



SAN FRANCISCO MARITIME NATIONAL PARK ASSOCIATION

Hyde Street Pier Science and Living History Programs

This document summarizes how the education programs offered by the San Francisco Maritime National Park Association address CA content-area standards.

The education programs at Hyde Street Pier provide a unique opportunity to bring the many strands of the content standards together in engaging, hands-on experiences. With the help of our crew of professional experiential education instructors, the students are persuaded to imagine the colorful world of the famous Barbary Coast waterfront in the mid-19th to early 20th century. As students are transported to the hard but adventurous life of a sailor, gold prospector, or merchant among the historic ships at San Francisco Maritime National Historic Park, they learn about the challenges posed by life in a different era. The programs integrate social studies, math, science, language arts, and visual and performing arts. Whether it's the physics of how a block-and-tackle works or the music and poetry of sea chanteys, the core themes of the content standards are presented in a lively and imaginative way.

Additional Classroom Activities

The educators on Hyde Street Pier work with teachers to make each group's experience the best it can be. This can include providing practice materials related to the AOS activities that can be used in-class to prepare for the students' eventual visit to the Pier. It can also include a possible early visit and instruction from an AOS educator. For suggested pre and post-visit lesson plans and activities, visit our [website](#). The Hyde Street Pier education programs, in conjunction with in-class lessons and activities, form a complete system addressing CA content standards.

Explorers STEM Sailing Program on *Alma*

Take your class on a voyage into history aboard the *Alma*! Built in 1891, the *Alma* is one of the last surviving links to San Francisco's maritime past, is Coast Guard licensed and inspected to carry passengers, and operated by a professional skipper and crew. You will sail the beautiful waters of San Francisco Bay with the exhilaration of the wind at your back, the sun on your face, and the deck of a historic sailing schooner under your feet. With our instructors, students work in small groups and learn to navigate using a magnetic compass, charts, and speed equations. They will also learn the science behind wind, weather, and how they impact the environment of the bay and are used to power the sails. Interspersed with these lessons are chances to actually sail the *Alma* themselves by hoisting the sails and even taking a trick at the helm with *Alma's* captain. Through these activities and experiences, the students learn first-hand what it was like for early explorers and immigrants to travel to the bay by sea.

Meeting and Supporting the Standards Grades 4 and 5: Explorers

Science, Technology, and Engineering

The student activities in the Explorers educational program are especially compatible with 4th and 5th grade California content standards for the STE fields of Earth Systems and Space Systems.

- **4th Grade Earth Systems:** In 4th grade, students are expected to understand processes that shape the earth, especially in relation to plate tectonics and large-scale system interactions (ESS2.B). They must also “generate and compare solutions to reduce the impacts of natural Earth processes on humans” (4-ESS3-2). This is especially important when discussing natural hazards such as earthquakes (ESS3.B). Such natural hazards are the result of natural processes. Students must understand that humans cannot eliminate these hazards but can take steps to reduce their impacts.

During the history station on *Alma* students learn about the history of the San Francisco Bay while sailing through it. This includes analysis of maps of the Bay Area as it developed over time (4-ESS2-2). This analysis and discussion includes changes to topography, especially settlement in mountainous areas and expansion of land and settlement in areas that were once water. This analysis also includes discussion of

what happens when natural disasters, such as earthquakes, hit the area and their varying impact depending on where people had settled.

- **5th Grade Earth Systems:** These discussions also relate to 5th grade Earth System standards. Analysis of historic maps from the first Spanish maps of the Bay Area to modern twentieth century maps demonstrates the huge impact human settlement in the area has had on the water of the bay (5-ESS2-2). As more people settle the area, the bay shrinks. Much of the city of San Francisco itself, as one example, has been built over “reclaimed” land (ESS2.C). This demonstration then leads to discussion of the impacts such human actions has on local environment, ecosystems, and general earth systems (ESS2.C, 5-ESS3-1).
- **Space Systems:** In 5th grade, students must learn about space systems, especially how spatial bodies like the Earth, Sun, and Moon interact with each other. This includes understanding that the gravitational force exerted by Earth on objects is directed down toward the planet’s center (5-PS2-1, PS2.B). They must also understand that all objects in the solar system have similar gravitational pulls and therefore have impacts on each other. Specifically, the earth rotates around the sun, the moon rotates around the earth, and these rotations and gravitational interactions cause observable patterns (ESS1.B).

