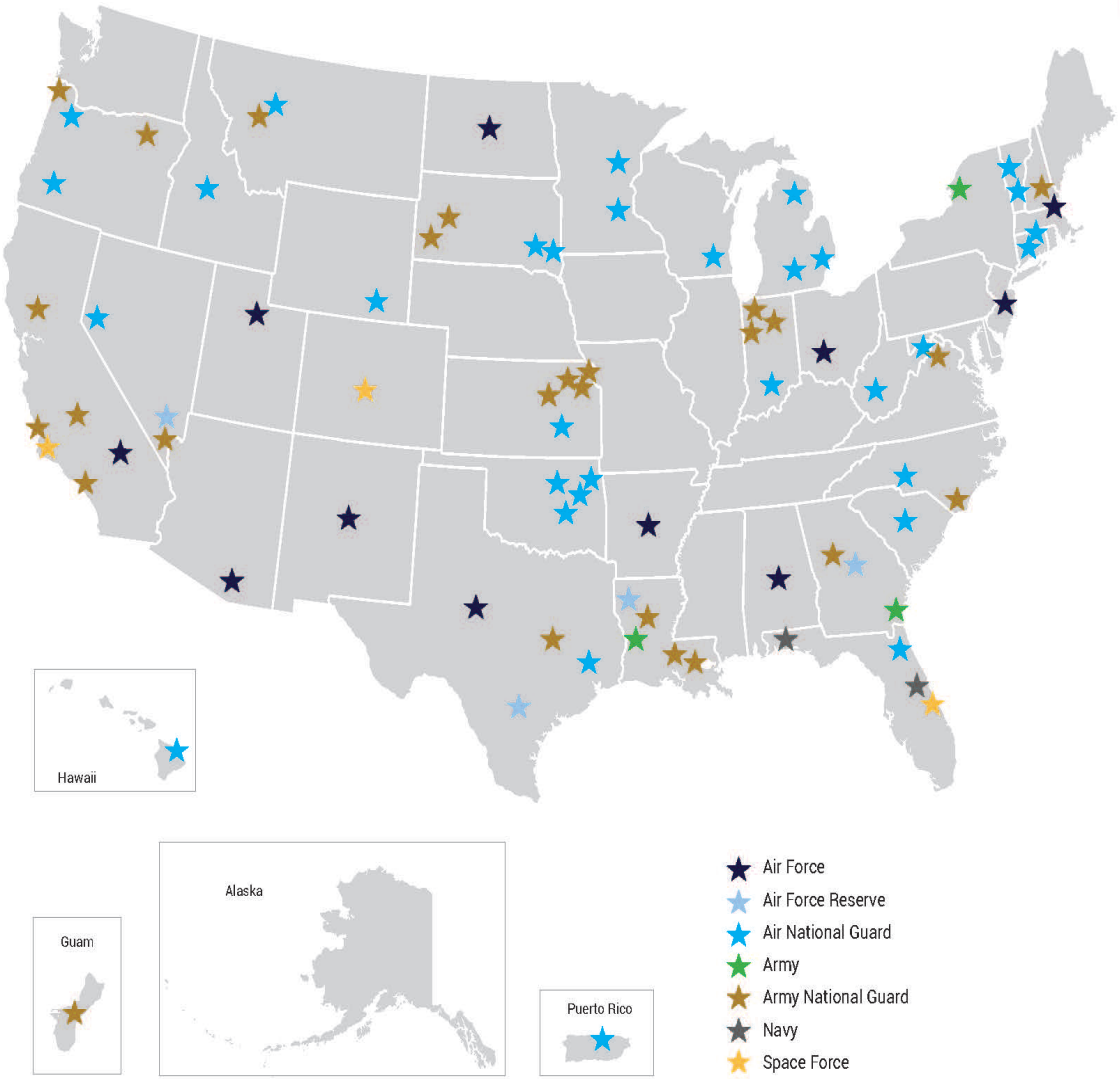
ASD M&RA (DASD(RI))



DoD STARBASE: Making a better future for our most valuable commodity…our children.

DoD STARBASE
A Department of Defense Youth Program

STARBASE Locations



TOTAL LOCATIONS–81

ST	Service Component Sponsor	Academy
AL	Air Force	STARBASE Maxwell
AR	Air Force	STARBASE Little Rock
AZ	Air Force	STARBASE Arizona
CA	Space Force	STARBASE Vandenberg
	Air Force	STARBASE Edwards
	Army National Guard	STARBASE Los Alamitos
	Army National Guard	STARBASE Sacramento
	Army National Guard	STARBASE Porterville
	Army National Guard	STARBASE San Luis Obispo
CO	Space Force	STARBASE Peterson
CT	Air National Guard	STARBASE Connecticut Windsor Locks
	Air National Guard	STARBASE Connecticut Waterbury
FL	Space Force	STARBASE Patrick
	Air National Guard	STARBASE Florida
	Navy	STARBASE Central Florida
	Navy	STARBASE Pensacola
GA	Army National Guard	Peach State STARBASE
	Air Force Reserve	STARBASE Robins
	Army	STARBASE Savannah
GU	Army National Guard	STARBASE Guam
HI	Air National Guard	STARBASE Hawaii
ID	Air National Guard	STARBASE Idaho
IN	Army National Guard	STARBASE Indiana Gary
	Army National Guard	STARBASE Indiana South Bend
	Army National Guard	STARBASE Indianapolis
	Air National Guard	STARBASE Fort Wayne
KS	Army National Guard	STARBASE Kansas City
	Army National Guard	STARBASE Manhattan
	Army National Guard	STARBASE Salina
	Army National Guard	STARBASE Topeka
	Air National Guard	STARBASE Wichita
LA	Army National Guard	Pelican State STARBASE
	Army National Guard	Bayou State STARBASE
	Army National Guard	STARBASE Jackson Barracks
	Air Force Reserve	STARBASE Louisiana
	Army	STARBASE Fort Polk
MA	Air Force	STARBASE Hanscom
MI	Air National Guard	STARBASE Alpena
	Air National Guard	STARBASE Battle Creek
	Air National Guard	STARBASE Onc

ST	Service Component Sponsor	Academy
MN	Air National Guard	STARBASE Minnesota St. Paul
	Air National Guard	STARBASE Minnesota Duluth
MT	Army National Guard	STARBASE Fort Harrison
	Air National Guard	STARBASE Great Falls
NC	Air National Guard	STARBASE Charlotte
	Army National Guard	STARBASE Wilmington
ND	Air Force	STARBASE North Dakota
NH	Army National Guard	STARBASE Granite Guardian
NJ	Air Force	STARBASE McGuire-Dix-Lakehurst
NM	Air Force	STARBASE New Mexico
NV	Air Force Reserve	STARBASE Nellis
	Air National Guard	STARBASE High Sierra
	Army National Guard	STARBASE Henderson
NY	Army	STARBASE Fort Drum
OH	Air Force	STARBASE Wright-Patt
OK	Air National Guard	STARBASE Oklahoma Oklahoma City
	Air National Guard	STARBASE Oklahoma Tulsa
	Air National Guard	STARBASE Oklahoma Fort Sill
	Air National Guard	STARBASE Oklahoma Burns Flat
OR	Army National Guard	STARBASE Camp Rilea
	Army National Guard	STARBASE Camp Umatilla
	Air National Guard	STARBASE Kingsley
	Air National Guard	STARBASE Portland
PR	Air National Guard	STARBASE Puerto Rico
SC	Air National Guard	STARBASE Swamp Fox
SD	Air National Guard	STARBASE NOVA Courage
	Army National Guard	STARBASE NOVA Honor
	Army National Guard	STARBASE Rapid City
	Air National Guard	STARBASE Sioux Falls
TX	Air Force	STARBASE Goodfellow
	Air Force Reserve	STARBASE Kelly
	Army National Guard	Texas STARBASE Austin
	Air National Guard	Texas STARBASE Houston
UT	Air Force	STARBASE Utah
VA	Army National Guard	Winchester STARBASE Academy
VT	Air National Guard	STARBASE Vermont Rutland
	Air National Guard	STARBASE Vermont South Burlington
WI	Air National Guard	STARBASE Wisconsin
WV	Air National Guard	STARBASE Martinsburg
	Air National Guard	West Virginia STARBASE Academy
WY	Air National Guard	Wyoming STARBASE Academy

