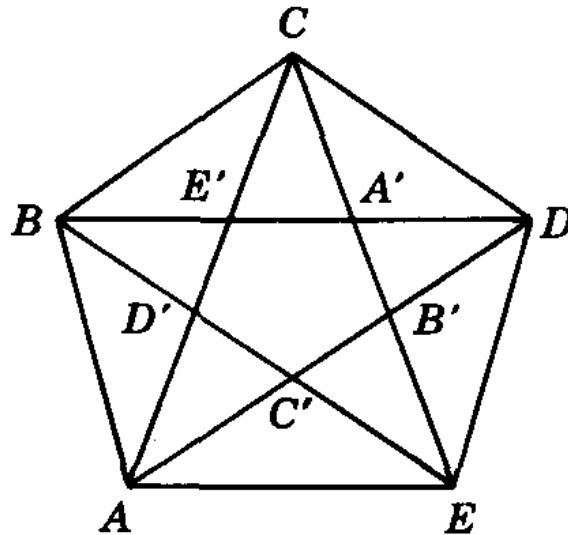
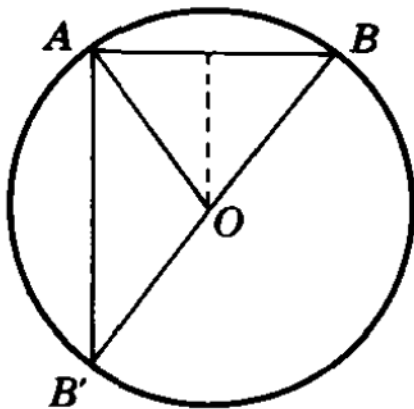


# Thales and Pythagoras



# Essay competition by AWM

## Submission Procedure

**Submission Period.** December 1 – February 1 through [MathPrograms.org](https://www.mathprograms.org).

**Submission Packet.** A valid submission will contain the following information:

- A biographical essay of approximately 500 – 1000 words in length, based primarily on an interview you conduct with a woman currently working in or retired from a mathematical career;
- A short (approximately 100 words) biographical sketch of the student contestant. This biographical sketch should include the student's name, grade level, school, and mathematical interests;
- Information about the student:
  - student's name;
  - address of student (or parent);
  - phone number or email address of student (or parent);
- Information about the subject of the biography:
  - name;
  - address;
  - phone number and/or email address.

**How to Submit.** All information must be submitted using the [online submission form](#) (available December 1). Click on "Apply" and you will then be asked to create an account login. Once your login is created, please continue the submission process by answering the questions and submitting the requested documents. If you have any problems submitting your essay, please contact AWM Essay Contest Organizer, Dr. Johanna Franklin ([johanna.n.franklin@hofstra.edu](mailto:johanna.n.franklin@hofstra.edu)).

**Categories.** This essay contest is open to students in the following categories:

- Grades 6 – 8
- Grades 9 – 12
- Undergraduate

At least one winning submission will be chosen from each category.

**Judging Criteria.** Your essay should be based primarily on an interview you conduct with a woman currently working in or retired from a mathematical career.

- The submission must be in essay form, not just a transcript of your interview.
- The essay should be approximately 500 to 1000 words in length.
- Essays will be judged by a panel of mathematicians on content, grammar, and presentation.

**Essay Subject.** You may interview and write about any woman currently working in a mathematical sciences career. Here are some suggestions for finding possible women to interview:

- Female math teachers.
- Female professors in mathematics at a local college or university (you can try looking up the school's website and looking for the mathematics department; many departments list their faculty and their email addresses).
- Consider other mathematical departments at colleges and universities, such as applied mathematics, computer science, statistics, physics, engineering, finance, etc.
- To find mathematicians from underrepresented minorities, you may want to try the website for the National Association of Mathematicians (NAM), the National Society of Black Engineers (NSBE), or the Society for Advancement of Chicanos and Native Americans in Science (SACNAS).
- To find out about other mathematical careers, you can look at the resources at the [Bureau of Labor Statistics](#) website, the [SIAM](#) website, or the [ASA](#) website. Try contacting a woman in one of these industries!

If you would like to be put in contact with someone who has agreed to be interviewed for this contest, please contact AWM Essay Contest Interviewee Coordinator Dr. Joanna Bieri ([joanna\\_bieri@redlands.edu](mailto:joanna_bieri@redlands.edu)). Please note that interviewee contacts will only be given out for requests received by January 10 each year.

