Open Response Questions

1. If Nathaniel Bowditch had been born into vastly different economic, historical, or geographical circumstances, how would his life or contributions have changed?

2. How would Nathaniel's life have been different if he had been able to attend Harvard?

3. Describe how you would feel if you were forced to live away from home at the age of 12, indentured for the next 9 years, and never given an opportunity to go to school with your friends?

4. What do you think are the qualities of a genius? Based on your answer, was Nathaniel Bowditch a genius? Why or why not?

5. If Bowditch had been able to converse with Sir Isaac Newton, how would that discussion have influenced the direction of Nathaniel's life or his con tribution to mathematics and to science?

6. Like Bowditch, how could you explain a problem to someone younger than you, for instance, in elementary school? Select a problem and write down the steps you would take to teach that student. Then, mentor a younger student, correcting your teaching method as you go along so that it works better the next time.

7. Compare your town's population and pattern of growth with that of Salem's during the last two hundred years. What could have caused these patterns? Can you predict future trends? Include immigration patterns and economic factors if possible.

8. Explain in your own words the following quote about Bowditch, *His intuitive mind sought and amassed knowledge, to impart it to the world in more easy forms.*

Glossary

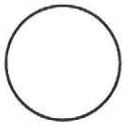
accuracy
exactness; precision

actuary
a statistician who uses probabilities to compute insurance risks and premiums

approximate
very close to

bookkeeper
one who records the accounts and transactions of a business

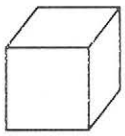
circle
the set of all points in a plane that are a fixed distance from a fixed point (center)



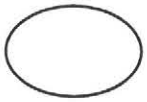
congruent
same size and same shape

consecutive
in a row, one right after the other

cube
a solid (three-dimensional) figure with six congruent, square faces; a number raised to the third power



ellipse
oval

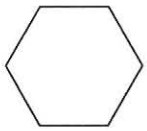


exponent
the power to which a (base) number is raised. In the example below, 3 is the exponent and 5 is the base. 5 is used as a factor 3 times.

$$5^3 = 5 \times 5 \times 5 = 125$$

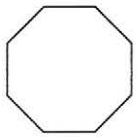
hexagon

a six-sided closed plane figure



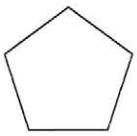
octagon

an eight-sided closed plane figure



pentagon

a five-sided closed figure

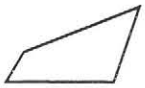


plane

a two-dimensional flat surface---i.e., a surface with length and width, but no thickness

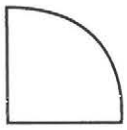
quadrilateral

any four-sided closed plane figure



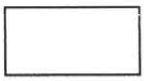
quarter

circle-1/4 of a circle



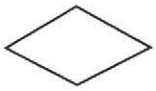
rectangle

a closed plane figure with four equal angles (90°). Opposite sides are equal and parallel.



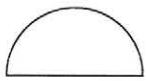
rhombus

a closed plane figure with four equal sides, but not necessarily four equal angles. A rhombus has a diamond shape.



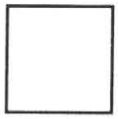
semicircle

1/2 of a circle



square

a closed plane figure with four sides of equal length and four angles of equal measure (90°)



square number

a number which is the result of multiplying another number by itself, and which can be represented by a square arrangement of dots. For example, 25 is a square number because it is the result of multiplying 5 by itself (i.e., 5 x5 = 25) and can be represented by a square arrangement of dots.

supercargo

an officer on a merchant ship who has charge of the goods traded

surveyor

one who measures angles and distance to determine boundaries, area, elevation.

symmetry

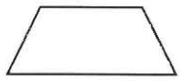
balance; exact correspondence of design and form on opposite sides of a dividing line or around a central point

transaction

any kind of business activity, such as a sale or a purchase, a debit or a credit

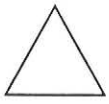
trapezoid

a closed plane figure with four sides, two of which are parallel and two of which are not



triangle

a three-sided closed plane figure



Terms of the Sea

1. **Ash Breeze** – Becalmed. Under this condition, a ship's boats were put out to tow her by rowing. Oars were made of ash wood.

