



WAS THERE SCIENCE BEFORE THE SCIENTIFIC REVOLUTION?

Name:

Date:

Directions: Read the documents assigned by your teacher and answer the four questions about each.

Passage 1 : _____

1. Were hypotheses made or questions asked in the passages you read? What were they?

2. Was evidence provided to help answer those questions?





WAS THERE SCIENCE BEFORE THE SCIENTIFIC REVOLUTION?

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3. Does this qualify as science? Why or why not?

4. If it does qualify as science, why don't we recognize or consider the science that came before the so-called scientific revolution?





Name:

Date:

Passage 2 : _____

1. Were hypotheses made or questions asked in the passages you read? What were they?

2. Was evidence provided to help answer those questions?





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Passage 3 : _____

1. Were hypotheses made or questions asked in the passages you read? What were they?

2. Was evidence provided to help answer those questions?





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3. Does this qualify as science? Why or why not?

4. If it does qualify as science, why don't we recognize or consider the science that came before the so-called scientific revolution?

Note: We have borrowed this activity and the reading materials with permission from World History for Us All (<http://worldhistoryforusall.sdsu.edu/units/six/landscape/Era06landscape6.php>).



Was There Science Before the Scientific Revolution?

Passage 1 - “The Shape of the Seas” from Al-Mas’udi’s tenth-century work on geography

The philosophers differ about the shape of the seas. Most of the ancients, such as the mathematicians of the Hindus and the Greeks, believe that they are round. They provide many arguments as proofs of their statement. [For instance,] if you sail away on the sea, land and mountains disappear gradually, until you lose sight of even the highest mountain peaks. On the other hand, as you near the coast, you first see the mountains. Only when you come nearer do you see the trees and plains.

But those who strictly follow the revelation [the Qur’an], reject this hypothesis.

Source: Qtd. in Seyyed Hossein Nasr, *Science and Civilization in Islam* (Cambridge: Harvard UP, 1968), 107. Language simplified by Anne Chapman.

Passage 2 - “Lead into Gold?” from ibn Sina’s (Avicenna’s) eleventh-century *Book of the Healing*

As to the claims of the alchemists [that they can turn one metal into another, and particularly into silver or gold], it must be clearly understood that it is not in their power to bring about any true change of species. [Ibn Sina considered that each metal was a distinct species of the genus “metals.” Just as it was impossible to turn a horse into a dog, so it was impossible to turn one metal into another.]

They can, however, produce excellent imitations, dyeing the red [metal] white so that it closely resembles silver, or dyeing it yellow so it closely resembles gold. . . . Yet in these [dyed metals] the essential nature remains unchanged; they are merely so dominated by induced qualities that errors may be made concerning them.

I do not deny that such a degree of accuracy may be reached as to deceive even the shrewdest, but [as for] the possibility of eliminating or imparting the [difference in species], I regard it as impossible. . . . Those properties which are perceived by the sense are probably not the differences which separate the metals into species, but rather accidents or consequences, the [actual] differences being unknown. And if a thing is unknown, how is it possible for anyone to endeavor to produce it or to destroy it?

Source: E. J. Holmyard and D. C. Mandeville, eds. and trans., *Avicennae “De congelatione et conglutinatione lapidum” Being Sections of the “Kitab al-Shifa”* (Paris: Librairie Orientaliste Paul Geuthner, 1927), 17-32. Quoted in Edward Grant, ed. *A Source Book in Medieval Science* (Cambridge: Harvard UP, 1974), 572.

Passage 3 - “Answers to Questions About Nature” from Adelard of Bath’s twelfth-century natural history

I have learnt one thing from my Arab masters, with reason as guide, but you another: you follow the halter of authority. As brute animals are led by a halter, but do not know where or why they are led, so the authority of written words leads not a few of you into danger, since you are held captive by brutish blind faith. These days listeners do not demand arguments based on judgment. They do not understand that reason has been given to each single individual in order to decide between true and false with reason as the prime judge. However, I do not unconditionally state that authority should be rejected. Rather, reason should be sought first, and an authority, if one is at hand, be added later. Authority alone cannot win credibility for a philosopher. . . . If you wish to hear anything more from me, give and receive reason. . . .

Question: Why is seawater bitter and salty?

