

For other uses, see [Aristotle \(disambiguation\)](#).

Aristotle
Ἀριστοτέλης



Roman copy (in marble) of a [Greek bronze](#) bust of Aristotle by [Lysippos](#) (c. 330 BC), with modern alabaster mantle

| | |
|-------------------------|---|
| Born | 384 BC Stagira , Chalcidian League |
| Died | 322 BC (aged 61–62) Chalcis , Euboea , Macedonian Empire |
| | Education |
| Education | Platonic Academy |
| | Philosophical work |
| Era | Ancient Greek philosophy |
| Region | Western philosophy |
| School | Peripatetic school |
| Notable students | Alexander the Great , Theophrastus , Aristoxenus |
| Main interests | <ul style="list-style-type: none">● Logic● Natural philosophy● Metaphysics● Ethics● Politics● Rhetoric● Poetics |
| Notable works | <ul style="list-style-type: none">● Organon● Physics |

- [Metaphysics](#)
- [Nicomachean Ethics](#)
- [Politics](#)
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Theoretical philosophy

Notable ideas

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Practical philosophy

•

Aristotle^[A] ([Attic Greek](#): Ἀριστοτέλης, romanized: *Aristotélēs*;^[B] 384–322 BC) was an [ancient Greek philosopher](#) and [polymath](#). His writings cover a broad range of subjects spanning the [natural sciences](#), [philosophy](#), [linguistics](#), [economics](#), [politics](#), [psychology](#), and [the arts](#). As the founder of the [Peripatetic school](#) of philosophy in the [Lyceum](#) in [Athens](#), he began the wider [Aristotelian](#) tradition that followed, which set the groundwork for the development of modern [science](#).

Little is known about Aristotle's life. He was born in the city of [Stagira](#) in [northern Greece](#) during the [Classical period](#). His father, [Nicomachus](#), died when Aristotle was a child, and he was brought up by a guardian. At around eighteen years old, he joined [Plato's Academy](#) in Athens and remained there until the age of thirty seven (c. 347 BC). Shortly after Plato died, Aristotle left Athens and, at the request of [Philip II of Macedon](#), tutored his son [Alexander the Great](#) beginning in 343 BC. He established a library in the Lyceum, which helped him to produce many of his hundreds of books on [papyrus scrolls](#).

Though Aristotle wrote many treatises and dialogues for publication, only around [a third of his original output has survived](#), none of it intended for publication. Aristotle provided a complex synthesis of the various philosophies existing prior to him. His teachings and methods of inquiry have had a significant impact across the world, and remain a subject of contemporary philosophical discussion.

Aristotle's views profoundly shaped [medieval scholarship](#). The influence of [his physical science](#) extended from [late antiquity](#) and the [Early Middle Ages](#) into the [Renaissance](#), and was not replaced systematically until [the Enlightenment](#) and theories such as [classical mechanics](#) were developed. He influenced [Judeo-Islamic philosophies](#) during the Middle Ages, as well as [Christian theology](#), especially the [Neoplatonism](#) of the [Early Church](#) and the [scholastic](#) tradition of the [Catholic Church](#).

Aristotle was revered among medieval Muslim scholars as "The First Teacher", and among medieval Christians like [Thomas Aquinas](#) as simply "The Philosopher", while the poet [Dante](#) called him "the master of those who know". He has been referred to as the first [scientist](#). His works contain the earliest known systematic study of logic, and were studied by medieval scholars such as [Peter Abelard](#) and [Jean Buridan](#). His influence on

logic continued well into the 19th century. In addition, [his ethics](#), although always influential, has gained renewed interest with the modern advent of [virtue ethics](#).

Life

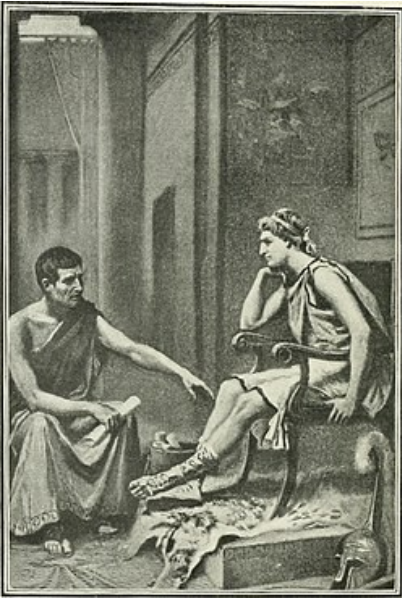
In general, the details of Aristotle's life are not well-established. The biographies written in ancient times are often speculative and historians only agree on a few salient points.
[C] Aristotle was born in 384 BC [D] in [Stagira](#), [Chalcidice](#), [2] about 55 km (34 miles) east of modern-day [Thessaloniki](#). [3] [4] He was the son of [Nicomachus](#), the personal physician of [King Amyntas of Macedon](#), [5] and Phaestis, a woman with origins from [Chalcis](#), [Euboea](#). [6] Nicomachus was said to have belonged to the medical guild of [Asclepiadae](#) and was likely responsible for Aristotle's early interest in biology and medicine. [7] Ancient tradition held that Aristotle's family descended from the legendary physician [Asclepius](#) and his son [Machaon](#). [8] Both of Aristotle's parents died when he was still at a young age and [Proxenus of Atarneus](#) became his guardian. [9] Although little information about Aristotle's childhood has survived, he probably spent some time in the [Macedonian](#) capital, making his first connections with the [Macedonian monarchy](#). [10]



School of Aristotle in [Mieza](#), [Macedonia](#),

[Greece](#)

At the age of seventeen or eighteen, Aristotle moved to [Athens](#) to continue his education at [Plato's Academy](#). [11] He became distinguished as a researcher and lecturer, earning for himself the nickname "mind of the school" by his tutor [Plato](#). [12] In Athens, he probably experienced the [Eleusinian Mysteries](#) as he wrote when describing the sights one viewed at the Mysteries, "to experience is to learn" (παθεῖν μαθεῖν). [13] Aristotle remained in Athens for nearly twenty years before leaving in 348/47 BC after Plato's death. [14] The traditional story about his departure records that he was disappointed with the academy's direction after control passed to Plato's nephew [Speusippus](#), although it is possible that the anti-Macedonian sentiments in Athens could have also influenced his decision. [15] [16] Aristotle left with [Xenocrates](#) to [Assos](#) in [Asia Minor](#), where he was invited by his former fellow student [Hermias of Atarneus](#); he stayed there for a few years, leaving around the time of Hermias' death. [E] While at Assos, Aristotle and his colleague [Theophrastus](#) did extensive research in [botany](#) and [marine biology](#), which they later continued at the near-by island of [Lesbos](#). [17] During this time, Aristotle married [Pythias](#), Hermias's adoptive daughter and niece, and had a daughter whom they also named Pythias. [18]