2. **Astrolabe** – A predecessor to the sextant; an instrument for measuring the altitude of celestial bodies. From the Greek word *astrolabeon,* meaning star taking.

3. **Bowditch** – A household word among navigators; a navigation textbook and navigation tables still in use by the U.S. Navy.

4. **Chronometer** – A highly accurate clock used in navigation. Used to determine accurate longitude readings. A British carpenter named John Harrison designed and built the first truly accurate chronometer in the mid-18th century.

5. **East India Company** – An organization set up by Queen Elizabeth in 1600 to trade in India. Given monopolistic power, the company controlled India, acting as the governmental authority for British possessions in the Far East. The "John Company" as it was known, remained in power until 1857 after which it was dissolved by the British government following the disastrous Sepoy Rebellion.

6. **East Indiaman** – A large, heavily armed merchant ship built for the East Indies trade.

7. **Indentured Servant** – A contract for labor for a specified time period.

8. **Letter of Marquée** – a royal license, authorizing a vessel to privateer under a recognized flag.

9. **Lunar** – Term for taking a celestial measurement of the moon when determining longitude.

10. **Magazine** – A special hold on naval and merchant vessels in which ammunition is stowed.

11. **Pitch** – A mixture of tar and other substances used to caulk and preserve the wood and cordage of sailing vessels.

12. **Privateer** – A privately owned vessel of war, furnished with a commission – Letters of Marquée.

13. **Ropewalk** – A place of rope manufacture. Typically a long, narrow building in which rope is twisted to form cordage for sailing ships.

14. **Sail loft** – A place of sail manufacture, typically located on the top floor of warehouses in any port.
15. **Ship chandlery** – The shoreside supermarket for all nautical equipment.
16. **Slaver** – A vessel that transports slaves.
17. **Supercargo** – An officer or a supernumerary on a merchant ship who was in charge of trading – a sea-going merchant.
18. **Typhoon** – A strong tropical storm in the Pacific.

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NATHANIEL BOWDITCH 1773-1838

Abridged Version, To obtain an unabridged version with references contact Susan Bowditch at The House of the Seven Gables.

ORIGINS OF THE BOWDITCH FAMILY IN ENGLAND, 1170-1670

The family name is said to have originated in Chardstock, County Dorset, England in the early 12th century. Bowditch is thought to mean boundary-ditch because the family's holdings and houses began around an ancient pre-historic curved ditch. Ditches were dug by tribes to protect themselves from their neighbors. The curve of the ditch may have inspired the "Bow" in the name.

NATHANIEL BOWDITCH, THE EARLY YEARS, 1773-1784

Nathaniel was born in Salem, the 4th child of Habakkuk and Mary Ingersoll Bowditch. The family moved to Danvers when Nathaniel was two. He and his siblings attended the Dame's School located directly across from his home. Tuition is assumed, and since the family was of humble means it is not known how they afforded the schooling for the children, nor is it known how long or how often the children actually attended school.

At the age of seven, Nathaniel and his family moved back to Salem where life became very difficult financially. His mother was to have favored Nathaniel and was highly influential in molding his character and his high regard for truth above all values.

At the age of seven or eight, Nathaniel and his older brother Hab attended Master Watson's school. He looked forward to school and begged to be given challenging mathematical problems reserved for older students. The master resisted Nathaniel's efforts, but having got Nathaniel's father's permission, decided to give him a problem he was sure he could not solve. When Nathaniel came back the next day with the correct answer, Master Watson accused him of getting someone else to solve the problem. Had not Nathaniel's older brother Hab intervened, Master Watson would have whipped Nathaniel for lying. The bitterness accompanying this incident was felt by Nathaniel for the rest of his life, as much an accusation against his integrity as his mathematical skills.