Answer: The heat of the sun and the planets causes the saltiness. Since the true Ocean flows through the hot central zone of the earth, and the planets move through the same zone, so because of the great heat of the stars [Adelard uses “planet” and “star” interchangeably] the sea itself becomes hot. As a result it becomes salty. This is confirmed by the fact that on seashores near that Ocean seawater dried on the rocks becomes salt without any artifice. To get salt from seas further away, distant from heat, the seawater must be heated again by boiling. But even some fresh water can be turned into salt if it is boiled down. Moreover, in summer all seawater is saltier than in the winter, which anyone can experience for themselves. . . .

Question: Are stars animate or inanimate?

Answer: Whoever thinks they are inanimate is himself without a soul in my opinion. If this [earthly] region which is churned about with hail, bristling with clouds, and murky with darkness can sustain reason and judgment, how much more is the ethereal plane [the Heavens, which is] purged of all uncleanness, obedient to mind and reason?

Again, if of all created things nothing can be better than the mind, should the place [the perfect Heavens] which is most suitable for it be deprived of it? As for stars’ form, it is clear that the form of the stars, which is full and round [the circle being considered the most perfect shape] is of all forms the most appropriate to the soul. . . .

Nothing, then, among creatures is more rational than [stars].

Source: Charles Burnett, ed. and trans., *Adelard of Bath: Conversations With His Nephew* (Cambridge: Cambridge UP, 1998), 103-4, 185-6, 219-22. Language simplified by Anne Chapman.

Passage 4 - “Accuracy of Measurement” from Abu’l-Fath al-Khazini’s twelfth-century book on mechanics

[The main principle al-Khazini used in determining specific gravities was that a given body will float in a liquid to a depth proportional to the specific gravity of the liquid, sinking further in a light than a dense one. Great care was taken to ensure the maximum possible accuracy in the design, manufacture, and calibration of his measuring instrument, based on that of the Greek mathematician and scholar of mechanics, Pappus.]

Substances	al-Khazini’s 1121 values for their specific gravity	Twentieth-century values
Water	1.00	1.00
Sea water	1.04	1.029--1.04
Olive oil	0.92	0.918—0.919
Cow’s milk	1.11	1.02—1.04
Mercury	13.56	13.56
Brass	8.57	8.45—8.60
Tin	7.32	7.29
Iron	7.74	7.60—7.79

Source: Qtd. in Donald R Hill, *Islamic Science and Engineering* (Edinburgh: Edinburgh UP, 1993), 66.

Passage 5 - “The Ecstatic Camel” from al-Musta’fi al-Qazwini’s thirteenth-century encyclopedia

The Eternal Wisdom designed animals to be of use to man, the perfected of perfections. Since He created them as tools for man, God (may He be praised and exalted!) directed man so he got the upper hand of them. . . .

Of domestic animals, I shall list ten kinds in alphabetical order. . . .

The camel is a large-bodied, strangely made animal that eats little, bears burdens, and is obedient to commands. It is liable to ecstasy and gladness. Shaikh Sa’di [Persian poet and traveler] says: “The camel becomes ecstatic and dances at the Arab’s song; if you are not joyful, you are a cross-grained beast.”

All the sects are allowed to eat its flesh, which is warm and dry. The camel is intelligent, so when it is sick it eats oak-leaves and gets better, and when a poisonous snake bites it, it eats a crab and the poison is neutralized.

Its liver gives clear sight and prevents cataracts. Snakes flee from wherever its fat is put down. Tying its hair around the left thigh halts diabetes.

The Arabs call a male camel *jamal*, the female *naqat*, the young *bakr*, the old *nab*, a baggage carrier *hamulet*, a milk camel *laquh*, a 3-year old *hiqq*, a 4-year old *jadha*. . . .

Source: Qtd. in Seyyed Hossein Nasr, *Science and Civilization in Islam* (Cambridge: Harvard UP, 1968), 119-20. Language simplified by Anne Chapman.

Passage 6 - “Description of the Magnet” from Bartholomew the Englishman’s thirteenth-century account

The magnet is an Indian stone that attracts iron, as Isidore [Spanish bishop and encyclopedist] says. It is also believed to attract clear glass. As Augustine [African bishop, theologian, and philosopher] says, its force is so great that iron will follow its movement even through a shield of gold or bronze. Due to this power of a magnet, a statue made of iron was seen to hang in the air in a temple.

There is another species of magnet in Ethiopia which repels iron and flees from itself. Also, the magnet sometimes attracts iron from one angle, and repels it from another. Isidore adds that this kind of stone restores husbands to wives and increases elegance and charm in speech.