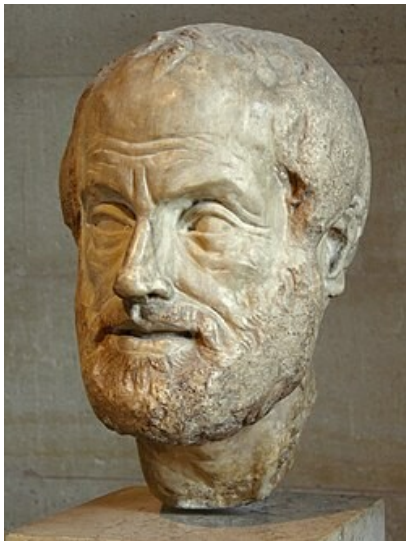
"Aristotle tutoring Alexander" (1895) by Jean Leon Gerome

Ferris

In 343/42 BC, Aristotle was invited to [Pella](#) by [Philip II of Macedon](#) to become the tutor to his thirteen-year-old son [Alexander](#);^[19] a choice perhaps influenced by the relationship of Aristotle's family with the Macedonian dynasty.^[20] Aristotle taught Alexander at the private school of [Mieza](#), in the gardens of the [Nymphs](#), the royal estate near Pella.^[21] Alexander's education probably included a number of subjects, such as [ethics](#) and [politics](#),^[22] as well as standard literary texts, like [Euripides](#) and [Homer](#).^[23] It is likely that during Aristotle's time in the Macedonian court, other prominent nobles, like [Ptolemy](#) and [Cassander](#), would have occasionally attended his lectures.^[24] Aristotle encouraged Alexander toward eastern conquest, and his own attitude towards [Persia](#) was strongly [ethnocentric](#). In one famous example, he counsels Alexander to be "a leader to the Greeks and a despot to the barbarians".^[25] Alexander's education under the guardianship of Aristotle likely lasted for only a few years, as at around the age of sixteen he returned to Pella and was appointed regent of Macedon by his father Philip.^[26] During this time, Aristotle gifted Alexander an annotated copy of the [Iliad](#), which is said to have become one of Alexander's most prized possessions.^[27] Scholars speculate that two of Aristotle's now lost works, *On kingship* and *On behalf of the Colonies*, were composed by the philosopher for the young prince.^[28] Aristotle returned to Athens for the second and final time a year after Philip II's assassination in 336 BC.^[29]

As a [metic](#), Aristotle could not own property in Athens and thus rented a building known as the [Lyceum](#) (named after the sacred [grove](#) of [Apollo Lykeios](#)), in which he established his own school.^[30] The building included a [gymnasium](#) and a [colonnade](#) (*peripatos*), from which the school acquired the name [Peripatetic](#).^[31] Aristotle conducted courses and research at the school for the next twelve years. He often lectured small groups of distinguished students and, along with some of them, such as [Theophrastus](#), [Eudemus](#), and [Aristoxenus](#), Aristotle built a large library which included manuscripts, maps, and museum objects.^[32] While in Athens, his wife Pythias died and Aristotle became involved with [Herpyllis](#) of Stagira. They had a son whom Aristotle named after his father, [Nicomachus](#).^[33] This period in Athens, between 335 and 323 BC, is when Aristotle is believed to have composed many of his philosophical works.^[34] He wrote many dialogues, of which only fragments have survived. Those works that have survived are in [treatise](#) form and were not, for the most part, intended for widespread publication; they

are generally thought to be lecture aids for his students. His most important treatises include [Physics](#), [Metaphysics](#), [Nicomachean Ethics](#), [Politics](#), [On the Soul](#) and [Poetics](#). Aristotle studied and made significant contributions to "logic, metaphysics, mathematics, physics, biology, botany, ethics, politics, agriculture, medicine, dance, and theatre."^[35]



Portrait bust of Aristotle; an [Imperial Roman](#) (1st or 2nd century AD) copy of a lost [bronze sculpture](#) made by [Lysippos](#)

While Alexander deeply admired Aristotle, near the end of his life, the two men became estranged having diverging opinions over issues, like the optimal administration of city-states, the treatment of conquered populations, such as the Persians, and philosophical questions, like the definition of braveness.^[36] A widespread speculation in antiquity suggested that Aristotle played a role in Alexander's death, but the only evidence of this is an [unlikely claim](#) made some six years after the death.^[37] Following Alexander's death, anti-Macedonian sentiment in Athens was rekindled. In 322 BC, Demophilus and [Eurymedon the Hierophant](#) reportedly denounced Aristotle for impiety,^[38] prompting him to flee to his mother's family estate in [Chalcis](#), Euboea, at which occasion he was said to have stated "I will not allow the Athenians to sin twice against philosophy"^[39] – a reference to Athens's [trial and execution of Socrates](#).^[15] He died in Chalcis, Euboea^[40] ^[41] of natural causes later that same year, having named his student [Antipater](#) as his chief [executor](#) and left a [will](#) in which he asked to be buried next to his wife.^[42] Aristotle left his works to Theophrastus, his successor as the head of the Lyceum, who in turn passed them down to [Neleus of Scepsis](#) in Asia Minor. There, the papers remained hidden for protection until they were purchased by the collector [Apellicon](#). In the meantime, many copies of Aristotle's major works had already begun to circulate and be used in the Lyceum of Athens, [Alexandria](#), and later in Rome.^[43]

Theoretical philosophy

Logic

Main article: [Term logic](#)

Further information: [Non-Aristotelian logic](#)

With the [Prior Analytics](#), Aristotle is credited with the earliest systematic study of logic, [44] and his conception of it was the dominant form of Western logic until 19th-century advances in [mathematical logic](#). [45] Kant stated in the [Critique of Pure Reason](#) that with Aristotle, logic reached its completion. [46]

Organon

Main article: [Organon](#)



Plato (left) and Aristotle in [Raphael's](#) 1509 fresco, [The School of Athens](#). Aristotle holds his [Nicomachean Ethics](#) and gestures to the earth, representing his view in immanent realism, whilst Plato gestures to the heavens, indicating his Theory of Forms, and holds his [Timaeus](#). [47][48]

Most of Aristotle's work is probably not in its original form, because it was most likely edited by students and later lecturers. The logical works of Aristotle were compiled into a set of six books called the [Organon](#) around 40 BC by [Andronicus of Rhodes](#) or others among his followers. [49] The books are:

1. [Categories](#)
2. [On Interpretation](#)
3. [Prior Analytics](#)
4. [Posterior Analytics](#)
5. [Topics](#)
6. [On Sophistical Refutations](#)