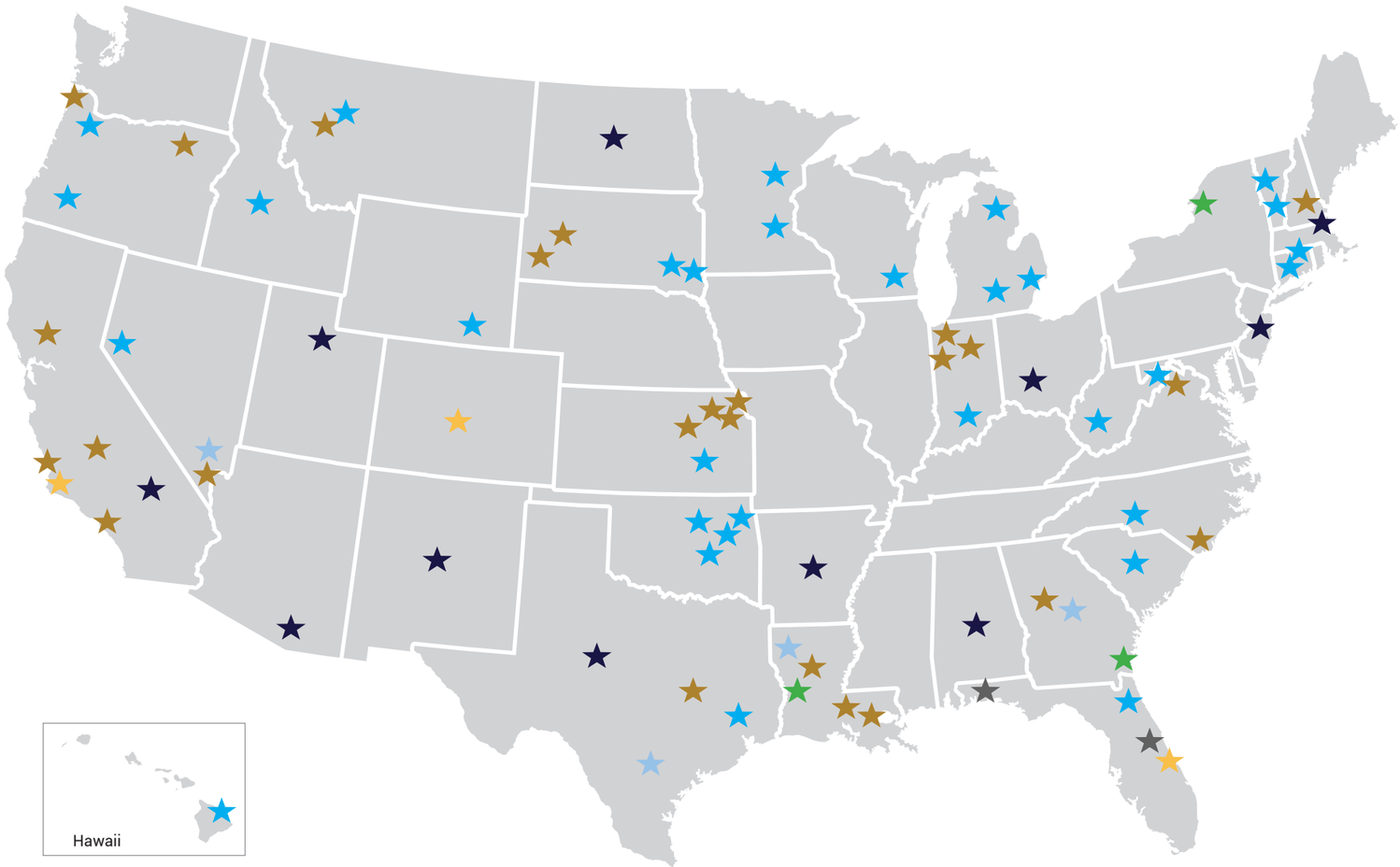
Updated 01 September 2022

Program and Contact Information

- https://dodstarbase.org/
- https://dodstarbase.org/resources/

DoD STARBASE
A Department of Defense Youth Program

STARBASE Locations



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	Army	STARBASE Fort Polk
MA	Air Force	STARBASE Hanscom
MI	Air National Guard	STARBASE Alpena
	Air National Guard	STARBASE Battle Creek
	Air National Guard	STARBASE One

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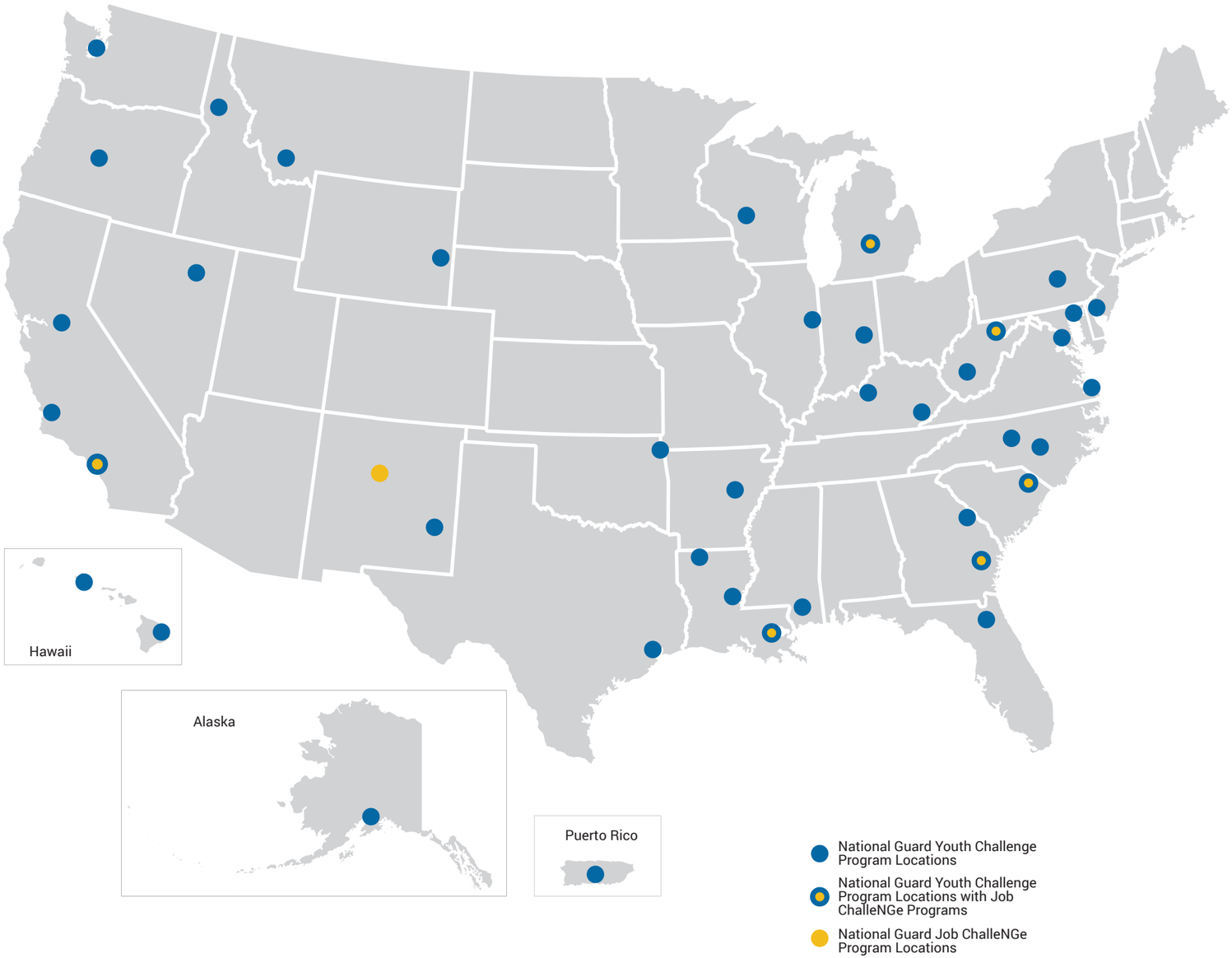
MN	Air National Guard	STARBASE Minnesota—St. Paul
	Air National Guard	STARBASE Minnesota Duluth
MT	Army National Guard	STARBASE Fort Harrison
	Air National Guard	STARBASE Great Falls
NC	Air National Guard	STARBASE Charlotte
	Army National Guard	STARBASE Wilmington
ND	Air Force	STARBASE North Dakota
NH	Army National Guard	STARBASE Granite Guardian
NJ	Air Force	STARBASE McGuire-Dix-Lakehurst
NM	Air Force	STARBASE New Mexico
NV	Air Force Reserve	STARBASE Nellis
	Air National Guard	STARBASE High Sierra
	Army National Guard	STARBASE Henderson
NY	Army	STARBASE Fort Drum
OH	Air Force	STARBASE Wright-Patt
OK	Air National Guard	STARBASE Oklahoma—Oklahoma City
	Air National Guard	STARBASE Oklahoma—Tulsa
	Air National Guard	STARBASE Oklahoma—Fort Sill
	Air National Guard	STARBASE Oklahoma—Burns Flat
OR	Army National Guard	STARBASE Camp Rilea
	Army National Guard	STARBASE Camp Umatilla
	Air National Guard	STARBASE Kingsley
	Air National Guard	STARBASE Portland
PR	Air National Guard	STARBASE Puerto Rico
SC	Air National Guard	STARBASE Swamp Fox
SD	Air National Guard	STARBASE NOVA Courage
	Army National Guard	STARBASE NOVA Honor
	Army National Guard	STARBASE Rapid City
	Air National Guard	STARBASE Sioux Falls
TX	Air Force	STARBASE Goodfellow
	Air Force Reserve	STARBASE Kelly
	Army National Guard	Texas STARBASE Austin
	Air National Guard	Texas STARBASE Houston
UT	Air Force	STARBASE Utah
VA	Army National Guard	Winchester STARBASE Academy
VT	Air National Guard	STARBASE Vermont—Rutland
	Air National Guard	STARBASE Vermont—South Burlington
WI	Air National Guard	STARBASE Wisconsin
WV	Air National Guard	STARBASE Martinsburg
	Air National Guard	West Virginia STARBASE Academy
WY	Air National Guard	Wyoming STARBASE Academy