There are mountains made of such stones that attract and dissolve ships made of iron. Its dust is especially valuable for wounds and against dropsy, spleen, and fox mange, as Avicenna [ibn Sina, Muslim physician, scientist and philosopher] says.

Source: Anglici Bartholomaei, *De genuinis rerum coelestium terrestrium et inferarum proprietatibus libri XVIII* Edward Grant, trans. (Frankfurt: Minerva, 1964). Qtd. in Edward Grant, ed. *A Source Book In Medieval Science* (Cambridge: Harvard UP, 1974), 367-8. Language adapted by Anne Chapman.

Passage 7 - “The Nature of Comets” from Albertus Magnus’ thirteenth-century treatise

We will give the correct view about comets, and confirm it by the authority of many physicists. I say, then, that a comet is nothing else than a coarse earthly vapor or fumes; coarse, because if it were thin it would quickly evaporate and dissolve. It gradually rises from the bottom of the layer of air to the top, where it touches the curved inner surface of the sphere of fire. There it is thinned out by the heat of the fire and inflamed. Its middle always stays dense, but what is thinned out at the sides often seems long, has a thin flame, and is called the “tail.”

The famous philosophers Avicenna [ibn Sina, Muslim physician, scientist and philosopher] and Algazel [al-Ghazali, Arab theologian and philosopher] give evidence that this is so. Ptolemy [Greek astronomer and geographer] and Albumasar [Abu Ma'shar, Persian astronomer and mathematician] also imply this.

Reason, too, supports this opinion. Since it is evident that flame is nothing but kindled fumes; and a comet is a sort of flame, as is apparent to the sight, therefore, a comet is kindled fumes.

Furthermore, if a comet is always produced by one of the five planets as some have argued, then it should never be seen outside the path of the planets. Yet this is false, since Aristotle [Greek philosopher and scientist] says we see comets in every part of the sky. Moreover, I with many others in Saxony in the year 1240 saw a comet close to the North Pole. It projected its rays between east and south, and it is evident that there was not the path of any planet.

Source: Lynn Thorndike, ed. *Latin Treatises On Comets Between 1238 and 1368 AD* (Chicago: University of Chicago Press, 1950), 499-508. Qtd. in Edward Grant, ed. *A Source Book In Medieval Science*. Cambridge: Harvard UP, 1974), 543-4.

Document H. “A New Theory of Motion” from Jean Buridan’s fourteenth-century “Questions On Aristotle”

The question is what moves a thing that has been thrown after it has left the hand of the thrower. Is it moved by air, or if not, by what is it moved?

Aristotle has not solved this problem well. He suggests that the thing thrown leaves the place where it was quickly, and would leave emptiness behind. But nature, which does not allow a vacuum, quickly sends air in behind to fill up emptiness. The air that has moved in fast this way, comes up against the end of the thing thrown, and pushes it along further. This is repeated continually. But it seems to me this explanation is without value because of many experiences that contradict it.

For instance, a lance having a pointed back end as sharp as the front would be moved, after having been thrown, just as fast as it would be with a blunt back end. But surely the air following would push a pointed end less well, because the air would be easily divided by the sharpness.

Again, a ship pulled along fast in the river even against the current cannot be stopped quickly, but rather continues to move for a long time after the pulling stops. And yet a sailor on deck does not feel any air from behind pushing him. On the contrary, he feels the air from the front resisting him.

Instead, we can and should say that the mover in moving anything impresses in that thing a certain impetus or motive force, which acts in the direction that the mover was moving the thing. The faster the mover moves the thing, the stronger the impetus he impresses in it. This theory explains why the motion of a heavy body downwards is continually accelerated. At the

beginning, only gravity was moving it; but moving impressed in it an impetus, which, added to the gravity, made the movement faster, in turn making the impetus stronger and so on.

Also, the Bible does not state that each heavenly body is moved by an intelligence [or angel—the two words were used interchangeably.]. So it could be said that it does not appear necessary to hypothesize intelligences of this kind to account for the movement of planets and fixed stars, as many do. It could instead be said that God, when he created the world, moved each heavenly body as He pleased, and in doing so impressed in them impetuses that moved them without him, or anything else, having to move them any longer. But this I do not say assertively, only tentatively, so that I might seek from the theological masters that they teach me in these matters.

Source: Qtd. in Marshall Clagett, *The Science of Mechanics In the Middle Ages* (Madison: University of Wisconsin Press, 1957), 532-6. Language adapted by Anne Chapman.