The order of the books (or the teachings from which they are composed) is not certain, but this list was derived from analysis of Aristotle's writings. It goes from the basics, the analysis of simple terms in the [Categories](#), the analysis of propositions and their elementary relations in [On Interpretation](#), to the study of more complex forms, namely, syllogisms and demonstration (in the [Analytics](#)) [50][51] and dialectics (in the [Topics](#) and [Sophistical Refutations](#)). The first three treatises form the core of the

logical theory *stricto sensu*: the grammar of the language of logic and the correct rules of reasoning. The *Rhetoric* is not conventionally included, but it states that it relies on the *Topics*.^[52]

Syllogism

One of Aristotle's [types of syllogism](#)^[F]

| In words | In terms ^[G] | In equations ^[H] |
|-------------------------------------|-------------------------|--|
| All men are mortal. | M a P | $\exists x: Mx \wedge \overline{Px}$ |
| All Greeks are men. | S a M | $\wedge \exists x: Sx \wedge \overline{Mx}$ |
| \therefore All Greeks are mortal. | S a P | $\Rightarrow \exists x: Sx \wedge \overline{Px}$ |

What is today called *Aristotelian logic* with its [types of syllogism](#) (methods of logical argument),^[53] Aristotle himself would have labelled "analytics". The term "logic" he reserved to mean *dialectics*.^{[55][56]}

Demonstration

Aristotle's *Posterior Analytics* contains his account of demonstration, or demonstrative knowledge, what would today be considered the study of [epistemology](#) rather than logic, but which for Aristotle is deeply connected with his account of syllogism.^[52] For Aristotle, knowledge is that which is necessarily the case, along with the study of causes.^[52]

Metaphysics

Main article: [Metaphysics \(Aristotle\)](#)

The word "metaphysics" comes from the title of a collection of works by Aristotle bearing that title. However, Aristotle did not use that term himself, which is due to a later compiler, but instead called it "first philosophy" or [theology](#).^[57] He distinguished this as "the study of being qua being" which, as opposed to other studies of being, such as mathematics and natural science, studies that which is eternal, unchanging, and immaterial.^[57] He wrote in his *Metaphysics* (1026a16):

If there were no other independent things besides the composite natural ones, the study of nature would be the primary kind of knowledge; but if there is some motionless independent thing, the knowledge of this precedes it and is first philosophy, and it is universal *in just this way*, because it is first. And it belongs to this sort of philosophy to study being as being, both what it is and what belongs to it just by virtue of being.^[58]

Substance

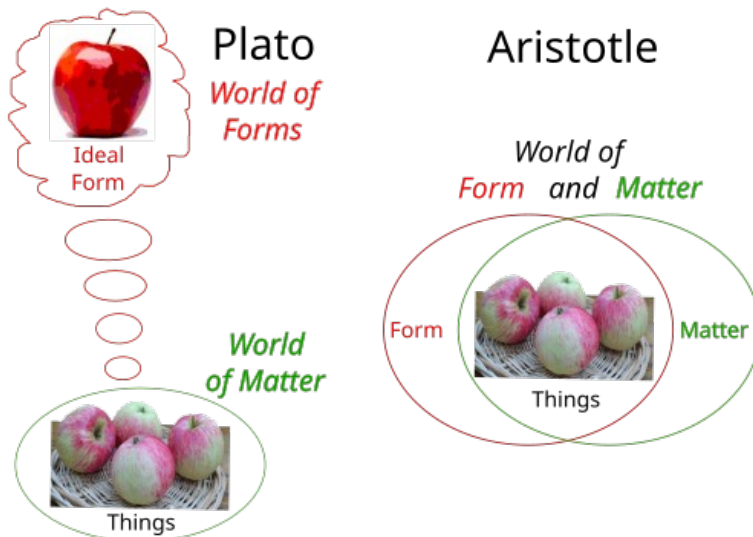
Further information: [Hylomorphism](#)

Aristotle examines the concepts of [substance](#) (*ousia*) and [essence](#) (*to ti ên einai*, "the what it was to be") in his *Metaphysics* (Book VII), and he concludes that a particular substance is a combination of both matter and form, a philosophical theory called [hylomorphism](#). In Book VIII, he distinguishes the matter of the substance as the [substratum](#), or the stuff of which it is composed. For example, the matter of a house is the bricks, stones, timbers,

etc., or whatever constitutes the *potential* house, while the form of the substance is the *actual* house, namely 'covering for bodies and chattels' or any other [differentia](#) that let us define something as a house. The formula that gives the components is the account of the matter, and the formula that gives the differentia is the account of the form. [\[59\]\[57\]](#)

Moderate realism

Main article: [Aristotle's theory of universals](#)



Plato's [forms](#) exist as [universals](#), like the ideal form of an apple. For Aristotle, both matter and form belong to the individual thing ([hylomorphism](#)).

Like his teacher Plato, Aristotle's philosophy aims at the [universal](#). Aristotle's [ontology](#) has the universal (*katholou*) exist in a lesser sense than [particulars](#) (*kath' hekaston*), things in the world, whereas for Plato the [universal](#) is a realer, separately existing form which particular things merely imitate. For Aristotle, universals still exist, but are only encountered when "instantiated" in a particular substance. [\[57\]](#)

In addition, Aristotle disagreed with Plato about the location of universals. Where Plato spoke of the forms as existing separately from the things that participate in them, Aristotle maintained that universals are multiply located. So, according to Aristotle, the form of apple exists within each apple, rather than in the world of the forms. [\[57\]\[60\]](#)

Potentiality and actuality

Concerning the nature of change ([kinesis](#)) and its causes, as he outlines in his [Physics](#) and [On Generation and Corruption](#) (319b–320a), he distinguishes coming-to-be (*genesis*, also translated as 'generation') from:

1. growth and diminution, which is change in quantity;
2. locomotion, which is change in space; and
3. alteration, which is change in quality.



Aristotle argued that a capability like playing the flute could be acquired — [the potential made actual](#) — by learning.

Coming-to-be is a change where the substrate of the thing that has undergone the change has itself changed. In that particular change he introduces the concept of potentiality ([dynamis](#)) and actuality ([entelecheia](#)) in association with the matter and the form. Referring to potentiality, this is what a thing is capable of doing or being acted upon if the conditions are right and it is not prevented by something else. For example, the seed of a plant in the soil is potentially (*dynamis*) a plant, and if it is not prevented by something, it will become a plant. Potentially, beings can either 'act' (*poiein*) or 'be acted upon' (*paschein*), which can be either innate or learned. For example, the eyes possess the potentiality of sight (innate – being acted upon), while the capability of playing the flute can be possessed by learning (exercise – acting). Actuality is the fulfilment of the end of the potentiality. Because the end (*telos*) is the principle of every change, and potentiality exists for the sake of the end, actuality, accordingly, is the end. Referring then to the previous example, it can be said that an actuality is when a plant does one of the activities that plants do.^[57]

For that for the sake of which (*to hou heneka*) a thing is, is its principle, and the becoming is for the sake of the end; and the actuality is the end, and it is for the sake of this that the potentiality is acquired. For animals do not see in order that they may have sight, but they have sight that they may see.^[61]