During the Explorers program’s science station, the students learn how the tides work. Through discussion and models (5-ESS1-2) they learn that they are created by the forces of the moon and the earth interacting with each other. These tides create powerful currents in the Bay, knowledge of which was essential for the success and survival of *Alma*’s sailors.

During the science activities, students also learn about earth systems and how they interact to create the wind necessary to propel the boat they are sailing on. Hot air over the inland areas rises creating a vacuum which pulls ocean air in from over the Pacific and blows over the bay as wind. Students engage with these concepts through visual aids and hands-on demonstration (5-ESS2-1, ESS2.C).

Mathematics

The following is based on the California Common Core State Standards (<https://www.cde.ca.gov/be/st/ss/documents/ccssmathstandardaug2013.pdf>). These standards list eight base mathematical practices that are encouraged in common core:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

The Explorers program supports each of these practices through direct, real world problem solving experience. As the students sail aboard the historic scow-schooner *Alma*, the students rotate through four different stations: science, navigation, history, and helm. Every station has activities that require the students to work together strategically. They must reason out problems as a team and persevere through complications, mistake, and missteps. Many of the steps of these activities require direct application of mathematical models and tools, including Algebra (4.OA), Number and Operations (4.NBT, 4.NF), Measurement and Data (4.MD), and Geometry (4.G).

4th Grade

- **Word Problems with Measurements:** In the 4th grade, students must solve multistep word problems using the four operations and whole numbers (4.OA, 4.OA.3). These word problems must involve “measurement and conversion of measurements from a larger unit to a smaller unit” (4.MD) including distances and intervals of times (4.MD.2). They must competently represent and interpret measurement data including the use of fractions when necessary (4.MD.4, 4.NBT, 4.NF).

While sailing on *Alma*, the students go to a science station where they learn all about the natural sciences of the San Francisco Bay while they sail through it. This includes, especially, lessons and activities involving the need of wind to propel a sailing boat like the *Alma*, and where and why this wind occurs on the bay. Students also become sailors themselves and learn the science and mathematics

behind how sailors from *Alma's* time determined their speed. This includes numerous examples and mathematical equations that the students learn and work through in order to understand the process. For example, prior to the 1500s, sailors would note how long it took a piece of debris to float past their boat or ship. *Alma* is 80 feet long, so if it takes debris 4 seconds to pass the whole boat, then you are moving 80 feet every 4 seconds, or 20ft/sec. This would then need to be converted into nautical miles, or "knots." This entire conversion process is represented by the equation:

$$\text{Speed (knots)} = \text{Distance (nautical miles)} / \text{Time (hours)}$$

$$\text{Or: } S = D / T$$

After working through how and why the calculations work, the students then put their knowledge into practice. They work together to measure how fast the *Alma* is currently going by using a "chip log," which was a more precise system invented after the 1500s and used during *Alma's* time. Put simply, a wooden chip attached to a spooled line is thrown into the water and it is timed how long it takes for the spool to run out. If the *Alma* were going just 1 knot, then it would take exactly 60 seconds for the spool to run out. The students throw the chip into the water, measure the distance and time, and then calculate how fast the *Alma* is going. They do this multiple times in order to be sure there is an accurate proper reading.

- **Angles and Shapes:** 4th grade students must also "recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement" (4.MD.5). They must be able to "sketch angles of specified measure" and measure such angles using mathematical tools like a protractor (4.MD.6). These are best represented by real-world problems and mathematical diagrams where the students can find unknown angles using addition and subtraction (4.MD.7). Students must then be able to identify shapes based on their lines and angles (4.G.1-3).

During the Explorers program the students learn how to navigate as sailors from *Alma's* time would have navigated. For this activity, the students use a number of tools, including a nautical chart, bearing compass, and parallel rule. They use LOPs (Lines of Positions) based on landmarks, each ideally 120 degrees apart. These lines, their crossing, the angles, and the shapes they make are how they determine their position on the nautical chart. The students work together to obtain their positioning and take multiple bearings from different landmarks and as the boat travels to compare the differences.