**Suggested Interview Questions.** The following questions are suggestions for what ask your interviewee about during the interview:

- What motivated your interviewee to pursue a career in the mathematical sciences?
- What is your interviewee's educational, family and cultural background?
- What kind of work does she do?
- Does she have any advice to students who are interested in pursuing a career in the mathematical sciences?
- What are your interviewee's hobbies?

All submissions become the property of the Association for Women in Mathematics.

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# The Thalassic age

- The period between 800 BCE and 800 CE has been referred to as the Thalassic age (or the “sea” age) to indicate development along the Mediterranean sea.
  - Surely there was borrowing from the Egyptian and Babylonian cultures.
  - But the question now shifts from “what do we know?” to “how do we know?”
  - A parallel development is evident in the Indus valley civilization in India especially with respect to philosophy and epistemology in particular.
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# Greek literature and science

- Through the literary works of Homer and Hesiod, we know that Greek literature developed remarkably around 776 BCE, a time when the first Olympic games were held.
  - This indicates that the culture recognized that both the body and the mind need to be developed.
  - With respect to science, Thales and Pythagoras stand out from this time period.
  - Unfortunately, there is very little documentary evidence regarding these two personalities.
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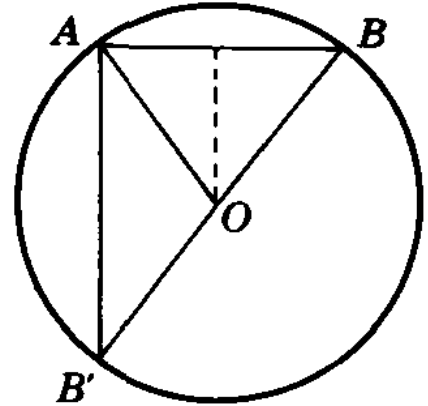
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# Thales and astronomy

- Thales (624 – 548 BCE) and Pythagoras (580 – 500 BCE) traveled widely in Egypt, Babylon and some even say India.
  - They gathered knowledge about geometry and astronomy from their travels.
  - One story says Thales met with the learned Babylonian king, Nebuchadnezzar, where he had access to astronomical tables and instruments and could predict the solar eclipse of 585 BCE.
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# The theorem of Thales

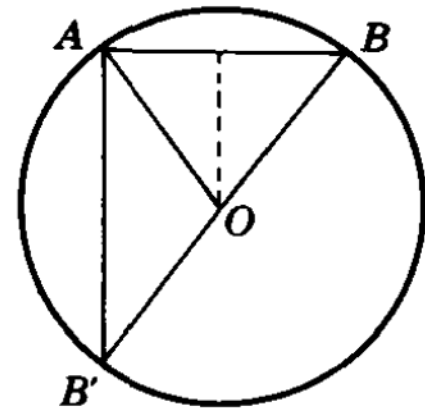
- By all accounts, Thales is considered as a “pupil of the Egyptians and the Chaldeans”.
- The “theorem of Thales” regarding angles inscribed in a semi-circle being a right angle seems to have been learned from the Babylonians.



# Four theorems of Thales

1. A circle is bisected by a diameter.
2. The base angles of an isosceles triangle are equal.
3. The pairs of vertical angles formed by two intersecting lines are equal.
4. If two triangles are such that two angles and a side of one are equal, respectively, to two angles and a side of the other, then the triangles are congruent.

All of these can be understood from the following diagram.





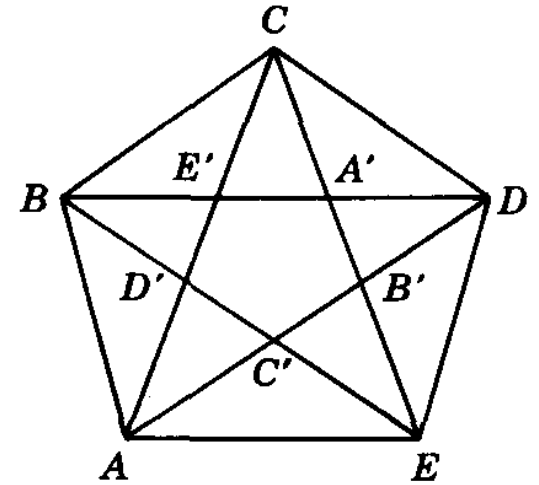
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# Pythagoras of Samos