In summary, the matter used to make a house has potentiality to be a house and both the activity of building and the form of the final house are actualities, which is also a [final cause](#) or end. Then Aristotle proceeds and concludes that the actuality is prior to potentiality in formula, in time and in substantiality. With this definition of the particular substance (i.e., matter and form), Aristotle tries to solve the problem of the unity of the beings, for example, "what is it that makes a man one"? Since, according to [Plato](#) there are two Ideas: animal and biped, how then is man a unity? However, according to Aristotle, the potential being (matter) and the actual one (form) are one and the same.^[57]
^[62]

Natural philosophy

Aristotle's "natural philosophy" spans a wide range of natural phenomena including those now covered by physics, biology and other natural sciences.^[63] In Aristotle's terminology, "natural philosophy" is a branch of philosophy examining the phenomena of the natural world, and includes fields that would be regarded today as physics, biology and other natural sciences. Aristotle's work encompassed virtually all facets of intellectual inquiry. Aristotle makes philosophy in the broad sense coextensive with reasoning, which he also would describe as "science". However, his use of the term *science* carries a different meaning than that covered by the term "scientific method". For Aristotle, "all science

(*dianoia*) is either practical, poetical or theoretical" (*Metaphysics* 1025b25). His practical science includes ethics and politics; his poetical science means the study of fine arts including poetry; his theoretical science covers physics, mathematics and metaphysics.[63]

Physics



The four [classical elements](#) (fire, air, water, earth) of [Empedocles](#) and Aristotle illustrated with a burning log. The log releases all four elements as it is destroyed.

Main article: [Aristotelian physics](#)

Five elements

Main article: [Classical element](#)

In his *On Generation and Corruption*, Aristotle related each of the four elements proposed earlier by [Empedocles](#), [earth](#), [water](#), [air](#), and [fire](#), to two of the four sensible qualities, hot, cold, wet, and dry. In the Empedoclean scheme, all matter was made of the four elements, in differing proportions. Aristotle's scheme added the heavenly [aether](#), the divine substance of the [heavenly spheres](#), stars and planets.[64]

Aristotle's elements[64]

| Element | Hot/Cold | Wet/Dry | Motion | Modern state of matter |
|------------------------|--------------------|---------|-----------------------|------------------------|
| Earth | Cold | Dry | Down | Solid |
| Water | Cold | Wet | Down | Liquid |
| Air | Hot | Wet | Up | Gas |
| Fire | Hot | Dry | Up | Plasma |
| Aether | (divine substance) | None | Circular (in heavens) | Vacuum |

Motion

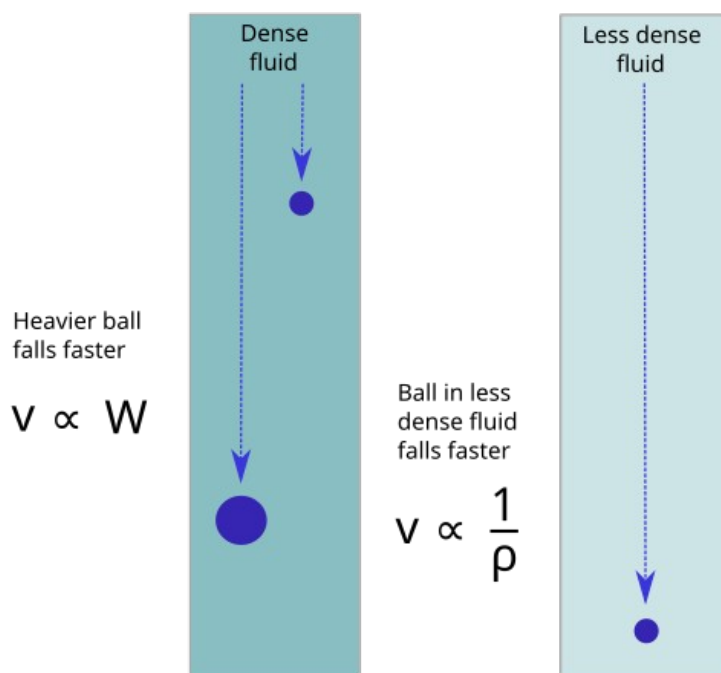
Further information: [History of classical mechanics](#)

Aristotle describes two kinds of motion: "violent" or "unnatural motion", such as that of a thrown stone, in the *Physics* (254b10), and "natural motion", such as of a falling object, in *On the Heavens* (300a20). In violent motion, as soon as the agent stops causing it, the motion stops also: in other words, the natural state of an object is to be at rest,^{[65][I]} since Aristotle does not address [friction](#).^[66] With this understanding, it can be observed that, as Aristotle stated, heavy objects (on the ground, say) require more force to make them move; and objects pushed with greater force move faster.^{[67][J]} This would imply the equation^[67]

$$F = mv,$$

incorrect in modern physics.^[67]

Natural motion depends on the element concerned: the aether naturally moves in a circle around the heavens,^[K] while the 4 Empedoclean elements move vertically up (like fire, as is observed) or down (like earth) towards their natural resting places.^{[68][66][L]}



Aristotle's laws of motion.

In *Physics* he states that objects fall at a speed proportional to their weight and inversely proportional to the density of the fluid they are immersed in.^[66] This is a correct approximation for objects in Earth's gravitational field moving in air or water.^[68]

In the *Physics* (215a25), Aristotle effectively states a quantitative law, that the speed, v , of a falling body is proportional (say, with constant c) to its weight, W , and inversely proportional to the density,^[M] ρ , of the fluid in which it is falling:;^{[68][66]}

$$v = c \frac{W}{\rho}$$

Aristotle implies that in a [vacuum](#) the speed of fall would become infinite, and concludes from this apparent absurdity that a vacuum is not possible.^{[68][66]} Opinions have varied on whether Aristotle intended to state quantitative laws. Henri Carteron held the "extreme view"^[66] that Aristotle's concept of force was basically qualitative,^[69] but other authors reject this.^[66]

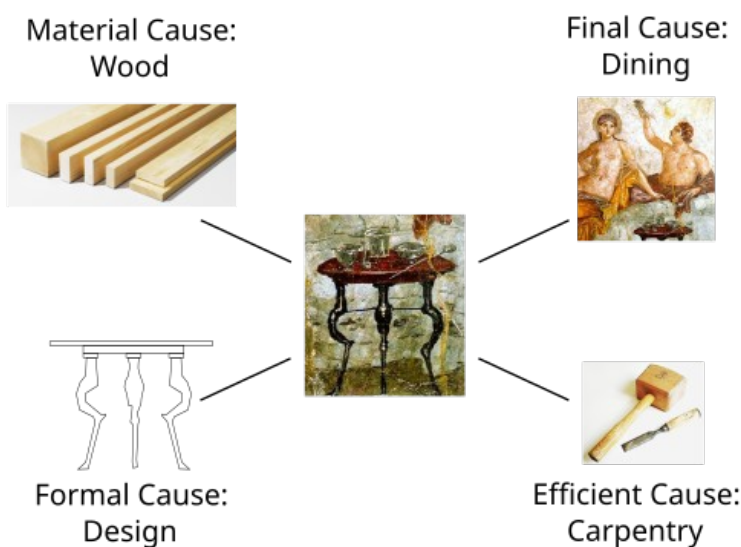
[Archimedes](#) corrected Aristotle's theory that bodies move towards their natural resting places; metal boats can float if they [displace enough water](#); floating depends in Archimedes' scheme on the mass and volume of the object, not, as Aristotle thought, its elementary composition.^[68]

