SCIENCE 3D

WEST COAST WHITE SHARK

SCIENCE PERFORMANCE EXPECTATIONS AND DISCIPLINARY CORE IDEAS

In the Middle School Mission, students will address the general topics below. For a complete list of NGSS standards covered in each segment of the mission, continue reading after the general standards. *Note: Be sure to complete the **Mission Reader** and **Mission Research** before viewing the full **Mission Video**. Explore How to Use Science 3D to get suggestions on how to pace the mission and options for the order of activities. Math and Language Arts standards will be added shortly.*

- In the **Mission Reader**, *West Coast White Shark*, students will learn about structure and function, the geological time scale and change through time, conductors and insulators, human impacts on the environment, and how scientists, engineers, and communities solve environmental problems. They will also explore energy, technology, waves, and digital and analog signals.
- During **Mission Research**, students will investigate the geological time scale and change through time using the fossil record of sharks. They will also explore continental drift. Using fossils, they will test a prediction they make about the relationship between the extinct Megalodon and modern white sharks. An additional, optional activity allows students to explore natural selection and relatedness using traits in modern day species.
- In the **Science Mission**, students will explore how gillnets, and a gillnet ban, have affected white shark populations in California. Then, they will determine if genetic material in the environment (eDNA) can be used to detect the presence of white sharks. Finally, they will investigate how the warm water from a power plant affects round stingray populations and, in turn, how stingray populations might affect the number of young white sharks in the area.
- In the **STEM Project**, students will explore careers in science, engineering, and communication that help teams like the Shark Lab study and solve environmental challenges. An additional (or alternative) project allows students to explore the physics of waves using technology designed by the Shark Lab.
- The **Explore Your Backyard** activity has students investigate how people solve environmental problems in their local communities.

SCIENCE/ENGINEERING AND DESIGN DISCIPLINARY CORE IDEAS AND PERFORMANCE EXPECTATIONS

MISSION READER

MS-LS1-4	Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants.
LS1.B	Growth and development of organisms: plant and animal reproduction and behavior.
MS-LS2-1	Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
LS2.A	Interdependent relationships in ecosystems: dependence on environment and may compete; resource limitation on organisms and populations.
MS-LS2-2	Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
LS2.A	Interdependent relationships in ecosystems: predation, mutualism, interactions similar across ecosystems.
MS-LS2-4	Construct and argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
LS2.C	Ecosystem dynamics, functioning and resilience: change through time possible.
MS-LS2-5	Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
LS4.D	Biodiversity and humans.
ESS1.C	History of Earth: geological time scale used to organize history.
ESS3.A	Natural Resources.
MS-ESS3-3	Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
ESS3.C	Human impacts on Earth systems.
PS3.A	Definitions of energy: kinetic energy.
PS3.A	Definitions of energy: potential energy.
PS3.B	Conservation of energy and energy transfer: energy flows from hot to cold.
ETS1.A	Defining and delimiting engineering problems: criteria and constraints.
PS4.A	Wave properties: characteristics. Focus is more on the ways waves are used in marine science.
PS4.B	Electromagnetic radiation: light.
MS-PS4-3	Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.
PS4.C	Information technologies and Instrumentation.

*ELA and Math standards to come

MISSION RESEARCH

MS-LS4-1	Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.
LS4.A	Evidence of common ancestry and diversity: collection of fossils and placement is know from position and dating known as the fossil record; it documents existence, diversity, extinction.
MS-LS4-2	Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and modern and fossil organisms to infer evolutionary relationships
LS4.A	Evidence of common ancestry and diversity: anatomical similarities and differences between fossils and modern taxa allow evolutionary history reconstruction.
ESS1.C	History of Earth: geological time scale used to organize history.
ESS1.B	Plate tectonics and large-scale system interactions: supported by rocks and fossils.
ESS1.C	The history of planet Earth: tectonics.

SCIENCE MISSION

MS-LS1-4	Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants.
MS-LS2-1	Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
MS-LS2-2	Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
LS2.A	Interdependent relationships in ecosystems: predation, mutualism, interactions similar across ecosystems.
MS-LS2-4	Construct and argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
LS2.C	Ecosystem dynamics, functioning and resilience: change through time possible.
MS-LS2-5	Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
LS4.D	Biodiversity and humans.
MS-ESS3-3	Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
ESS3.C	Human impacts on Earth systems.
MS-ESS3-4	Construct an argument supported by evidence for how increases in human population and per capita consumption of natural resources impact Earth's systems. The focus is on human impacts on the populations of white sharks and stingrays rather than on Earth systems. Also, per capita consumption is not explicitly considered, but population growth in California is graphed and the possible impact of a growing population is considered. An extension could help students explore per capita consumption.
ESS3.C	Human impacts on Earth systems: link to population size and need for solutions. The focus is on human impacts on the populations of white sharks and stingrays rather than on Earth systems. Also, per capita consumption is not explicitly considered, but population growth in California is graphed and the possible impact of a growing population is considered. An extension could help students explore per capita consumption.
ETS1.B	Developing possible solutions: solutions need to be tested and modified.