National Guard Youth Challenge Program Locations



TOTAL LOCATIONS – 41

ST	Project	Location
AK	Alaska Military Youth Academy	Fort Richardson
AR	Arkansas Youth ChalleNGe Academy	Camp Robinson
CA	Grizzly ChalleNGe Academy	Camp San Luis Obispo
	Sunburst ChalleNGe Academy	Los Alamitos
	Discovery ChalleNGe Academy	Lathrop
DC	Capital Guardian ChalleNGe Academy	Laurel, MD
FL	Florida Youth ChalleNGe Academy	Camp Blanding
GA	Fort Gordon Youth ChalleNGe Academy	Fort Gordon
	Fort Stewart Youth ChalleNGe Academy	Fort Stewart
HI	Kalaeloa Youth ChalleNGe Academy	Kapolei
	Hilo Youth ChalleNGe Academy	Hilo
ID	Idaho Youth ChalleNGe Academy	Pierce
IL	Lincoln's ChalleNGe Academy	Rantoul
IN	Hoosier ChalleNGe Academy	Knightstown
KY	Bluegrass ChalleNGe Academy	Fort Knox
	Appalachian ChalleNGe Academy	Gray's Knob
LA	Camp Beauregard Youth ChalleNGe Academy	Pineville
	Camp Minden Youth ChalleNGe Academy	Minden
	Gillis Long Youth ChalleNGe Academy*	Carville
MD	Freestate ChalleNGe Academy	Aberdeen Proving Grounds
MI	Michigan Youth ChalleNGe Academy	Battle Creek
MS	Mississippi Youth ChalleNGe Academy	Camp Shelby
MT	Montana Youth ChalleNGe Program	Dillon
NC	Tarheel ChalleNGe Academy	Salemburg
	Tarheel ChalleNGe Academy	New London
NJ	New Jersey Youth ChalleNGe Academy	Sea Girt
NM	New Mexico Job ChalleNGe Academy	Albuquerque
NM	New Mexico Youth ChalleNGe Academy	Roswell
NV	Battle Born ChalleNGe Academy	Carlin
OK	Thunderbird ChalleNGe Academy	Pryor
OR	Oregon Youth ChalleNGe Academy	Bend
PA	Keystone State ChalleNGe Academy	Fort Indiantown Gap
PR	Puerto Rico Youth ChalleNGe Academy	Juana Diaz
SC	South Carolina Youth ChalleNGe Academy	McCrady Training Center
TX	Texas Youth ChalleNGe Academy	Eagle Lake
VA	Commonwealth ChalleNGe Academy	Camp Pendleton in Virginia Beach
WA	Washington Youth Challenge Academy	Bremerton
WI	Wisconsin Youth ChalleNGe Academy	Fort McCoy
WV	Mountaineer ChalleNGe Academy–North	Camp Dawson
	Mountaineer ChalleNGe Academy–South	Montgomery
WY	Cowboy ChalleNGe Academy	Camp Guernsey

* LA Job Challenge is Department of Labor funded.

Updated 01 September 2022

DoD STARBASE
A Department of Defense Youth Program

STANDARDS, OBJECTIVES, AND ACTIVITIES

THE DOD STARBASE APPROVED CURRICULUM GUIDEBOOK

October 2020

STANDARDS, OBJECTIVES, AND ACTIVITIES:
The DoD STARBASE Approved Curriculum Guidebook

TABLE OF CONTENTS

USING THIS GUIDEBOOK

Early in the DoD STARBASE Program's history, its leaders recognized that it could only be a premier, high-performing STEM education program if its curriculum was innovative, creative, and accurate in the science it represented. They developed a process to evaluate, enhance/develop, and standardize a compendium of approved lesson plans for STARBASE instructors to teach.

This guidebook is a resource for all STARBASE personnel as to how to best utilize the curriculum at each STARBASE location. Specifically, it:

1. Designates key concepts addressed in the STARBASE curriculum across all the core curriculum areas: Science, Technology, Engineering, and Mathematics. These key concepts offer sites a concise illustration of the extensive academic focus areas addressed by the STARBASE curriculum to provide to stakeholder groups.
2. Presents the approved STARBASE curriculum, organized on the four major disciplines of STEM: Science, Technology, Engineering, and Mathematics.
3. Provides STARBASE programs with a clear presentation of the internal objectives that guide the STARBASE curriculum and how the approved lesson plans fulfill those objectives.
4. Outlines the alignment between the STARBASE curriculum and different STEM national standards that may be utilized throughout the country.
5. Provides a curriculum-at-a-glance planning tool to help ensure all objectives are met.

STARBASE KEY CONCEPTS

Below is a list of key concepts that are addressed within the DoD STARBASE curriculum. While the STARBASE objectives referenced in each curriculum area are specific to the DoD STARBASE program, these key concepts represent a generalized look at the information addressed in each lesson plan.

KEY CONCEPT	DEFINITION
Biometrics	The measurement of physical characteristics, such as fingerprints, DNA, or retinal patterns, for use in verifying the identity of individuals.
Characteristic Properties of Matter	A characteristic property is a chemical or physical property that helps identify and classify substances. The characteristic properties of a substance are always the same whether the sample you are observing is large or small. Examples of characteristic properties include freezing/melting point, boiling/condensing point, density, magnetism, and solubility.
Chemical Change	A change resulting from a chemical reaction in which bonds are broken and new bonds are formed between different atoms in a substance. A chemical change produces one or more new substances with different chemical properties.
Chemical Formula	A model that gives information about the atoms that makes up a particular chemical compound. They are used in chemical equations to represent how atoms are rearranged in a chemical reaction.
Circuitry	The design of an electrical circuit.
Coding	Manipulating a system of signals used to represent letters or numbers in transmitting messages.
Computer Aided Design (CAD)	Software used in art and architecture and engineering and manufacturing to assist in precision drawing.
Conservation of Energy	A principle stating that the total energy of an isolated system remains constant regardless of changes within the system.