Aristotle's writings on motion remained influential until the [early modern](#) period. [John Philoponus](#) (in [late antiquity](#)) and [Galileo](#) (in the early modern period) are said to have shown by experiment that Aristotle's claim that a heavier object falls faster than a lighter object is incorrect.^[63] A contrary opinion is given by [Carlo Rovelli](#), who argues that Aristotle's physics of motion is correct within its domain of validity, that of objects in the [Earth's](#) gravitational field immersed in a fluid such as air. In this system, heavy bodies in steady fall indeed travel faster than light ones (whether friction is ignored, or not^[68]), and they do fall more slowly in a denser medium.^{[67][N]}

Newton's "forced" motion corresponds to Aristotle's "violent" motion with its external agent, but Aristotle's assumption that the agent's effect stops immediately it stops acting (e.g., the ball leaves the thrower's hand) has awkward consequences: he has to suppose that surrounding fluid helps to push the ball along to make it continue to rise even though the hand is no longer acting on it, resulting in the Medieval [theory of impetus](#).^[68]

Four causes

Main article: [Four causes](#)



Aristotle argued by analogy with woodwork that a thing takes its form from [four causes](#): in the case of a table, the wood

used (material cause), its design (formal cause), the tools and techniques used (efficient cause), and its decorative or practical purpose (final cause).[70]

Aristotle distinguished between four different "causes" ([Ancient Greek](#): αἰτία, *aitia*) or explanations for why an object exists or changes:[71][72]

- The [material cause](#) describes the material out of which something is composed. Thus the material cause of a wooden table is the wood it is made of.[71]
- The [formal cause](#) is its form, i.e., the arrangement of that matter, the design of the table independent of the specific material it is made of.[71]
- The [efficient cause](#) is "the primary source", the modern definition of "cause" as either the agent or agency of particular events or states of affairs. In the case of two dominoes, when the first is knocked over it *causes* the second to fall.[71] In the case of an animal, this agency is a combination of [how it develops from the egg](#), and [how its body functions](#).[73]
- The [final cause](#) (*telos*) is its purpose, the reason why it exists or is done, or function that something is supposed to serve.[71] In the case of living things, it implies [adaptation](#) to a particular way of life.[73]

Optics

Aristotle was aware of Pythagorean optics.[74] He used optics in his *Meteorology*, treating it as a science.[75] He viewed optics as stating the laws of sight, thus combining what is now treated as physics and biology.[76] The process of seeing involved the movement of a visible form from the thing seen through the air (or other medium) to the eye, where the form comes to rest. Aristotle does not analyse the nature of this movement; he does not anticipate [geometrical optics](#).[77]

Chance and spontaneity

Further information: [Accident \(philosophy\)](#)

According to Aristotle, spontaneity and chance are causes of some things, distinguishable from other types of cause such as simple necessity. Chance as an incidental cause lies in the realm of [accidental things](#), "from what is spontaneous". There is also more a specific kind of chance, which Aristotle names "luck", that only applies to people's moral choices.
[78][79]

Astronomy

Further information: [History of astronomy](#)

In [astronomy](#), Aristotle refuted [Democritus](#)'s claim that the [Milky Way](#) was made up of "those stars which are shaded by the earth from the sun's rays," pointing out partly correctly that if "the size of the sun is greater than that of the earth and the distance of the stars from the earth many times greater than that of the sun, then... the sun shines on all the stars and the earth screens none of them." [80] He also wrote descriptions of comets, including the [Great Comet of 371 BC](#). [81]

Geology and natural sciences

Further information: [History of geology](#)



Aristotle noted that the ground level of the [Aeolian islands](#) changed before a [volcanic eruption](#).

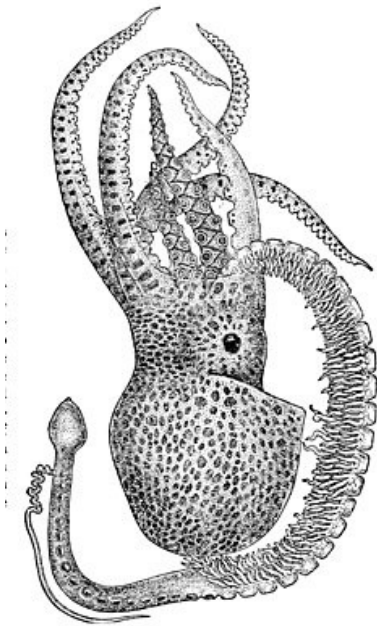
Aristotle was one of the first people to record any [geological](#) observations. He stated that [geological change](#) was too slow to be observed in one person's lifetime.^{[82][83]} The geologist [Charles Lyell](#) noted that Aristotle described such change, including "lakes that had dried up" and "deserts that had become watered by rivers", giving as examples the growth of the [Nile delta](#) since the time of [Homer](#), and "the upheaving of one of the [Aeolian islands](#), previous to a [volcanic eruption](#)."^[84]

Meteorologica lends its name to the modern study of meteorology, but its modern usage diverges from the content of Aristotle's ancient treatise on [meteors](#). The ancient Greeks did use the term for a range of atmospheric phenomena, but also for [earthquakes](#) and volcanic eruptions. Aristotle proposed that the cause of earthquakes was a gas or vapor (*anathymiaseis*) that was trapped inside the earth and trying to escape, following other Greek authors [Anaxagoras](#), [Empedocles](#) and [Democritus](#).^[85]

Aristotle also made many observations about the hydrologic cycle. For example, he made some of the earliest observations about desalination: he observed early – and correctly – that when seawater is heated, freshwater evaporates and that the oceans are then replenished by the cycle of rainfall and river runoff ("I have proved by experiment that salt water evaporated forms fresh and the vapor does not when it condenses condense into sea water again.")^[86]

Biology

Main article: [Aristotle's biology](#)



Among many pioneering zoological observations, Aristotle described the reproductive [hectocotyl arm](#) of the [octopus](#) (bottom left).