- Pythagoras seems to have traveled widely into Egypt, Babylon and even India, where he learned much about astronomy, mathematics and religion.
  - He was a contemporary of the Buddha, Confucius and Lao-Tzu so this period is seen as a pivotal time in history when both mathematics and religion developed side by side and often symbiotically.
  - This is evident in the number mysticism of Pythagoras. He formed a religious cult and settled in southeastern Italy after his extensive travels.
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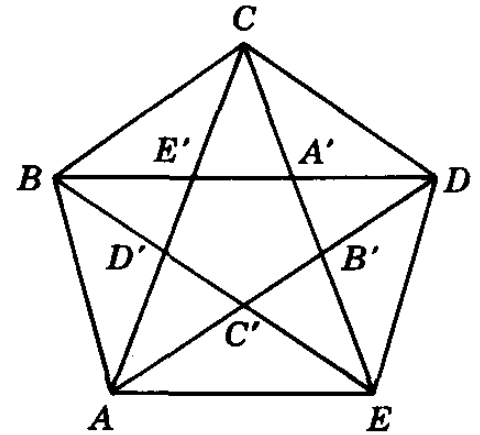
# The Pentagram and the Golden Section

- The aphorism “all is number” can be attributed to the Pythagoreans. But their concept of number seems to have been limited to whole numbers or at best rational numbers.
- The pentagram became the symbol of their secret society.



# The Golden Ratio

- The triangle BCE is similar to BD'C.
- The diagonals are divided into a “short” segment of length  $s$  (say) and a longer segment of length  $d-s$ .
- The similarity of the triangles leads to  $s/(d-s) = (d-s)/d$ .
- Thus,  $d^2 - sd + s^2 = 0$ .
- $d/s = \frac{1}{2}(1 + \sqrt{5})$ .



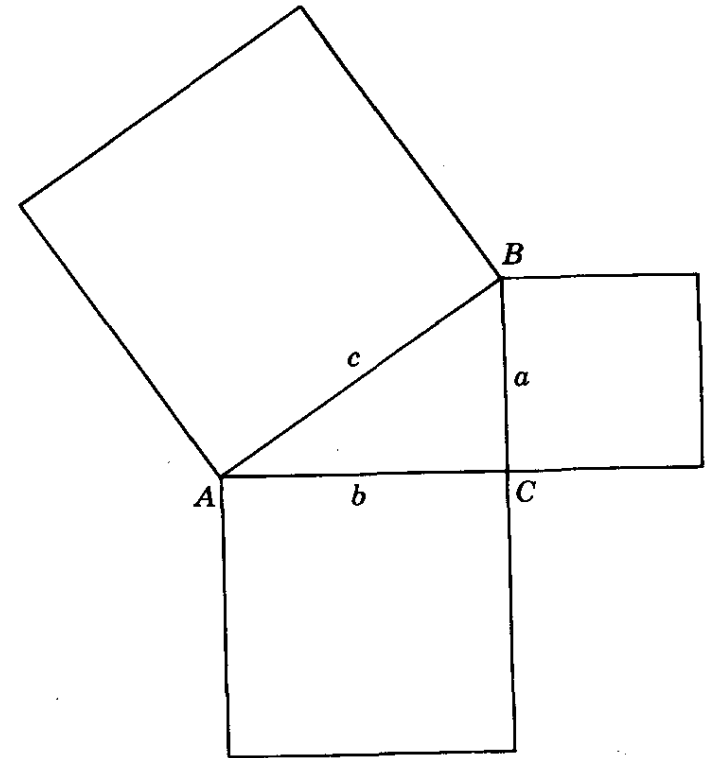
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# Number mysticism

- The Pythagoreans practiced a strange form of number mysticism and carried it to a ludicrous extreme.
  - The Pythagorean Philolaus wrote, “All things which can be known have number, for it is not possible that without number anything can either be conceived or known.”
  - They noticed harmonies of sounds and thus assigned numbers to musical notes, though other cultures had also such as a designation.
-

# Ratios, proportions and $\sqrt{2}$

- The number mysticism and its adherence to ratios of numbers ran into some difficulties with  $\sqrt{2}$ .
- $\sqrt{2}$  is an irrational number.
- The story is that the Pythagorean who discovered this was thrown into the sea for this “heresy”!.



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# The Pythagorean theorem

- As we have seen, the Babylonians, a thousand years before Pythagoras, seemed to know how to generate Pythagorean triples.
  - The Sulva Sutras in India, dating to 800 BCE have the explicit statement of the Pythagorean theorem.
  - It is doubtful that Pythagoras or his school knew how to prove this theorem.
  - The first rigorous proof seems to have been written down by Euclid, two centuries later.
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