5th Grade

- **Word Problems with Multiplication and Division:** In 5th grade, students must “apply and extend understandings of multiplication and division to multiply and divide fractions” (5.NF). As always, these are best represented with real-world problems “by using visual fraction models or equations to represent the problem” (5.NF.6). They must also be able to divide unit fractions by whole numbers and vice versa (5.NF.7, 5.NF.7.C).

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After working through how and why the calculations work, the students then put their knowledge into practice. They work together to measure how fast the *Alma* is currently going by using a “chip log,” which was a more precise system invented after the 1500s and used during *Alma*'s time. Put simply, a wooden chip attached to a spooled line is thrown into the water and it is timed how long it takes for the spool to run out. If the *Alma* were going just 1 knot, then it would take exactly 60 seconds for the spool to run out. The students throw the chip into the water, then measure the distance, time, and calculate how fast the *Alma* is going. They do this multiple times, in order to be sure there is a proper reading.

- **Geometry:** 5th grade geometry revolves around the students learning “points on the coordinate plane to solve real-world and mathematical problems.” Students must learn about “perpendicular number lines,” or axis (5.G.1) and be able to graph points in order to solve real-world problems (5.G.2).

Understanding angles, lines, and being able to represent them in these ways were essential to a life at sea on sailing boats like *Alma*. For the Explorers navigation activity, the students learn why as they learn how to navigate as sailors from *Alma's* time would have navigated. For this activity, the students use a number of tools, including a nautical chart, bearing compass, and parallel rule. They use LOPs (Lines of Positions) based on landmarks, each ideally 120 degrees apart. These lines, their crossing, the angles, and the shapes they make are how they determine their position on the nautical chart. The students work together to obtain their positioning and take multiple bearings from different landmarks and as the boat travels to compare the differences.

Summary of 4th and 5th Grade Content Standards for Explorers

Standards Directly Addressed

Standard	Standard Language
4.OA	Operations and Algebraic Thinking : Use the four operations with whole numbers to solve problems.
4.OA.3	Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.
4.MD	Measurement and Data: Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.
4.MD.2	Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.
4.MD.4	Representing and interpreting measurement data including the use of fractions when necessary.
4.NBT	Numbers and Operations in Base Ten.
4-5.NF	Numbers and Operations including fractions.
4.MD.5	Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement.
4.MD.7	Using real world problems and mathematical diagrams to find unknown angles using additions and subtraction.

4.G.1-3	Identifying lines and angles, and classify shapes by properties of their lines and angles.
5.NF.6	Solve real-world problems involving multiplication of fractions and mixed numbers.
5.NF.7	Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions.
5.NF.7.C	Solve real-world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions, e.g., by using visual fraction models and equations to represent the problem.
5.G.1-2	Graph points on the coordinate plane to solve real-world and mathematical problems.
5-ESS2-1	Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
5-PS2-1	Understanding the gravitational forces of Earth acting on an object near Earth's surface pulls that object toward the planet's center.
5-ESS1-2	Developing a model using an example to describe how different "spheres" of Earth interact.
4-ESS2-2	Analyze and interpret data from maps to describe patterns of Earth's features.
5-ESS2-2	Analysis of historic maps and modern twentieth century maps to demonstrates the huge impact human settlement in the area has had on the water of the Bay Area.
HSS4.1	Demonstrate an understanding of the physical and human geographic features that define places and regions in California.
HSS4.2	Describe the social, political, cultural, and economic life and interactions among people of California.
HSS4.3	Explain the economic, social, and political life in Californian History
HSS5.1	Describe the major pre-Columbian settlements, including the cliff dwellers and pueblo people of the desert Southwest, the American Indians of the Pacific Northwest, the nomadic nations of the Great Plains, and the woodland peoples east of the Mississippi River.
HSS5.2	Tracing the routes of early explorers and describe the early explorations of the Americas.
HSS5.8	Tracing the colonization, immigration, and settlement patterns of the American people from 1789 to the mid-1800s, with emphasis on the role of economic incentives.
SL4-8.1-6	Accomplishing objectives given through communication and cooperation, through critical thinking, active listening, problem solving, self-respect, teamwork, and leadership.
L4-8.1-6	Demonstrating command of the conventions of standard English grammar and usage when writing or speaking, using knowledge of language and its conventions when writing, speaking, reading, or listening, and determine or clarify the meaning of unknown and multiple-meaning words and phrases.