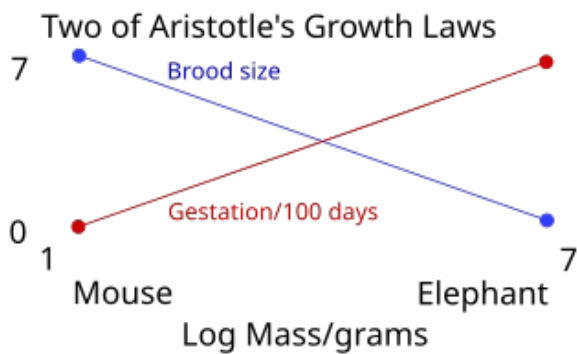
Empirical research

Aristotle was the first person to study biology systematically,^[87] and biology forms a large part of his writings. He spent two years observing and describing the zoology of [Lesbos](#) and the surrounding seas, including in particular the Pyrrha lagoon in the centre of Lesbos.^{[88][89]} His data in [History of Animals](#), [Generation of Animals](#), [Movement of Animals](#), and [Parts of Animals](#) are from his own observations,^[90] statements by knowledgeable people such as beekeepers and fishermen, and accounts by travellers.^[91] His apparent emphasis on animals rather than plants is a historical accident: his works on [botany](#) have been lost, but two books on plants by his pupil Theophrastus have survived.^[92]

Aristotle reports on sea-life from observation on Lesbos and the catches of fishermen. He describes the [catfish](#), [electric ray](#), and [frogfish](#), as well as [cephalopods](#) such as the [octopus](#) and [paper nautilus](#). His description of the [hectocotyl arm](#) of cephalopods, used in sexual reproduction, was widely disbelieved until the 19th century.^[93] He gives accurate descriptions of the four-chambered stomachs of [ruminants](#),^[94] and of the [ovoviviparous](#) embryological development of the [hound shark](#).^[95]

He notes that an animal's structure is well matched to function so the [heron](#) has a long neck, long legs, and a sharp spear-like beak, whereas [ducks](#) have short legs and webbed feet.^[96] [Darwin](#), too, noted such differences, but unlike Aristotle used the data to come to the theory of [evolution](#).^[97] Aristotle's writings can seem to imply evolution, but Aristotle saw mutations or [hybridizations](#) as rare accidents, distinct from natural causes. He was thus critical of Empedocles's theory of a "survival of the fittest" origin of living things and their organs, and ridiculed the idea that accidents could lead to orderly results.^[98] In modern terms, he nowhere says that different species can have a [common ancestor](#), that one kind can [change into another](#), or that kinds can become [extinct](#).^[99]

Scientific style



Aristotle inferred growth laws from his observations on animals, including that [brood size](#) decreases with body mass, whereas [gestation](#) period increases.

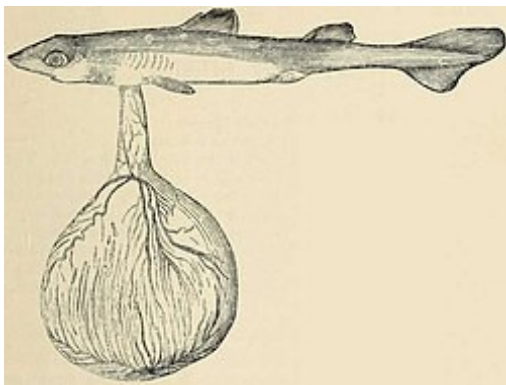
Aristotle did not do experiments in the modern sense.^[100] He made observations, or at most investigative procedures like dissection.^[101] In *Generation of Animals*, he opens a fertilized hen's egg to see the embryo's heart beating inside.^{[102][103]}

Instead, he systematically gathered data, discovering patterns common to whole groups of animals, and inferring possible causal explanations from these.^{[104][105]} This style is common in modern biology when large amounts of data become available in a new field, such as [genomics](#). This sets out testable hypotheses and constructs a narrative explanation of what is observed. In this sense, [Aristotle's biology](#) is scientific.^[104]

From his data, Aristotle inferred [rules](#) relating the life-history features of live-bearing tetrapods (terrestrial placental mammals) that he studied. He correctly predicted that brood size decreases with body mass; that [lifespan](#) increases with [gestation period](#) and with body mass, and that [fecundity](#) decreases with lifespan.^[106]

Classification of living things

Further information: [Scala naturae](#)



Aristotle recorded that the [embryo](#) (fetus pictured) of a [dogfish](#) was attached by a cord to a kind of placenta (the [yolk sac](#)), like a higher animal; this formed an exception to the linear scale from highest to lowest.^[107]

Aristotle distinguished about 500 [animal](#) species,^{[108][109]} arranging them in a nonreligious graded [scale of perfection](#), with man at the top. The highest gave [live birth](#) to hot and wet creatures, the lowest laid cold, dry mineral-like eggs.^{[110][111]} He grouped what a zoologist would call [vertebrates](#) as "animals with blood", and [invertebrates](#) as "animals without blood". Those with blood were divided into live-bearing ([mammals](#)), and egg-laying ([birds](#), [reptiles](#), [fish](#)). Those without blood were insects, crustacea and hard-shelled [molluscs](#). He recognised that animals did not exactly fit onto a scale, and noted exceptions, such as that sharks had a [placenta](#). To a biologist, the explanation is [convergent evolution](#).^[112] Philosophers of science have concluded that Aristotle was not interested in taxonomy,^{[113][114]} but zoologists think otherwise.^{[115][116][117]}

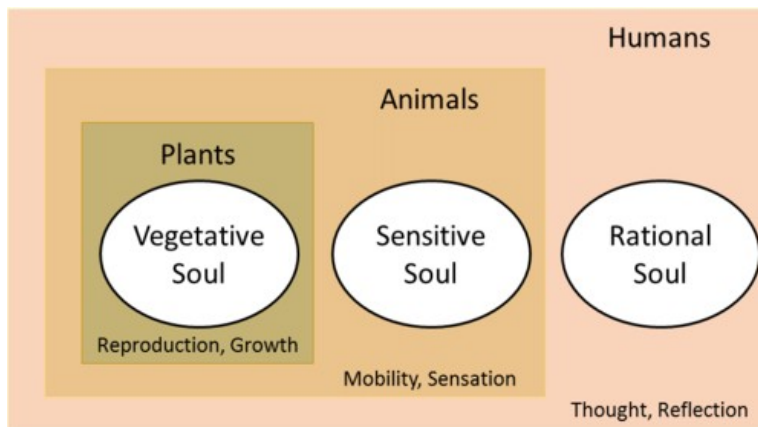
Aristotle's *Scala naturae* (highest to lowest)