STEM PROJECT

ETS1.B	Developing possible solutions: solutions need to be tested and modified. The following standards are addressed in the suggested extend the lesson. The primary focus of the STEM Project is careers and building teams of scientists and engineers.
MS-PS4-1	Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
PS4.A	Wave properties: characteristics.
PS4.A	Wave properties: sound must go through a medium.

EXPLORE YOUR BACKYARD

MS-LS2-4	Construct and argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
LS4.D	Biodiversity and humans.
MS-ESS3-3	Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
ESS3.C	Human impacts on Earth systems.

*ELA and Math standards to come

MS-ESS3-4	Construct an argument supported by evidence for how increases in human population and per capita consumption of natural resources impact Earth's systems. The degree to which this standard is covered depends on the direction of the local investigation. The focus will likely be on local ecosystems and organisms but could include a focus on larger Earth systems and climate change. Also, per capita consumption is not explicitly considered, but could be discussed in the context of the exploration.
ESS3.C	Human impacts on Earth systems: link to population size and need for solutions. Links to population size are not explicit in the activity but could be made so.
ETS1.B	Developing possible solutions: solutions need to be tested and modified.

CROSS CUTTING CONCEPTS

Patterns: Reader, Mission Research, Science Mission, STEM Project, Explore Your Backyard
Cause and effect: Mechanisms and Predictions Reader, Mission Research, Science Mission, STEM Project, Explore Your Backyard
Scale, proportion and quantity: Reader, Mission Research, Science Mission, STEM Project, Explore Your Backyard
System and system models: Reader, Mission Research, Science Mission, STEM Project, Explore Your Backyard
Energy and matter: Reader, Science Mission, STEM Project
Structure and function: Reader, Mission Research
Stability and change: Reader, Mission Research, Science Mission, Explore Your Backyard

CONNECTION TO ENGINEERING, TECHNOLOGY AND APPLICATIONS OF SCIENCE

Interdependence of science, engineering and technology: Reader, Science Mission, STEM Project, Explore Your Backyard
Influence of science, engineering and technology on society and the natural world: Reader, STEM Project, Explore Your Backyard

CONNECTION TO NATURE OF SCIENCE

Scientific investigations use a variety of methods: Reader, Science Mission, STEM Project, Explore Your Backyard
Scientific knowledge is based on empirical evidence: Reader, Mission Research, Science Mission, STEM Project, Explore Your Backyard
Scientific knowledge is open to revision in light of new evidence: Reader, Mission Research, Science Mission, Explore Your Backyard
Science models, laws, mechanisms and theories explain natural phenomena: Reader, Mission Research, Science Mission, STEM Project, Explore Your Backyard
Science is a way of knowing: Reader, Mission Research, Science Mission, STEM Project, Explore Your Backyard
Scientific knowledge assumes an order and consistency in natural systems: Reader, Mission Research, Science Mission, STEM Project, Explore Your Backyard
Science is a human endeavor: Reader, Mission Research, Science Mission, STEM Project, Explore Your Backyard
Science addresses questions about the natural and material world: Reader, Mission Research, Science Mission, STEM Project, Explore Your Backyard

SCIENCE AND ENGINEERING PRACTICES

Asking questions and defining: Reader, Mission Research, Science Mission, STEM Project, Explore Your Backyard
Developing and using models: Reader, Mission Research, Science Mission, STEM Project, Explore Your Backyard
Planning and carrying out investigations: Reader, Mission Research, Science Mission, STEM Project
Analyzing and interpreting data: Mission Research, Science Mission, STEM Project
Using mathematics and computational thinking: Science Mission, STEM Project
Constructing explanations and designing solutions: Mission Research, Science Mission, STEM Project, Explore Your Backyard
Engaging in argument from evidence: Mission Research, Science Mission, STEM Project, Explore Your Backyard
Obtaining, evaluating and communicating information: Mission Research, Science Mission, STEM Project, Explore Your Backyard

*ELA and Math standards to come