Due to hard times, in 1783 Nathaniel's father withdrew him from school so that he could help in his cooper's shop. Nathaniel hated leaving school and barrel making did not agree with him due to his health and stature. After two years, his father enrolled him in a bookkeeping course and then inden-

tured Nathaniel to the ship chandlery shop of Ropes and Hodges. During this period Nathaniel's mother died. When Ropes and Hodges went out of business in 1790, Nathaniel continued his apprenticeship with Samuel Curwen Ward, also a ship chandler and grocer.

Nathaniel discovered algebra through an older brother at the age of fourteen. He was highly motivated and excited at the notion of calculating with letters as well as numbers. It was through this method that he was to learn navigation. The basics of navigation were thought to have been taught to him by an English sailor and a local mariner, George Chapman. When the sailor left him to return to England he said, "Nat my boy, go on studying as you do now, and you will be a great man one of these days." Nathaniel never forgot those encouraging words and continued to be self directed, motivated, and a self- taught individual, thus achieving more than the sailor ever could have imagined.

At the age of 15 or 16, Nathaniel constructed an odd barometer and compiled a navigational almanac that identified reference points at sea by fixing a ship's position north or south of the equator. At 17 he decided to learn Latin so that he could read Newton's *Principia*, which dealt with the workings of the universe. By the age of 21 he completed the translation and detected an error in the calculations. This error was noted in correspondence that Nathaniel had with a mathematics professor at Harvard. The letter was discounted as being from a young upstart. Nathaniel later published this error.

By the time he was 19 Nathaniel knew enough about navigation to design and create a quadrant, the most common instrument of navigation for the time. (It is presently in the custody of the Peabody Essex Museum.) At the age of 19 he also constructed a wooden sundial.

Nathaniel created his own college experience by reading what is known today as Salem's Philosophical Library. This scientific library, captured aboard the English ship *Mary* and belonging to Dr. Richard Kirwan, a noted Irish scientist, was acquired by privateers out of Beverly and sold to intellectuals in Salem. These readings provided Nathaniel with an education that far exceeded Harvard College of the day. Nathaniel was also self taught with regard to surveying skills and foreign languages.

NATHANIEL BOWDITCH AS A YOUNG MAN, 1795-1803

For most of the next nine years Bowditch was at sea, engaged in five different voyages.

The voyages:

I. *The Henry,* January 11, 1795-January 11, 1796, to the Isle of Bourbon and Isle of France

II. *The Astrea,* March 15, 1796-May 22, 1797, to Portugal and the Philippines

III. *The Astrea,* August 21, 1798-April 6, 1799, to Spain

IV. *The Astrea,* July 23, 1799-September 15, 1800, to Indonesia and the Philippines

V. *The Putnam,* November 21, 1802-December 25, 1803, to Sumatra

During these voyages Bowditch made notes on slavery and tried his ideas on celestial navigation, thus training crew members to do "lunars." Lunars involved taking three simultaneous sights on the moon and a fixed star , or the sun, and calculating the angular distance between them; then, with reference to a nautical almanac, obtain Greenwich time and hence the exact longitude. Bowditch also spent a great deal of time correcting the book by John Hamilton Moore, *The Practical Navigator.* His extensive journal- writing on these voyages reflected on the cultures of the people and the ports he visited.

Bowditch married Elizabeth Boardman in March 1798, but this union was ill fated as Elizabeth died in October while Bowditch was in Spain.

In May 1799, Bowditch was elected to the American Academy of Arts and Sciences, an important and impressive honor for a self-educated man.

In 1800 Bowditch married Mary Ingersoll, his first cousin. They continued to live with Mrs. Boardman, his first wife's mother, as Elizabeth his first wife and Mary, had been close.

The East India Marine Society was founded in Salem in 1799. All members had to be captains or supercargoes (businessmen) who had traversed the Cape of Good Hope or Cape Horn. Bowditch was asked to be a member. Through this union he was instrumental on insisting that each crew member be provided with a journal. Following each voyage the completed journals were to be available to the Society to aid future voyages. Another requirement of the Society was to bring back art forms plus natural and cultural artifacts representative of the places to which the ships had sailed. (This

enormous collection housed above the Asiatic Bank in Salem eventually became the Peabody and then the Peabody Essex Museum.)