| Group | Examples (given by Aristotle) | Blood | Legs | Souls (Rational, Sensitive, Vegetative) | Qualities (Hot –Cold, Wet– Dry) |
|--|--|------------|-----------|--|---|
| Man | Man | with blood | 2 legs | R, S, V | Hot, Wet |
| Live-bearing tetrapods | Cat, hare | with blood | 4 legs | S, V | Hot, Wet |
| Cetaceans | Dolphin , whale | with blood | none | S, V | Hot, Wet |
| Birds | Bee-eater , nightjar | with blood | 2 legs | S, V | Hot, Wet, except Dry eggs |
| Egg-laying tetrapods | Chameleon , crocodile | with blood | 4 legs | S, V | Cold, Wet except scales, eggs |
| Snakes | Water snake, Ottoman viper | with blood | none | S, V | Cold, Wet except scales, eggs |
| Egg-laying fishes | Sea bass , parrotfish | with blood | none | S, V | Cold, Wet, including eggs |
| (Among the egg-laying fishes): placental selachians | Shark , skate | with blood | none | S, V | Cold, Wet, but placenta like tetrapods |
| Crustaceans | Shrimp , crab | without | many legs | S, V | Cold, Wet except shell |
| Cephalopods | Squid , octopus | without | tentacles | S, V | Cold, Wet |
| Hard-shelled animals | Cockle , trumpet snail | without | none | S, V | Cold, Dry (mineral shell) |
| Larva-bearing insects | Ant , cicada | without | 6 legs | S, V | Cold, Dry |
| Spontaneously generating | Sponges , worms | without | none | S, V | Cold, Wet or Dry , from earth |
| Plants | Fig | without | none | V | Cold, Dry |
| Minerals | Iron | without | none | none | Cold, Dry |

Psychology

Soul

Further information: [On the Soul](#)



Aristotle proposed a three-

part [structure for souls](#) of plants, animals, and humans, making humans unique in having all three types of soul.

Aristotle's [psychology](#), in his treatise *On the Soul* (*peri psychēs*), posits three kinds of [soul](#) (*psyches*): the vegetative, sensitive, and rational. Humans have all three. The vegetative soul is concerned with growth and nourishment. The sensitive soul experiences sensations and movement. The uniquely human, rational soul receives forms of things and compares them using the [nous](#) (intellect) and *logos* (reason).^[118]

For Aristotle, the soul is the [form](#) of a living being. Because all beings are composites of form and matter, the form of living beings is that which endows them with what is specific to living beings, e.g. the ability to initiate movement.^[119] In contrast to earlier philosophers, but in accordance with the Egyptians, he placed the rational soul in the heart.^[120] Aristotle distinguished sensation and thought, unlike previous philosophers except for [Alcmaeon](#).^[121]

In *On the Soul*, Aristotle criticizes Plato's theory of the soul and develops his own in response. Firstly he criticises Plato's *Timaeus* which holds the soul takes up space and can come into physical contact with bodies.^[122] 20th-century scholarship held that Aristotle had here misinterpreted Plato.^[123] Aristotle also argued that Plato's view of reincarnation entails that a soul and its body can be mis-matched; in principle, Aristotle alleges, any soul can go with any body, according to Plato's theory.^[124]

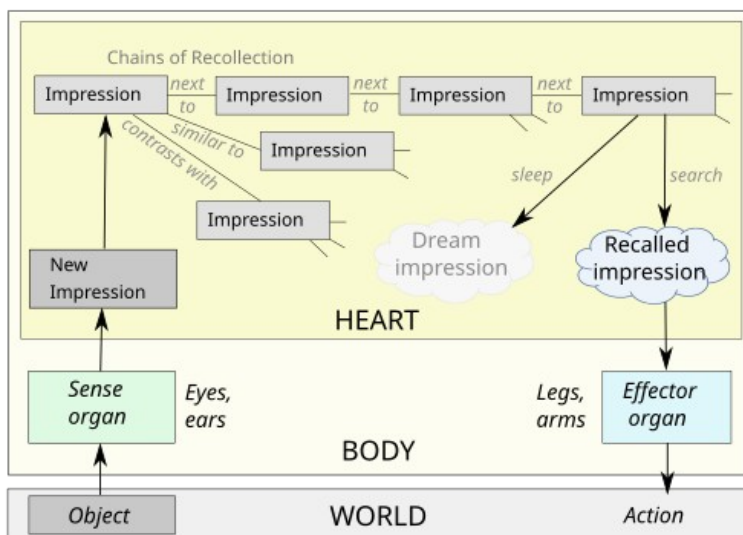
Memory

According to Aristotle in *On the Soul*, memory is the ability to hold a perceived experience in the mind and to distinguish between the internal "appearance" and a past occurrence.^[125] A memory is a mental picture ([phantasm](#)) that can be recovered. An impression is left on a semi-fluid bodily organ that undergoes changes in order to make a memory. A memory occurs when [stimuli](#) such as sights or sounds are so complex that the nervous system cannot receive them all at once. These changes are the same as those involved in sensation, '[common sense](#)', and thinking.^{[126][127]}

Aristotle uses the term 'memory' for the actual retaining of an experience in the impression that develops from sensation, and for the intellectual anxiety that comes with the impression because it is formed at a particular time and processing specific contents. Memory is of the past, prediction is of the future, and sensation is of the present. Retrieval

of impressions cannot be performed suddenly. A transitional channel is needed and located in past experiences, both for previous experience and present experience.[128]

Because Aristotle believes people perceive all kinds of sense perceptions as impressions, people continually weave together new impressions of experiences. To search for impressions, people search memory itself.[129] Within memory, if an experience is offered instead of a specific memory, that person will reject this experience until they find what they are looking for. Recollection occurs when a retrieved experience naturally follows another. If the chain of "images" is needed, one memory stimulates the next. When people recall experiences, they stimulate certain previous experiences until they reach the one that is needed.[130] Recollection is thus the self-directed activity of retrieving information stored in a memory impression.[131] Only humans can remember impressions of intellectual activity, such as numbers and words. Animals that have perception of time can retrieve memories of their past observations. Remembering involves only perception of the things remembered and of the time passed.[132]



Senses, perception, memory, dreams, action in Aristotle's psychology. Impressions are stored in the [sensorium](#) (the heart), linked by his [laws of association](#) (similarity, contrast, and [contiguity](#)).