KEY CONCEPT	DEFINITION
Electricity	The physical phenomena arising from the behavior of electrons and protons that is caused by the attraction of particles with opposite charges and the repulsion of particles with the same charge.
Elements of a Map	The components of a diagrammatic representation of the earth's surface or part of it, showing the geographical distributions, positions, etc, of natural or artificial features such as roads, towns, relief, rainfall, etc.
Engineering Design Process	A cyclical method of problem solving used to create a system, a product, or a process that meets an identified need.
Engineering Drawing	A graphical language used by engineers and other technical personnel associated with the engineering profession.
Fluid Mechanics	The study of the mechanical and flow properties of fluids, especially as they apply to practical engineering.
Force	A push or a pull that gives energy to an object, sometimes causing a change in the motion of the object.
Geocaching	A type of scavenger hunt in which people search for a geocache using the geographic coordinates with Global Positioning System receivers.
Geographic Coordinate Systems	A system of latitude and longitude which defines the position of a point on the surface of the Earth with respect to the reference spheroid.
Geometry	The mathematics of the properties, measurement, and relationships of points, lines, angles, surfaces, and solids.
Graphing	A method of showing the relationship of quantities, such as a diagram in which lines, bars, or proportional areas represent how one quantity depends on or changes with another.
Kinetic Energy	The energy of a body with respect to its motion.
Mathematical Operations	A calculation by mathematical methods, including addition, subtraction, multiplication, and division.

KEY CONCEPT	DEFINITION
Matter	Anything that has mass and occupies space.
Nanotechnolgy	The science and technology of nanoscale devices and materials, such as electronic circuits, constructed using single atoms and molecules.
Navigation Instruments	Tools used to add in the science and method of determining the position, course, and distance of travel.
Newton's Laws of Motion	The three laws proposed by Isaac Newton to describe the motion of a body upon which forces may act and which may exert forces on other bodies, used as the basis of classical mechanics.
Numerical Representation	The representation of numbers as whole, fractions, decimals, and percents and the relationship of those values as compared to each other.
Periodic Table of Elements	A list of elements ordered in rows according to atomic number (number of protons in the nucleus of an atom of the element). The rows are arranged so that elements with similar chemical properties occur in the same column.
Physical Change	A change in physical properties that does not affect the chemical nature of a substance. Examples would include changes in texture, shape, size, color, volume, mass, weight, and density.
Polar Molecules	Chemical bonding is the result of either an atom sharing one or more outer orbit electrons with another atom or an atom taking outer orbit electrons from the atom with which it is bonding. Normally, an atom has an even distribution of electrons in the orbits or shells, but if more end up on one side than the other in a molecule, there can be a resulting electrical field in that area. Water is a polar molecule because of the way the atoms bind in the molecule such that there are excess electrons on the oxygen side and a lack or excess of positive charges on the hydrogen side of the molecule.
Potential Energy	Energy that is stored within an object, not in motion but capable of becoming active. A raised weight, coiled spring, or charged battery has potential energy.

KEY CONCEPT	DEFINITION
Robot	A machine that is programmed to do work on its own, automatically.
Robotic Programming	Specific operating instructions for a robot.
Rocketry	The science or study of rockets, embracing theory, research, development, and experimentation.
Standard Tools and Units of Measurement	The examination of the tools and units of measurement, such as mass, liquid volume, volume, length, grams, liters, meters, etc.
States of Matter	Distinct forms in which material can exist: solid, liquid, gas, and plasma.
Structure of Matter	The examination of the structure of matter, including atoms, elements, molecules, compounds, single/double bonds, etc.
Transfer of Energy	The conversion of one form of energy into another, or the movement of energy from one place to another.
Variables	A variable, independent or dependent, is any factor that can be controlled, changed, or measured in an experiment.

DoD STARBASE
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1. SCIENCE

STARBASE Science places emphasis on:

1. Understanding scientific concepts and developing abilities of inquiry.
2. Learning subject matter disciplines in the context of inquiry, technology, science in personal and social perspective, and history and nature or science.
3. Integrating all aspects of science content.
4. Studying science concepts.
5. Implementing inquiry as instructional strategies, abilities, and ideas to be learned.
6. Activities that investigate and analyze science questions.
7. Process skills in context.
8. Using multiple process skills – manipulation, cognitive, and procedural.
9. Teamwork and collaboration.
10. The importance of hands-on investigations in order to develop understanding, ability, values of inquiry and knowledge of science content.
11. Management of ideas and information.
12. Representing situations verbally, numerically, graphically, geometrically, or symbolically.
13. Identify and use functional relationships.

1. SCIENCE: A. Science Fundamentals

A. Science Fundamentals Objectives

1. The learner will conclude there are more than 100 known elements that combine in a multitude of ways to produce compounds, which account for all living and non-living substances, and that atoms combine to form molecules and molecules formed from different atoms combine to form compounds.
2. The learner will understand that all energy can be classified as potential energy (such as chemical, mechanical, nuclear, and gravitational energy) or kinetic energy (such as radiant, thermal, motion, sound, and electrical energy) and that energy transfers in many ways, such as heat, light, electricity, mechanical motion, sound, and the nature of a chemical.
3. The learner will conclude a change in the state of matter of a substance is the result of a change in kinetic energy.
4. The learner will differentiate between a physical change in which matter changes state or form and a chemical change in which one or more new substances are formed.

Approved Lesson Plans

Lesson Plans	Appendices	Objectives Met			
		1	2	3	4
Creating and Building Molecular Models *(Last Updated Aug 2020)*		●			
Energy Explorations *(Last Updated June 2018)*			●		
States of Matter Experiments *(Last Updated Aug 2020)*				●	
Physical and Chemical Changes Experiments *(Last Updated Aug 2020)*					●
Double Bubble Trouble *(Last Updated Aug 2020)*				●	●

1. SCIENCE: B. Characteristic Properties

B. Characteristic Properties Objectives

1. The learner will identify a fluid as a liquid or gas and will understand that any material that flows is a fluid, which has no fixed shape, and changes its shape continuously when acted on by an external stress.
2. The learner will recognize a substance has characteristics properties, such as density, viscosity, boiling point, surface tension, compressibility, and solubility, all of which are independent of the amount of the sample.

Approved Lesson Plans

Lesson Plans	Appendices	Objectives Met	
		1	2
Introduction to Fluid Mechanics (Parent)* *(Last Updated Apr 2018)*	Appendix A: Fluid Dynamics *(Last Updated Aug 2020)*	●	●
	Appendix B: Buoyancy *(Last Updated Apr 2018)*	●	●
Characteristic Properties Experiments *(Last Updated Jun 2015)*			●
Chromatography *(Last Updated May 2018)*			●
What's the Solution? *(Last Updated Jun 2015)*			●

* The parent lesson must be completed along with the appendices chosen to meet the listed objectives.

1. SCIENCE: C. Motion & Force

C. Motion & Force Objectives

1. The learner will demonstrate that an object in motion will stay in motion or an object at rest will stay at rest unless acted upon by an outside force. ***(Newton's First Law)***
2. The learner will determine that acceleration is produced when a force acts on a mass. The greater the mass, the greater the amount of force necessary to accelerate the mass. ***(Newton's Second Law)***
3. The learner will conclude every action is followed by a reaction equal in magnitude and opposite in direction. ***(Newton's Third Law)***

Approved Lesson Plans

Lesson Plans	Appendices	Objectives Met		
		1	2	3
Introduction to Motion & Force (Parent)* *(Last Updated May 2018)*	Appendix A: Newton's Activities *(Last Updated Aug 2020)*	●	●	●
	Appendix B: CO_2 Rocket Dragsters *(Last Updated Apr 2018)*	●	●	●
	Appendix C: Straw Rockets *(Last Updated Sep 2015)*	●	●	●
	Appendix D: Water Rockets *(Last Updated Apr 2018)*	●	●	●
	Appendix E: Solid Propellent Rockets *(Last Updated Sep 2015)*	●	●	●

* The parent lesson must be completed along with the appendices chosen to meet the listed objectives.

1. SCIENCE: D. Science Explorations

D. Science Explorations Objectives

1. The learner will utilize scientific principles to examine the world around us while investigating the relationship of science to society, technology, mathematics, and other disciplines.

Approved Lesson Plans

Lesson Plans	Appendices	Objective Met
		1
Bernoulli's Principle Experiments		●
Nanotechnology: Miniscule Matters *(Last Updated Apr 2018)*		●
Introduction to Circuitry (Parent)* *(New LP Coming Soon)*	Appendix A: littleBits of Energy *(Last Updated Apr 2018)*	●
	Appendix B: Starbits *(New Activity Coming Soon)*	●
Small Will Help All *(Last Updated Jun 2015)*		●
Introduction to Navigation and Mapping (Parent)* *(Last Updated Jun 2015)*	Appendix A: Top Secret Mission *(Last Updated May 2018)*	●
	Appendix B: Search and Rescue on the Big Island of HI *(Last Updated Nov 2015)*	●
	Appendix C: Global Positioning Systems *(Last Updated Nov 2015)*	●

* The parent lesson must be completed along with the appendices chosen to meet the listed objectives.

