

The following text is tailored for reading aloud to Delta Six students at Diamond Middle School by Jennifer Burgin while showing The Librarian who Measured the Earth by Kathryn Lasky. Most of the text is simply a shortened version of Kathryn Lasky's text. Some information is drawn from The Story of Science: Aristotle Leads the Way by Joy Hakim. Several steps in the geometry-based portion were reordered. Each paragraph goes with a two-page spread (starting with pp. 4 – 5) of the Kathryn Lasky book.

Over 2000 years ago, a very smart baby was born. His name was Eratosthenes (AIR-uh-TOS-thuh-neeZ). His parents were Greek, and they lived in a Greek city on the coast of Africa in the country that is now called Libya.

Even as a baby, Eratosthenes was curious and full of wonder. He would crawl following the path of ants. ... He wondered why there were beads of water on the cistern in the morning. ... When he could talk, he asked tons of questions: What makes the stars move? Where do the winds come from? Many of these questions his parents couldn't answer.

When he was six, he went to gymnasium, or school. You probably just learned more about what gymnasium was like in ancient Greece than this book tells.

He loved it, especially for the opportunity to ask more questions.

His favorite subject was geography: "How high is the highest mountain? Is there a map of the Earth?"

When Eratosthenes had learned all he could at the gymnasium he was sent to Athens to learn more.

One of Eratosthenes's talents was organizing information. For instance, he made a chronology of all the important dates in the history of Greece, and he wrote a book on the constellations. Eratosthenes' name began to get around.

When he was 30 the ruler of Egypt asked him to serve as tutor for his son in Alexandria. Eratosthenes was ecstatic because Alexandria was the center of learning, with a library and a museum. All the great questions about science, literature, and history could be asked and researched here.

The museum was not just a collection of things. Remember, “museum” means “place of the Muses”, the nine daughters of Zeus who inspire artists and scientists. At the museum there were laboratories and libraries.

It was here that Herophilus recognized the connection between a person’s heartbeat and pulse, and discovered the differences between arteries and veins. Ctesibius invented the first water-driven clock and the first keyboard musical instrument.

As you know, 2000 years ago, books were written on scrolls of animal skins or papyrus. In the library at Alexandria, there were 700,000 papyrus scrolls and 40 librarians who helped readers find what they were looking for. Often the scrolls were tucked into clay jars. There was a lot of rolling and tagging and tying that had to be done to keep that library in order.

Eratosthenes fit right in with all his questions and ideas. It was not long after he arrived that the head librarian died and Eratosthenes was appointed in his place.

As head librarian, he helped other scholars find information, but he also had to be ready with compliments and praise for the king at all times. Once when Eratosthenes had solved a particularly difficult geometry problem, he dedicated his solution to the king, wrote a poem about it, and had it carved into a column that he had erected in the king’s honor.

Eratosthenes’ main interest, however, was not flattering the king. It was geography. Once it had been thought that the earth was flat. Then for a while people thought it was the shape of a cylinder. But by Eratosthenes’ time, they had known for sure for over 100 years that the earth was a sphere.

Eratosthenes began to put together information and figure out mathematical methods of determining new information for the first complete geography book.

He wanted to include the size of the earth. It seemed impossible to figure that out, because one could not walk around the earth without running into an ocean, and Greek ships could not sail as far as these oceans might reach.

Eratosthenes figured out that since the earth was a sphere like a grapefruit, if he knew the **distance** along the edge of **one** section, **and** he figured out how many same-size sections it would take to make up the whole sphere, then he could calculate the whole distance around. How did he know this? He knew that every circle, whether it is as small as a grapefruit or as big as the earth, is made up of 360 degrees. So if he could measure the inside angle of one section of his imaginary grapefruit section in degrees, he could divide 360 by that number and know how many sections of that size would make up the whole. The essentially parallel light from the sun was of key importance to his idea.

Eratosthenes had learned from one of the scrolls that on a certain day in June, that is, on the longest day of the year, at precisely midday, there were no shadows. In fact, the sun would shine all the way down the deep well in Syene (near modern Aswan, Egypt). The sunlight would reflect off the water at the bottom, but it would not light any of the well-wall at all. However, at midday in Alexandria, which was some distance north of Syene, there would be shadows.

Eratosthenes knew that you could measure the angle of the sun by the shadow it cast. And he knew that the angle of the sun in Alexandria at noon on the summer solstice would be the same

as the angle that lay at the center of the earth, making the inside of his Alexandria-to-Syene “grapefruit” section. He measured the sun angle at noon and found that it was 7.2 degrees from straight overhead. (Ours here turns out to be about 19 degrees from straight overhead, or 71 degrees up from the horizon.) So he divided 360 degrees by 7.2 degrees, and got 50: it would take 50 Alexandria-to-Syene sections to make up the circumference of the earth.

Next he had to determine the distance between the two cities. It turned out to be quite challenging to do this. Camel caravans did not travel at a steady rate.

He asked the king if people trained to walk with equal steps could be hired to measure the distance to Syene, and the king agreed. It turned out to be 5000 stades (or about 500 miles) from Alexandria to Syene.

Eratosthenes then calculated the circumference of the earth. When the earth was measured using all the latest technology recently, there was only a 200 mile difference between the new figure and the one that Eratosthenes had calculated over 2000 years ago. Eratosthenes was pleased to complete *Geographica*, the first geography book of the world.

He continued to ask questions for the rest of his long life.