While at sea, Bowditch published *The New American Practical Navigator* in 1802 in both Europe and America. It became the most important book on navigation ever published. It is still published and used today, in revised form, by The United States Navy.

Also in 1802, while windbound in Boston, Bowditch decided to visit Cambridge. By coincidence on this day, commencement exercises were being held at Harvard. As the honorary degrees were being conferred (in Latin) Bowditch thought he heard his name and soon discovered that he had been awarded an Honorary Master of Arts degree. This honor remained till his dying day the most touching and significant of all awards received during his lifetime.

Bowditch finally set sail on *The Putnam* as master and part owner. During this voyage he began translating the latest book on astronomy, *Mécanique Celeste* by Pierre La Place. Though written in French, the translation was a minor challenge, as Bowditch was self taught in Latin, French, Spanish, Portuguese, and German.

Bowditch returned to Salem aboard *The Putnam* on Christmas day under severe fog conditions. Using his navigational genius he was able to steer the Putnam into Salem Harbor as if it were a clear summer day. At 4:00 on December 25th he had sighted Cape Ann and with that sighting, plus the sighting of the sun two days earlier and one momentary glimpse of the light on Bakers Island, Bowditch was able to steer his way through the fog.

NATHANIEL BOWDITCH, THE MIDDLE YEARS, 1804-1823

Bowditch became the president and the first actuary of Essex Fire and Marine Insurance Company. With the risks attendant to ships, crews, and cargoes, insurance companies were very much needed. Such work appealed to Bowditch, as it afforded him an opportunity to continue calculating. By day he was an insurance calculator and by night an astronomer.

During the years from 1804-1806 he was asked to survey the harbors of Salem, Marblehead, Beverly, and Manchester and compute the height of Mt. Washington.

In 1805 the Bowditches had their first child and moved from the Boardman house on Washington Square to Chestnut Street where they shared a house with the Hodges, occupying the east side of the house. The Bowditches had four children before they were able to buy their own home in 1811.

In 1806 he observed an eclipse of the sun, which he later wrote about in the *Memoirs of the American Academy of Arts and Sciences*. During the same year he wrote about the variation of the magnetic needle of the compass. He later wrote about the orbits of comets that appeared in 1807, 1811, and 1819. Bowditch has been credited with publishing a total of 31 scientific articles.

Though an excellent teacher at sea, Bowditch did not like speaking in public and declined offers to teach at Harvard, the University of Virginia, and West Point.

In 1810 Bowditch was made Overseer of Harvard College and in 1816 he was awarded an Honorary Doctor of Laws at Harvard. From 1814 to 1817, he completed *The Translation and Commentary of Mécanique Celeste* but did not publish it until he could afford to do so personally between 1829 and 1838. His thorough research and interest doubled the pages of the original document. By 1820 Bowditch had become president of the East India Marine Society.

In 1823 the Bowditches left Salem to live in Boston.

NATHANIEL BOWDITCH, THE LATER YEARS, 1823-1838

At age fifty, Bowditch took responsibility as Actuary of the Massachusetts Hospital and Life Insurance Company, plus President of the Commercial Insurance Company (Fire and Marine), both in Boston.

Bowditch made the insurance company prosper by calculating new insurance tables, simplifying bookkeeping and weathering panics and inflation.

The epitome of Bowditch's career as a scholar of both mathematics and astronomy lies not only in *The New American Practical Navigator* but also in *The Translation and Commentary of Mecanique Celeste*. Bowditch thus earned entry into almost every scientific society in the world. It is considered by many to be the best follow-up to Newton's *Principia*. Bowditch's genius with respect to his translation of La Place's book does not lie in his own discoveries, but in his ability to analyze, correct and make readable difficult scientific content. This in the end was his most important contribution to the world. The amazing thing is that Bowditch accomplished these translations while working a full time job, caring for a large family and without the patronage that was prevalent in Europe at this time.

On March 16, 1838, Bowditch died at the age of 65 with his family around him. His library, considered the best mathematical library in the United States, was eventually given to The Boston Public Library.