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2. TECHNOLOGY

STARBASE Technology places emphasis on:

1. Understanding and use of technological systems.
2. Selecting and using applications effectively and productively.
3. Troubleshooting systems and applications.
4. Transfer current knowledge to learning of new technologies.
5. Understanding the connection between scientific advances and technology.

2. TECHNOLOGY: A. Applying Technology

A. Tools of Technology Objectives

1. The learner will investigate technological innovations.
2. The learner will employ technologies to solve a simulated or real-world problem.

Approved Lesson Plans

Lesson Plans	Appendices	Objectives Met	
		1	2
Coding the Road *(Last Updated Aug 2020)*		●	●
Guided Coding Experience *(Last Updated Apr 2018)*		●	●
Introduction to Robotics (Parent)* *(Last Updated Sep 2017)*	Appendix A: Programming Logic and Math Reasoning *(Last Updated Oct 2017)*	●	●
	Appendix B: Robotics Challenge Activities *(Last Updated Aug 2020)*	●	●
	Appendix C: Robo Loops *(Last Updated Apr 2018)*	●	●
Introduction to Simulation (Parent)* *(New LP Coming Soon)*	Appendix A: Simulation Imitating Life *(New Appendix Coming Soon)*	●	●
Introduction to Renewable Resources (Parent)* *(New LP Coming Soon)*	Appendix A: Wind Energy *(New Appendix Coming Soon)*	●	●
	Appendix B: Fuel Cells *(New Appendix Coming Soon)*	●	●
	Appendix C: Solar Energy *(New Appendix Coming Soon)*	●	●

* The parent lesson must be completed along with the appendices chosen to meet the listed objectives.

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3. ENGINEERING

STARBASE Engineering places emphasis on:

1. Asking questions and defining problems.
2. Planning and carrying out investigations.
3. Construction explanations and designing solutions.
4. Defining and delimiting engineering problems.
5. Developing possible solutions to a problem.
6. Optimizing a design solution.
7. Identifying appropriate problems for technological designs.
8. Designing a solution or product.
9. Implementing a proposed design.
10. Evaluating completed technological designs and products.
11. Communicating the process of technological design.

3. ENGINEERING: A. Engineering Design Process (EDP)

A. Engineering Design Process (EDP) Objectives

1. The learner will recognize the engineering design process is a method of problem solving used to create a system, a product, or a process that meets an identified need.
2. The learner will apply the steps of the Engineering Design Process to solve a simulated or real-world problem.

Approved Lesson Plans

Lesson Plans	Appendices	Objectives Met	
		1	2
Introduction to the Engineering Design Process (Parent)* *(Last Updated Sep 2017)*	Appendix A: Eggbert *(Last Updated Apr 2018)*	●	●
	Appendix B: Operation Bridge Quest *(Last Updated Sep 2017)*	●	●
	Appendix C: Contraption Action! *(Last Updated Apr 2018)*	●	●
	Appendix D: Sphero Solutions *(Last Updated Aug 2020)*	●	●

* The parent lesson must be completed along with one of the appendices listed.

3. ENGINEERING: B. 3-D Computer-Aided Design (CAD)

B. 3-D Computer-Aided Design (CAD) Objectives

1. The learner will construct a 3-D scale model based on geometric relationships using engineering design software and computer technology as required by OASD/RA.
2. The learner will use engineering design software to demonstrate basic CAD operation and skills in the areas of:
   - Sketching (2-D geometry creation and modification)
   - Geometric and dimensional constraints (applying appropriate constraints)
   - Modeling (3-D modeling skills and modifications)
   - Assemblies (understanding and creating simple assemblies)
3. The learner will relate geometric relationships and mathematical applications to parameters of CAD.

Approved Lesson Plans

Lesson Plans*		Appendices	Objectives Met		
			1	2	3
OnShape	DoD Scavenger Hunt			●	●
	DoD Gyrosphere		●	●	●
	DoD Space Station		●	●	●
Creo	DoD Lab Module and DoD Satellite		●	●	●
	DoD Life Support Module and DoD Submersible		●	●	●
	DoD Life Support Module and DoD Unmanned Aerial Vehicle (UAV)		●	●	●
	DoD Life Support Module and DoD Rover		●	●	●

*Mandatory: A minimum of 3 hours must be completed using 1 or several of the lessons listed above.

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4. MATHEMATICS OPERATIONS & APPLICATIONS

STARBASE Mathematics Operations & Application places emphasis on:

1. Applying metric measurement with length, volume, mass, density, and area and using appropriated measurement tools which help to solve problems.
2. Analyzing experimental data by using statistical methods to describe, analyze, and make decisions.
3. Displaying data using tables and graphs.
4. Using and understanding equivalent numbers by transforming fractions into decimals and percentages.
5. Using geometry in solving problems, such as calculating the area of 2D and 3D shapes and using angles and the Cartesian Coordinate System in navigation.
6. Creating experimental and theoretical models of situations involving probabilities.
7. Using estimations.

4. MATHEMATICS OPERATIONS & APPLICATIONS: A. Number Relationships

A. Number Relationships Objectives

1. The learner will solve problems using ratios expressed as a fraction, a decimal, or a percent.

Approved Lesson Plans

Lesson Plans	Appendices	Objective Met
Figure That *(Last Updated Nov 2015)*		●
Finding the Percentage *(Last Updated Jun 2015)*		●
Fingerprint Analysis *(Last Updated Apr 2018)*		●
Eggbert Extension Activities *(Last Updated Apr 2018)*		●
Atmospheric Ratios *(Last Updated Aug 2020)*		●
My Ratio Is Sinking *(Last Updated Aug 2020)*		●

4. MATHEMATICS OPERATIONS & APPLICATIONS: B. Measurement

B. Measurement Objectives

1. The learner will apply appropriate standard units and tools to measure length.
2. The learner will apply appropriate standard units and tools to measure liquid volume.
3. The learner will apply appropriate standard units and tools to measure mass.

Approved Lesson Plans

Lesson Plans	Appendices	Objectives Met		
		1	2	3
Basic Measurement - Length * *(Last Updated Jun 2018)*		●		
Basic Measurement - Liquid Volume* *(Last Updated Jun 2018)*			●	
Basic Measurement - Mass* *(Last Updated Jun 2018)*				●
Engineering Measurement Training *(Last Updated Sep 2015)*		●		●
Pop Goes the Fizz *(Last Updated Apr 2018)*		●	●	●
STEM Time Capsule *(Last Updated Jun 2015)*		●		

* Mandatory: This lesson and the chosen hands-on activity are required as an introduction to teach this concept.

4. MATHEMATICS OPERATIONS & APPLICATIONS: C. Geometry

C. Geometry Objectives

1. The learner will recognize geometric properties and relationships and apply them to specific problems using a coordinate plane, angle, area, surface area, or volume.

Approved Lesson Plans

Lesson Plans	Appendices	Objective Met
Basic Geometry *(New LP Coming Soon)*		●
What's My Angle? *(Last Updated Aug 2020)*		●
What's Up Dock? *(Last Updated Jun 2015)*		●
The Fly on the Ceiling *(Last Updated Apr 2018)*		●
Robo Putt-Putt *(Last Updated Apr 2018)*		●
Does My Robot Measure Up? *(Last Updated Aug 2020)*		●

4. MATHEMATICS OPERATIONS & APPLICATIONS: D. Data Analysis

D. Data Analysis Objectives

1. The learner will collect data using observations and experiments.
2. The learner will represent data using tables and graphs.
3. The learner will collect and analyze data to identify solutions and/or make informed decisions.

Approved Lesson Plans

Lesson Plans	Appendices	Objectives Met		
		1	2	3
Basic Graphing* *(Last Updated Apr 2018)*		●	●	●
Warm Ups and Cool Downs *(Last Updated Aug 2015)*		●	●	●
Rocket Launch *(Last Updated Aug 2015)*		●	●	●

* Mandatory: This lesson and the chosen hands-on activity are required as an introduction to teach this concept.

