

Photonics Timeline Puzzle

Instructions:

This activity is designed to have students put themselves in the shoes of early optical engineers. In groups, they will work to piece together the timeline of early lens technologies.

Time: 15 minutes

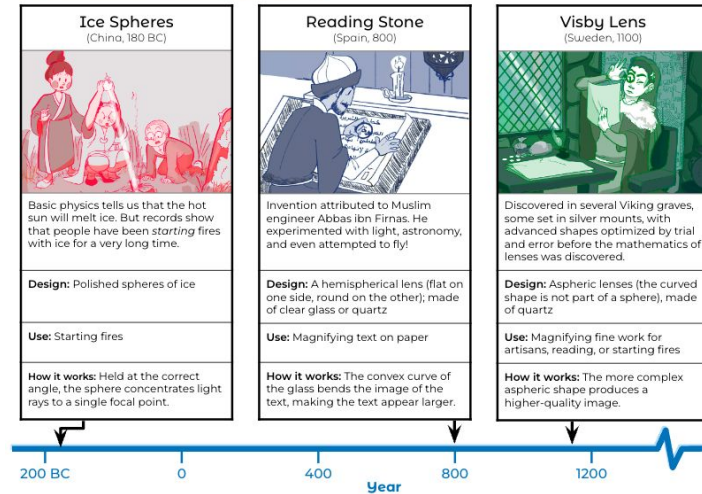
Steps:

1. Lay the timelines from student handout pages 3 and 4 next to each other on a table. Tape together.
2. Cut out each invention panel on pages 1 and 2 of the student handout, scramble the cards on the table.
3. (optional) Invention panels can be cut at any of the horizontal lines to increase difficulty. For example, cut horizontally to separate the image of the lens from its description, and see if students can match the image to the description AND to the timeline.

Note: Student versions of cards do not display invention year.

When was it invented?

GALACTIC POLYMATH | "Photonics" Lesson 1 (Key)



Students getting stuck? Try these discussion prompts:

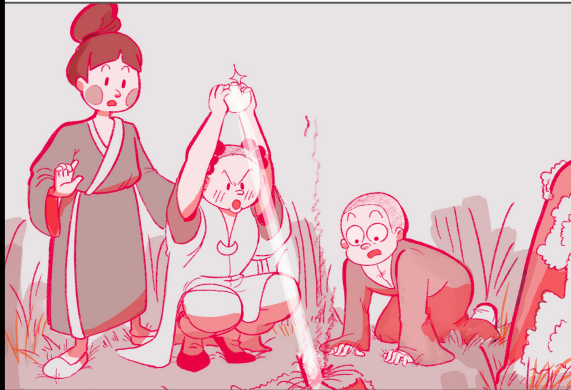
- Which inventions fulfilled the most immediate societal needs?
- Do inventions typically get simpler or more complex over time?



When was it invented?

Ice Spheres

(China, 180 BC)



Basic physics tells us that the hot sun will melt ice. But records show that people have been *starting* fires with ice for a very long time.

Design: Polished spheres of ice

Use: Starting fires

How it works: Held at the correct angle, the sphere concentrates light rays to a single focal point.

Reading Stone

(Spain, 800)



Invention attributed to Muslim engineer Abbas ibn Firnas. He experimented with light, astronomy, and even attempted to fly!

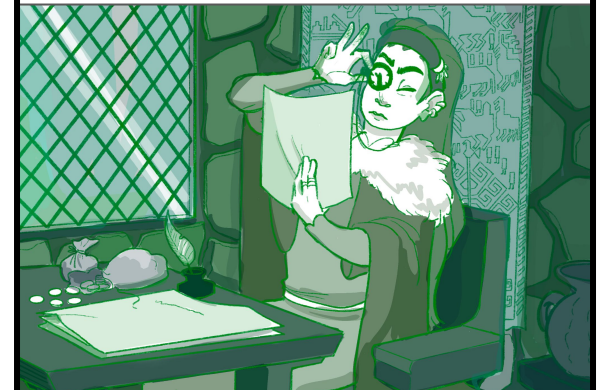
Design: A hemispherical lens (flat on one side, round on the other); made of clear glass or quartz

Use: Magnifying text on paper

How it works: The convex curve of the glass bends the image of the text, making the text appear larger.

Visby Lens

(Sweden, 1100)



Discovered in several Viking graves, some set in silver mounts, with advanced shapes optimized by trial and error before the mathematics of lenses was discovered.

Design: Aspheric lenses (the curved shape is not part of a sphere), made of quartz

Use: Magnifying fine work for artisans, reading, or starting fires

How it works: The more complex aspheric shape produces a higher-quality image.

200 BC

0

400

800

1200

Year

When was it invented?

Compound Microscope

(The Netherlands, 1590)



Historians still debate who invented the compound microscope. Most believe it was Hans Janssen, with help from his teenage son!

Design: A foot long brass tube with two lenses; one at the base and one closer to the eye piece

Use: Study small insects or microbes

How it works: An "objective lens" at the bottom collects and magnifies light; an "ocular lens" on top focuses the image.

Fresnel Lens

(France, 1748)



Independently invented by two people at different times! First by Georges-Louis Leclerc and then by Augustin-Jean Fresnel 71 years later.

Design: Multiple pieces of glass cut at different angles and brought together in the shape of an oval

Use: First used in lighthouses to project light to ships at sea; later used in car headlights

How it works: Repeating sections of glass can increase magnification with a smaller mass and volume

Contact Lens

(Germany, 1888)



Invented by Adolf Gaston Eugen Fick after experimenting on himself, they were initially made of glass and could only be worn for a few hours!

Design: Thin lenses, now made of soft synthetic material, placed directly on the surface of the eyes

Use: Correcting nearsightedness, farsightedness, and other conditions, in substitute of glasses

How it works: Contacts bend light before it enters the eye's lens, in conjunction creating a clear image.

1600

1700

1800

1900

Year

Ice Spheres

Wu, Ling-An, et al. “Optics in Ancient China.” *E-EPS*, European Physical Society, 22 Oct. 2015, www.epsnews.eu/2015/10/optics-in-ancient-china/.

Reading Stones

Geoffrey de Villiers and E. Roy Pike (2016). *The Limits of Resolution*. [CRC Press](#). p. 1. [ISBN 9781498758123](#).
John H. Lienhard (2004). “Abbas Ibn Firnas”. [The Engines of Our Ingenuity](#). Episode 1910. NPR. KUHF-FM Houston. [Transcript](#).

Visby Lens

Schmidt, Olaf; Karl-Heinz Wilms; Bernd Lingelbach (September 1999). “[The Visby Lenses](#)”. *Optometry & Vision Science*. **76** (9): 624–630. [doi:10.1097/00006324-199909000-00019](#)

Compound Microscope

Ball, Clara Sue. “The Early History of the Compound Microscope.” *BIOS*, vol. 37, no. 2, May 1966, pp. 51–60, <https://www.jstor.org/stable/4606667>.

Fresnel Lens

Britannica, The Editors of Encyclopaedia. “Fresnel lens”. *Encyclopedia Britannica*, 26 Oct. 2023, <https://www.britannica.com/technology/Fresnel-lens>

Contact Lens

“Adolf Eugen Fick.” *Science Museum Group Collection*, Science Museum Group, collection.sciencemuseumgroup.org.uk/people/cp86267/adolf-eugen-fick