Standards Supported

Standard	Standard Language
RL4-8.1-10	Students gain adequate exposure to a range of texts and tasks. Students read increasingly complex texts through the grades.
RI4-8.1-10	Citing evidence, determining central text ideas and word meaning, analyzing how particular sections fit into overall text, tracing authors specific argument or point-of-view, and comparing and contrasting one author’s presentation with that of another.
RF4-8.1-10	Develop students’ understanding and working knowledge of concepts of print, the alphabetic principle, and other basic conventions of the English writing system.
W4-8.1-10	Students gain adequate mastery of a range of skills and applications. Each grade, students should demonstrate increasing sophistication in all aspects of language use, from vocabulary and syntax to the development and organization of ideas, and they should address increasingly demanding content and sources.

Meeting and Supporting the Standards

Middle School (grades 6-8): Explorers

The student activities of the Explorers educational program are compatible especially with middle school (6th - 8th grade) California content standards for the STE fields of Physical Science, Earth, and Space Systems.

- **Space Systems:** In middle school, students must demonstrate understanding of forces and interactions through the construction and presentation of “arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects (MS-PS2-4). This includes developing models of the “Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons (MS-ESS1-1, MS-ESS1-2, ESS1.B, ESS1.A).

During the Explorers program’s science station, the students learn how the tides work. Through discussion and models they learn how tides are created by the forces of the moon, the Earth, and sun interacting with each other (MS-ESS2-4). These tides create powerful currents in the bay, knowledge of which was essential for the success and survival of *Alma* sailors.

- **Weather and Climate:** Students in middle school are also expected to learn about weather and climate. They must “collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions” (MS-ESS2-5, ESS2.C) and “develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates” (MS-ESS2-6, ESS2.D).

Also during the science activities students learn about earth systems and how they interact to create the wind necessary to propel the boat they are sailing on. Hot air over the inland areas rises creating a vacuum which pulls ocean air in from over the Pacific and blows over the bay as wind. Students engage with these concepts through visual aids, maps, satellite images and hands-on demonstration.

- **Climate Change:** And finally, students are expected to discuss global climate change, especially the many “factors that have cause the rise in global temperatures over the past century” (MS-ESS3-5) including human activities (ESS3.D, MS-ESS3-4).

During the history station on *Alma* students learn about the history of the San Francisco Bay while sailing through it. This includes analysis of maps of the Bay Area as it developed over time. This analysis and discussion includes changes to topography, especially settlement in mountainous areas and expansion of land and settlement in areas that were once water. This analysis includes discussion of what happens when natural disasters, such as earthquakes, hit the area and their varying impact depending on where people had settled. These activities strongly support in-class discussions of these very important topics.

Mathematics

The following is based on the California Common Core State Standards (<https://www.cde.ca.gov/be/st/ss/documents/ccssmathstandardaug2013.pdf>). These standards list eight base mathematical practices that are encouraged in common core:

1. Make sense of problems and persevere in solving them.
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5. Use appropriate tools strategically.
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7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

The Explorers program supports each of these practices through direct, real world problem solving experience. As the students sail aboard the historic scow-schooner *Alma*, the students rotate through four different stations: science, navigation, history, and helm. Every station has activities that require the students to work together strategically. They must reason out problems as a team and persevere through complications, mistake, and missteps.

- **In 6th grade**, students must learn to “write, read, and evaluate expressions in which letters stand for numbers” (6.EE, 6.EE.2). These expressions should be used to solve real-world problems (6.EE.6) and “quantitative relationships between dependent and independent variables” (6.EE.9).
- **In 7th grade**, students must “apply and extend previous understandings of operations with fractions” (7.NS) by solving “real-world mathematical problems involving the four operations with rational numbers” (7.NS.3).