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5. STEM CAREERS

STARBASE STEM Careers places emphasis on:

1. The contributions of many different people who have advanced the fields of STEM.
2. Scientists, engineers, mathematicians and technologists work in many different settings, including the military, and students get first-hand experience through tours.
3. Correlation between academic endeavors in STEM areas to real-world applications in career fields.
4. Community engagement in STEM education opportunities to provide meaningful experiences for students and educators.
5. Expanding students' awareness in exciting STEM careers available, and how many different careers utilize STEM on a daily basis.
6. Promoting continued pursuit of STEM in school, including choosing higher-level math and science courses that expand their opportunities for the future.

5. STEM CAREERS: A. STEM Careers on Military Facilities

A. STEM Careers on Military Facilities Objectives

1. The learner will develop an awareness that scientists, technicians, engineers and mathematicians work on military facilities.

Approved Lesson Plans

Lessons are site-specific and do not require formal committee approval; however, all lessons conducted in STEM Careers should equal no more than 2.5 hours of overall instruction.

5. STEM CAREERS: B. Personal Investigations

B. Personal Investigations Objectives

1. The learner will correlate their academic endeavors in STEM areas to real-world applications in career fields.

Approved Lesson Plans

Lessons are site-specific and do not require formal committee approval; however, all lessons conducted in STEM Careers should equal no more than 2.5 hours of overall instruction.

APPENDIX A:
STARBASE Alignment with National Standards

Source: National Science Education Standards

Science as Inquiry: As a result of activities in grades 5-8, all students should develop:

- Understanding about scientific inquiry.
- Abilities necessary to do scientific inquiry: identify questions, design an investigation, collect and interpret data, use evidence, think critically, analyze and predict, communicate, and use mathematics.

There is no single, universally accepted, authoritative source for elementary-level STEM education. School systems throughout the country utilize a multitude of standards of learning to develop individual state or local community standards. This appendix lists applicable national standards that correlate to the DoD STARBASE curriculum. The internal objectives for the STARBASE curriculum were constructed from all of the standards listed below, so that every STARBASE Academy can choose an approved lesson plan or activity that most closely meets the academic needs of its participating school systems.

Specifically, the following national standards were considered. In each core curriculum area, Science, Technology, Engineering, and Math, the applicable standards have been identified. The source is noted using the color system below.

- **National Science Education Standards (NSES)**
  https://www.nationalacademies.org/
- **Next Generation Science Standards (NGSS)**
  https://www.nextgenscience.org/
- **International Society for Technology in Education Standards (ISTE)**
  https://www.iste.org/
- **National Council of Teacher of Mathematics Expectations (NCTM)**
  https://www.nctm.org/
- **Common Core Mathematics Standards**
  http://www.corestandards.org/

SCIENCE

NSES (NATIONAL SCIENCE EDUCATION STANDARDS)

SCIENCE AS INQUIRY

Abilities Necessary to do Scientific Inquiry

- Identify questions that can be answered through scientific investigations.
- Design and conduct a scientific investigation.
- Use appropriate tools and techniques to gather, analyze and interpret data.
- Develop descriptions, explanations, predictions and models using evidence.
- Think critically and logically to make the relationships between evidence and explanations.
- Recognize and analyze alternative explanations and predictions.
- Communicate scientific procedures and explanations.
- Use mathematics in all aspects of science inquiry.

PHYSICAL SCIENCES

Properties and Changes of Properties in Matter

- A substance has characteristic properties, such as density, a boiling point, and solubility, all of which are independent of the amount of the sample. A mixture of substances often can be separated into the original substances using one of more of the characteristic properties.
- Substances react chemically in characteristic ways with other substances to form new substances (compounds) with different characteristic properties. In chemical reactions, the total mass is conserved. Substances are often placed in categories or groups if they react in similar ways; metals is an example of such a group.
- Chemical elements do not break down during normal laboratory reactions involving such treatments as heating, exposure to electric current, or reaction with acids. There are more than 100 known elements that combine in a multitude of ways to produce compounds, which account for the living and nonliving substances that we encounter.

Transfer of Energy

- Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sound, nuclei, and the nature of a chemical. Energy is transferred in many ways.
- Heat moves in predictable ways, flowing from warmer objects to cooler ones, until both reach the same temperature.
- In most chemical and nuclear reactions, energy is transferred into or out of a system. Heat, light, mechanical motion, or electricity might all be involved in such transfers.

Conservation of Energy and the Increase in Disorder

- The total energy of the universe is constant. Energy can be transferred by collisions in chemical and nuclear reactions, by light waves and other radiations, and in many other ways. However, it can never be destroyed. As these transfers occur, the matter involved becomes steadily less ordered.

- All energy is considered to be either kinetic energy, which is the energy of motion; potential energy, which depends on relative position; or energy contained by a field, such as electromagnetic waves.
- Heat consists of random motion and the vibrations of atoms, molecules, and ions. The higher the temperature, the greater the atomic or molecular motion.

Motions and Force

- The motion of an object can be described by its position, direction of motion, and speed. That motion can be measured and represented on a graph.
- An object that is not being subjected to a force will continue to move at a constant speed and in a straight line.
- If more than one force acts on an object along a straight line, then the forces will reinforce or cancel one another, depending on their direction and magnitude. Unbalanced forces will cause changes in the speed or direction of an object's motion.

HISTORY AND NATURE OF SCIENCE

Science as a Human Endeavor

- Women and men of various social and ethnic backgrounds-and with diverse interests, talents, qualities and motivations-engage in the activities of science, engineering, and related fields such as the health professions. Some scientists work in teams, and some work alone, but all communicate extensively with others.
- Science requires different abilities depending on such factors as the field of study and type of inquiry. Science is very much a human endeavor, and the work of science relies on basic human qualities, such as reasoning, insight, energy, skill and creativity-as well as on scientific habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.

Nature of Science

- Scientists formulate and test their explanations of nature using observation, experiments, and theoretical and mathematical models. Although all scientific ideas are tentative and subject to change and improvement of principal, for most major ideas in science, there is much experimental and observational confirmation. Those ideas are not likely to change greatly in the future. Scientists do and have changed their ideas about nature when they encounter new experimental evidence that does not match their existing explanations.
- In areas where active research is being pursued and in which there is not a great deal of experimental or observational evidence and understanding, it is normal for scientists to differ with one another about the interpretation of the evidence or theory being considered. Different scientists might publish conflicting experimental results or might draw different conclusions from the same data. Ideally scientists acknowledge such conflict and work towards finding evidence that will resolve their disagreement.
- It is part of scientific inquiry to evaluate the results of scientific investigations, experiments, observations, theoretical models, and the explanations proposed by other scientists. Evaluation includes reviewing the experimental procedures, examining the evidence, identifying faulty reasoning, pointing out statements that go beyond the evidence, and suggesting alternative explanations for the same observations. Although scientists may disagree about explanations of phenomena, about interpretations of data, or about the value of rival theories, they do agree that questioning, response to criticism, and open communication are integral to the process of science. As scientific knowledge evolves, major disagreements are eventually resolved through such interactions between scientists.

History of Science

- Many individuals have contributed to the traditions of science. Studying some of these individuals provide further understanding of scientific inquiry, science as a human endeavor, the nature of science and the relationship between science and society.

NGSS (NEXT GENERATION SCIENCE STANDARDS)

DISCIPLINARY CORE CONCEPTS

MATTER AND ITS INTERACTIONS

Structure and Properties of Matter

- Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon; the effects of air on larger particles or objects.
- The amount of matter is conserved when it changes from, even in transitions in which it seems to vanish.

Chemical Reactions

- When two or more different substances are mixed, a new substance with different properties may be formed.
- No matter what reaction or change in properties occur; the Toal weight of the substance does not change.

ENERGY

Energy in Chemical Processes and Everyday Life

- The energy released from food was once energy from the sun that was captured by plants in the chemical process that forms plant matter.

Organization for Matter and Energy Flow in Organisms

- Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion.

SCIENCE AND ENGINEERING PRACTICES

Planning and Carrying Out Investigations

- Conduct and investigations collaboratively to produce data to serve as the basis for evidence, using fair tests in which variable are controlled and the number of trials considered.
- Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.

Using Mathematics and Computational Thinking

- Measure and graph quantities such as weight to address scientific and engineering questions and problems.

Engaging in Argument from Evidence

- Support an argument with evidence, data, or a model.

CROSSCUTTING CONCEPTS

Cause and Effect

- Cause and effect relationships are routinely identified, tested and used to explain change.

Scale, Proportion, and Quantity

- Natural objects exist from he very small to the immensely large.
- Standard units are used to measure and describe physical quantities such as weight, time, temperature and volume.

Energy and Matter

- Energy can be transferred in various ways and between objects.
- Matter is transported into, out of, and within systems.

Systems and System Models

- A system can be describes in terms of its components and their interactions.

TECHNOLOGY

NSES (NATIONAL SCIENCE EDUCATION STANDARDS)

SCIENCE AND TECHNOLOGY

Understandings about Science and Technology

- Scientific inquiry and technological design have similarities and differences. Scientists propose explanations for questions about the natural world, and engineers propose solutions relating to human problems, needs and aspirations. Technological solutions are temporary; technologies exist within nature and so they cannot contravene physical or biological principles; technological solutions have side effects; and technologies cost, carry risks and provide benefits.
- Many different people in different cultures have made and continue to make contributions to science and technology.
- Science and technology are reciprocal. Science helps drive technology, as it addresses the questions that demand more sophisticated instruments and provides principles for better instrumentation and technique. Technology is essential to science, because it provides instruments and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size and speed. Technology also provides tools for investigation, inquiry and analysis.
- Perfectly designed solutions do not exist. All technological solutions have trade-offs, such as safety, cost, efficiency and appearance. Engineers often build in back-up systems to provide safety. Risk is part of living in a highly technological world. Reducing risks often results in new technology.
- Technological designs have constraints. Some constraints are unavoidable, for example, properties of materials, or effects of weather and friction; other constraints limit choices in the design, for example, environmental protections, human safety and aesthetics.
- Technological solutions have intended benefits and unintended consequences. Some consequences can be predicted, others cannot.

SCIENCE IN PERSONAL AND SOCIETAL PERSPECTIVES

Science and Technology in Society

- Technology influences society through its products and processes. Technology influences the quality of life and the ways people act and interact. Technology changes are often accompanied by social, political, and economic changes that can be beneficial or detrimental to individuals and to society. Social needs, attitudes, and values influence the direction of technological development.

- Science and technology have advanced through contributions of many different people in different cultures, at different times in history.
- Science and technology have contributed enormously to economic growth and productivity among societies and groups within societies. Scientists and engineers work in many different settings, including colleges and universities, businesses and industries, specific research institutes, and government agencies.

NGSS (NEXT GENERATION SCIENCE STANDARDS)

CROSSCUTTING CONCEPTS

Influence of Engineering, Technology, and Science on Society and the Natural World

- People's needs and wants change over time, as do their demands for new and improved technologies.

ISTE (INTERNATIONAL SOCIETY FOR TECHNOLOGY IN EDUCATION STANDARDS)

CRITICAL THINKING, PROBLEM SOLVING, AND DECISION MAKING

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

- Identify and define authentic problems and significant questions for investigations.
- Plan and manage activities to develop a solution or complete a project.
- Collect and analyze data to identify solutions and/or make informed decisions.
- Use multiple processes and divers perspectives to explore alternative solutions.

TECHNOLOGY OPERATIONS AND CONCEPTS

Students demonstrate a sound understanding of technology concepts, systems and operations.

- Understand and use technology systems.
- Select and use applications effectively and productively.
- Troubleshoot systems and applications.
- Transfer current knowledge to learning of new technologies.

ENGINEERING

NSES (NATIONAL SCIENCE EDUCATION STANDARDS)

SCIENCE AND TECHNOLOGY

Abilities of Technological Design

- Identify appropriate problems for technological design.

- Design a solution or product.
- Implement a Proposed Design
- Evaluate completed technological designs or products.
- Communicate the process of technological design.

NGSS (NEXT GENERATION SCIENCE STANDARDS)

DISCIPLINARY CORE CONCEPTS

ENGINEERING DESIGN

Defining and Delimiting Engineering Problems

- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined be 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.

Developing Possible Solutions

- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigation how well it performs under a range of likely conditions.
- At whatever stages, communication with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.

Optimizing the Design Solution

- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

SCIENCE AND ENGINEERING PRACTICES

Asking Questions and Defining Problems

- Define a simple design problem that can be solved through the development of an object, tool, process, or system and include several criteria for success and constraints on materials, time or cost.

Planning and Carrying Out Investigations

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.

Constructing Explanations and Designing Solutions

- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.

CROSSCUTTING CONCEPTS

Influence of Engineering, Technology, and Science on Society and the Natural World

- Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.

ISTE (INTERNATIONAL SOCIETY FOR TECHNOLOGY IN EDUCATION STANDARDS)

COMMUNICATION AND COLLABORATION

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.

- Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
- Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
- Develop cultural understanding and global awareness by engaging with learners of other cultures.
- Contribute to project teams to produce original works or solve problems.

MATH

NCTM (NATIONAL COUNCIL OF TEACHER OF MATHEMATICS EXPECTATIONS)

CONCEPT STANDARDS AND EXPECTATIONS

NUMBER AND OPERATIONS

- Understand numbers, ways of representing numbers, relationships among numbers and number systems.

MEASUREMENT

- Understand measurable attributes of objects and the unite, systems, processes of measurement.
- Apply appropriate techniques, tools, and formulas to determine measurements.

GEOMETRY

- Specify locations and describe spatial relationships using coordinate geometry and other representational systems.
- Use visualization, spatial reasoning and geometric modeling to solve problems.

DATA ANALYSIS AND PROBABILITY

- Formulate questions that can be address with data and collect, organize and display relevant data to answer them.
- Select and use appropriate statistical method to analyze data.
- Develop and evaluate inferences and predictions that are based on data.

PROCESS STANDARDS

PROBLEM SOLVING

- Build new mathematical knowledge through problem solving.
- Solve problems that arise in mathematics and in other contexts.
- Apply and adapt a variety of appropriate strategies to solve problems.
- Monitor and reflect on the process of mathematical problem solving.

REASONING AND PROOF

- Recognize reasoning and proof as fundamental aspects of mathematics.
- Make and investigate mathematical conjectures
- Develop and evaluate mathematical arguments and proofs.
- Select and use various types of reasoning and methods of proof.

COMMUNICATION

- Organize and consolidate mathematical thinking through communication
- Communicate mathematical thinking coherently and clearly to peers, teachers and others.
- Analyze and evaluate the mathematical thinking and strategies of others.
- Use the language of mathematics to express mathematical ideas precisely.

CONNECTIONS

- Recognize and use connections among mathematical ideas.
- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
- Recognize and apply mathematics in contexts outside of mathematics.

REPRESENTATION

- Create and use representation to organize, record and communicate mathematical ideas.
- Select, apply and translate among mathematical representations to solve problems.
- Uses representation to model and interpret physical, social and mathematical phenomena.

COMMON CORE MATHEMATICS STANDARDS

MATHEMATICAL PRACTICES

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically.

- Attend to precision.
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning.

NUMBER AND OPERATIONS IN BASE TEN

Understand the place value system.

- Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the places to its right and 1/10 of what it represents in the place to the left.
- Read, write and compare decimals to the thousandths.
- Use place value understanding to round decimals to any place.

NUMBER AND OPERATIONS-FRACTIONS

Apply and extend previous understandings of multiplication and division to multiply and divide fractions.

- Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction. (Area of a rectangle with fractional sides).

MEASUREMENT AND DATA

Represent and interpret data.

Geometric Measurement: Understand concepts of volume and relate volume to multiplication and addition.

- Recognize volume as an attribute of solid figures and understand concepts of volume measurement.
- Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft. And improvise units.
- Relate volume to the operations of multiplication and addition and solve real-world and mathematical problems involving volume.

GEOMETRY

Graph point on the coordinate plane to solve real-world and mathematical problems.

- Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x-axis and x-coordinate, y-axis and y-coordinate).
- Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.