While sailing on *Alma*, the students go to a science station where they learn all about the natural sciences of the San Francisco Bay while they sail through it. This includes, especially, lessons and activities involving the need of wind to propel a sailing boat like the *Alma*, and where and why this wind occurs on the Bay. Students also become sailors themselves and learn the science and mathematics behind how sailors from *Alma*’s time determined their speed. This includes numerous examples and mathematical equations that they students learn and work through in order to understand the process. For example, prior to the 1500s, sailors would note how long it took a piece of debris to float past their boat or ship. *Alma* is 80 feet long, so if it takes debris 4 seconds to pass the whole boat, then you are moving 80 feet every 4 seconds, or 20ft/sec. This would then need to be converted into nautical miles, or “knots.” This entire conversion process is represented by the equation:

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which was a more precise system invented after the 1500s and used during Alma’s time. Put simply, a wooden chip attached to a spooled line is thrown into the water and it is timed how long it takes for the spool to run out. If the Alma were going just 1 knot, then it would take exactly 60 seconds for the spool to run out. The students throw the chip into the water, measure the distance and time, and then calculate how fast the Alma is going. They do this multiple times, in order to be sure there is an accurate reading.

- **7th grade geometry** revolves around drawing (freehand, with ruler and protractor, and with technology), constructing, and describing relationships between them. Students should “focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle” (7.G.2, 7.G.5).

For the Explorers navigation activity, the students learn why as they learn how to navigate as sailors from Alma’s time would have navigated. For this activity, the students use a number of tools, including a nautical chart, bearing compass, and parallel rule. They use LOPs (Lines of Positions) based on landmarks, each ideally 120 degrees apart. These lines, their crossing, the angles, and the shapes they make are how they determine their position on the nautical chart. The students work together to obtain their positioning and take multiple bearings from different landmarks and as the boat travels to compare the differences.

Summary of Middle School (6th-8th) Content Standards for Explorers

Standards Directly Addressed

MS-PS2-4	Demonstrate understanding of forces and interactions through the construction and presentation of “arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.
MS-ESS1-1	Utilizing models of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
MS-ESS1-2	Utilizing models of the larger celestial bodies to describe the role of gravity in the motions within galaxies and the solar system.
MS-ESS2-4	Modeling patterns and forces of gravity, along with the energy of the sun, impact the cycling of water through Earth’s systems.

MS-ESS2-5	Collecting data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.
MS-ESS2-6	Understand weather and climate through the development and use of models describing the relationships between the Earth heating, rotation, atmospheric patterns, and oceanic circulation.
HSS7.11	Analyzing political and economic change in the sixteenth, seventeenth, and eighteenth centuries.
HSS8.5	Analyze US Foreign Policy in the early Republic.
HSS8.8	Analyzing the divergent paths of the American people in the West from 1800 to the mid-1800s and the challenges they faced.
SL4-8.1-6	Accomplishing objectives given through communication and cooperation, through critical thinking, active listening, problem solving, self-respect, teamwork, and leadership.
L4-8.1-6	Demonstrating command of the conventions of standard English grammar and usage when writing or speaking, using knowledge of language and its conventions when writing, speaking, reading, or listening, and determine or clarify the meaning of unknown and multiple-meaning words and phrases.

Standards Supported

Standard	Standard Language
4-ESS2-2	Analyze and interpret data from maps to describe patterns of Earth's features.
5-ESS3-1	Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
5-LS2-1	Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
4-ESS3-2	Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.
RL4-8.1-10	Students gain adequate exposure to a range of texts and tasks. Students read increasingly complex texts through the grades.
RI4-8.1-10	Citing evidence, determining central text ideas and word meaning, analyzing how particular sections fit into overall text, tracing authors specific argument or point-of-view, and comparing and contrasting one author's presentation with that of another.
RF4-8.1-10	Develop students' understanding and working knowledge of concepts of print, the alphabetic principle, and other basic conventions of the English writing system.
W4-8.1-10	Students gain adequate mastery of a range of skills and applications. Each grade, students should demonstrate increasing sophistication in all aspects of language use, from vocabulary and syntax to the development and organization of ideas, and they should address increasingly demanding content and sources.