Core	Sub-Categories	Approved Lessons	Time (minutes)	# of Objectives	Objectives Met				STARBASE KEY CONCEPTS
					1	2	3	4	
1. Science	A. Science Fundamentals	Creating and Building Molecular Models	60	4	●				Structure of Matter, Periodic Table of Elements, Chemical Formula
		Energy Explorations	See Activity			●			Potential Energy, Kinetic Energy, Transfer of Energy, Conservation of Energy
		States of Matter Experiments	See Activity				●		Physical Change, Matter, States of Matter, Kinetic Energy
		Physical and Chemical Changes Experiments	See Activity					●	Chemical Change, Physical Change, Matter, States of Matter, Transfer of Energy, Chemical Reactions, Standard Tools and Units of Measurement
		Double Bubble Trouble	45-60				●	●	Chemical Change, Physical Change, Matter, States of Matter, Transfer of Energy, Chemical Reactions, Standard Tools and Units of Measurement
	B. Characteristic Properties	Introduction to Fluid Mechanics (Parent)	10-20	2					Parent LP must be followed with an Approved Appendix
		A. Fluid Characteristics	40-50		●	●			Characteristic Properties of Matter, Fluid Mechanics, Standard Tools and Units of Measurement
		B. Buoyancy Activities	40			●			Characteristic Properties of Matter, Fluid Mechanics, Force
		Chromatography	60			●			Characteristic Properties of Matter, Polar Molecules
		Characteristic Properties	30			●			Characteristic Properties of Matter
		What's the Solution	15			●			Characteristic Properties of Matter
	C. Motion & Force	Introduction to Motion & Force (Parent)	10-20	3					Parent LP must be followed with an Approved Appendix
		A. Newton's Activities	See Activity		●	●	●		Newton's Laws of Motion, Standard Tools and Units of Measurement, Variable
		B. CO_2 Rockets Dragsters	45-60		●	●	●		Rocketry, Newton's Laws of Motion, Standard Tools and Units of Measurement, Variable
		C. Straw Rockets	40-60		●	●	●		Rocketry, Newton's Laws of Motion, Standard Tools and Units of Measurement, Variable
		D. Water Rockets	25-30		●	●	●		Rocketry, Newton's Laws of Motion, Standard Tools and Units of Measurement, Variable
		E. Solid Propellent Rockets	45-60		●	●	●		Rocketry, Newton's Laws of Motion, Standard Tools and Units of Measurement, Variable
	D. Science Explorations	Bernoulli's Principle Experiments	See Activity	1	●				Characteristic Properties of Matter, Fluid Mechanics
		Nanotechnology: Miniscule Matters	60		●				Structure of Matter, Standard Units of Measurement, Characteristic Properties of Matter, Nanotechnology
		Introduction to Circuitry (Parent)	??						Activity In development
		A. littleBits of Energy	45-60		●				Circuitry, Structure of Matter, Electricity, Engineering Design Process

APPENDIX B: STARBASE Curriculum-at-a-Glance Planner

Core	Sub-Categories	Approved Lessons	Time (minutes)	# of Objectives	Objectives Met 1	2	3	4	STARBASE KEY CONCEPTS
1. Science	D. Science Explorations	*B. STARBITS Simple Circuits*	??	1	●				Activity In development
		Small Will Help All	60-75		●				Engineering Design Process, Standard Tools and Units of Measurement, Characteristic Properties of Matter, Structure of Matter
		Introduction to Navigation and Mapping (Parent)	10-15						Parent LP must be followed with an Approved Appendix
		A. Top Secret Mission	45		●				Geographic Coordinate Systems, Navigation Instruments, Standard Tools and Units of Measurement, Map Fundamentals
		B. Search and Rescue on the Big Island of HI	45-60		●				Geographic Coordinate Systems, Navigation Instruments, Standard Tools and Units of Measurement, Map Fundamentals
		C. Global Positioning Systems	See Activity		●				Geographic Coordinate Systems, Navigation Instruments, Geocaching, Map Fundamentals
2. Technology	A. Applying Technology	Coding the Road	45-60	2	●	●			Robot, Robotics Programming, Coding, Geometry
		Guided Coding Experience	30-40						Coding
		Introduction to Robotics (Parent)	30						Parent LP must be followed with an Approved Appendix
		A: Programming Logic and Math Reasoning	50		●	●			Robot, Robotics Programming , Standard Tools and Units of Measurement.
		B: Robotics Challenge Activities	See Activity		●	●			Robot, Robotics Programming, Standard Tools and Units of Measurement, Geometry
		C. Robo Loops	50		●	●			Robot, Robotics Programming, Standard Tools and Units of Measurement, Engineering Design Process,
		Introduction to Simulation (Parent)	10-15						Activity In development
		A. *Simulation--Imitating Life*			●	●			Activity In development
		Introduction to Renewable Resources	--						Activity In development
		A. Wind Energy			●	●			Activity In development
		B. Fuel Cells			●	●			Activity In development
		C. Solar Energy			●	●			Activity In development
3. Engineering	A. Engineering Design Process	Introduction to the Engineering Design Process (Parent)	10-15	2					Parent LP must be followed with an Approved Appendix
		A. Eggbert	40-60		●	●			Engineering Design Process, Newton's Laws of Motion, Force, Potential and Kinetic Energy, Mathematical Operations, Standard Tools and Units of Measurement
		B. Operation Bridge Quest	60		●	●			Engineering Design Process

Core	Sub-Categories	Approved Lessons	Time (minutes)	# of Objectives	Objectives Met				STARBASE KEY CONCEPTS
					1	2	3	4	
3. Engineering	A. Engineering Design Process	C. Contraption Action!	45-60	2	●	●			Engineering Design Process, Potential Energy, Kinetic Energy, Transformation of Energy, Conservation of Energy
		D. Sphero Solutions	50-60		●	●			Engineering Design Process, Robotic Programming, Coding, Standard Tools and Units of Measurement, Friction, Characteristic Properties of Matter
	B. 3-D Computer Aided Design	DoD Mandatory PTC Modules	180-240	4	●	●	●	●	Computer Aided Design, Engineering Drawing, Geometry, Standard Tools and Units of Measurement
4. Mathematics	A. Number and Number Relationships	Figure That	20	1	●				Numerical Representation, Mathematical Operations, Graphing
		Finding the Percentage	15		●				Numerical Representation, Mathematical Operations, Standard Tools and Units of Measurement, Characteristic Properties of Matter
		Fingerprint Analysis	45		●				Numerical Representation, Graphing, Standard Tools and Units of Measurement, Mathematical Operations, Biometrics
		Eggbert Extension Activities	See Activity		●				Numerical Representation, Mathematical Operations, Standard Tools and Units of Measurement, Graphing
		Atmospheric Ratios	10-15		●				Numerical Representation, Graphing, Structure of Matter, Characteristic Properties of Matter
		My Ratio Is Sinking	30		●				Characteristic Properties of Matter, Standard Tools and Units of Measurement, Numerical Representation, Mathematical Operations
	B. Measurement	Basic Measurement - Length*	10-30	3	●				Standard Tools and Units of Measurement, Mathematical Operations
		Basic Measurement - Liquid Volume*	10-30			●			Standard Tools and Units of Measurement
		Basic Measurement - Mass*	10-30				●		Standard Tools and Units of Measurement
		Engineering Measurement Training	20-30		●		●		Standard Tools and Units of Measurement, Mathematical Operations
		Pop Goes the Fizz	45		●	●	●		Standard Tools and Units of Measurement, Graphing
		STEM Time Capsule	45		●				Standard Tools and Units of Measurement, Geometry, Mathematical Operations
	C. Geometry	Basic Geometry		1	●				Activity In development
		What's My Angle	60		●				Geometry, Rocketry, Newton's Laws of Motion, Graphing, Mathematical Operations,
		What's Up Dock	30-45		●				Geometry, Standard Tools and Units of Measurement, Mathematical Operations

Core	Sub-Categories	Approved Lessons	Time (minutes)	# of Objectives	Objectives Met				STARBASE KEY CONCEPTS
					1	2	3	4	
4. Mathematics	C. Geometry	Fly on the Ceiling	45	1	●				Geometry
		Robo Putt-Putt	45-55		●				Geometry, Robotic Programming, Standards Tools and Units of Measurement
		Does Your Robot Measure Up?	45		●				Geometry, Mathematical Operations, Engineering Drawing, Standard Tools and Units of Measurement,
	D. Data Analysis	Basic Graphing*	15	3	●	●	●		Graphing
		Warm Ups and Cool Downs	15		●	●	●		Graphing, Physical Change, Chemical Change, Variables, Standard Tools and Units of Measurement, Chemical Reactions
		Rocket Launch	45-50		●	●	●		Graphing, Rocketry, Variables, Newton's Laws of Motion, Force
5. STEM Careers	A. STEM Careers on Military Facilities	No Lessons to Approve (Site-Specific)	50-60	1					N/A
	B. Personal Investigations	No Lessons to Approve (Site-Specific)	50-60	1					N/A

* Mandatory: This lesson and the chosen hands-on activity are required as an introduction to teach this concept.