Aristotle believed the chain of thought that achieves recollection of impressions was connected systematically in relationships such as similarity, contrast, and [contiguity](#), described in his [laws of association](#). Aristotle believed that past experiences are hidden within the mind. A force operates to awaken the hidden material to bring up the actual experience. Association is the power innate in a mental state, which operates upon the unexpressed remains of former experiences, allowing them to be recalled.[133][134]

Dreams

Further information: [Dream § Other](#)

Aristotle describes sleep in *On Sleep and Wakefulness*.^[135] It is a result of overuse of the senses^[136] or of digestion,^[137] and is vital to the body.^[136] While a person is asleep, the critical activities, which include thinking, sensing, recalling and remembering, do not function. Since a person cannot sense during sleep, they cannot have desire. However, the senses work during sleep,^[136] albeit differently.^[135]

Dreams do not involve sensing a stimulus. Sensation is involved, but in an altered manner.^[136] Aristotle explains that when a person stares at a moving stimulus such as the waves in a body of water, and then looks away, the next thing they look at appears to have a wavelike motion. When a person perceives a stimulus and it is no longer the focus of their attention, it leaves an impression.^[135] When the body is awake, a person constantly encounters new stimuli and so the impressions of previous stimuli are ignored.^[136] However, during sleep the impressions made throughout the day are noticed, free of distractions.^[135] So, dreams result from these lasting impressions. Since impressions are all that are left, dreams do not resemble waking experience.^[138] During sleep, a person is in an altered state of mind, like a person who is overtaken by strong feelings. For example, a person who has a strong infatuation with someone may begin to think they see that person everywhere. Since a person sleeping is in a suggestible state and unable to make judgements, they become easily deceived by what appears in their dreams, like the infatuated person.^[135] This leads them to believe the dream is real, even when the dreams are absurd.^[135] In *De Anima* iii 3, Aristotle ascribes the ability to create, to store, and to recall images to the faculty of imagination, *phantasia*.^[119]

One component of Aristotle's theory disagrees with previously held beliefs. He claimed that dreams are not foretelling and not sent by a divine being. Aristotle reasoned that instances in which dreams resemble future events are simply coincidences.^[139] Any sensory experience perceived while a person is asleep, such as actually hearing a door close, does not qualify as part of a dream. Images of dreams must be a result of lasting impressions of waking sensory experiences.^[138]

Practical philosophy

Aristotle's practical philosophy covers areas such as [ethics](#), [politics](#), [economics](#), and [rhetoric](#).^[63]

Ethics

Main article: [Aristotelian ethics](#)

Aristotle was a [virtue ethicist](#) who considered ethics to be a practical rather than theoretical study, i.e., one aimed at becoming good and doing good rather than knowing for its own sake. He wrote several treatises on ethics, most notably including the *Nicomachean Ethics*.^[140]

| Virtues and their accompanying vices ^[35] | | |
|--|-----------------|----------------|
| Too little | Virtuous mean | Too much |
| Humbleness | High-mindedness | Vainglory |
| Lack of purpose | Right ambition | Over-ambition |
| Spiritlessness | Good temper | Irascibility |
| Rudeness | Civility | Obsequiousness |
| Cowardice | Courage | Rashness |
| Insensibility | Self-control | Intemperance |
| Sarcasm | Sincerity | Boastfulness |
| Boorishness | Wit | Buffoonery |
| Callousness | Just resentment | Spitefulness |
| Pettiness | Generosity | Vulgarity |
| Meanness | Liberality | Wastefulness |

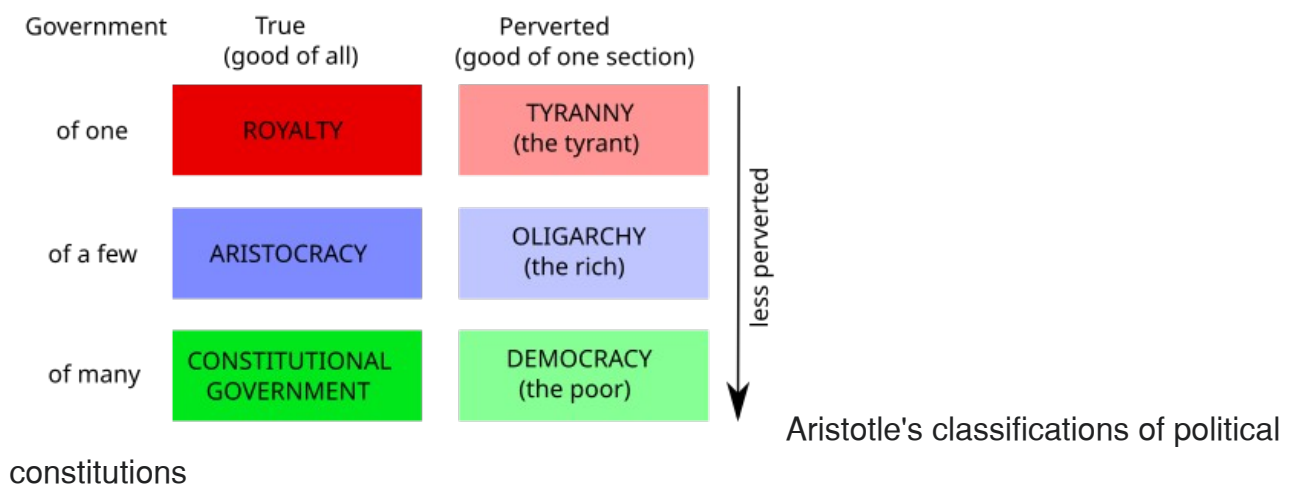
Aristotle taught that virtue has to do with the proper function (*ergon*) of a thing. An eye is only a good eye in so much as it can see because the proper function of an eye is sight. Aristotle reasoned that humans must have a function specific to humans, and that this function must be an activity of the *psuchē* (*soul*) in accordance with reason (*logos*). Aristotle identified such an optimum activity (the virtuous mean, between the accompanying vices of excess or deficiency^[35]) of the soul as the aim of all human deliberate action, *eudaimonia*, generally translated as "happiness" or sometimes "well-being". To have the potential of ever being happy in this way necessarily requires a good character (*ēthikē aretē*), often translated as moral or ethical virtue or excellence.^[141]

Aristotle taught that to achieve a virtuous and potentially happy character requires a first stage of having the fortune to be habituated, not deliberately, but by teachers, and experience, leading to a later stage in which one consciously chooses to do the best things, becoming the *phronimos* or virtuous man. When the best people come to live life this way their practical wisdom (*phronesis*) and their intellect (*nous*) can develop with each other towards the highest possible human virtue, the wisdom of an accomplished theoretical or speculative thinker, or in other words, a philosopher.[142]

Politics

Main article: [Politics \(Aristotle\)](#)

In addition to his works on ethics, which address the individual, Aristotle addressed the city in his work titled *Politics*. Aristotle considered the city to be a natural community. Moreover, he considered the city to be prior in importance to the family, which in turn is prior to the individual, "for the whole must of necessity be prior to the part".[143] He famously stated that "man is by nature a political animal" and argued that humanity's defining factor among others in the animal kingdom is its rationality.[144] Aristotle conceived of politics as being like an organism rather than like a machine, and as a collection of parts, none of which can exist without the others. Aristotle's conception of the city is organic, and he is considered one of the first to conceive of the city in this manner.[145]



The common modern understanding of a political community as a modern state is quite different from Aristotle's understanding. Although he was aware of the existence and potential of larger empires, the natural community according to Aristotle was the city (*polis*) which functions as a political "community" or "partnership" (*koinōnia*). The aim of the city is not just to avoid injustice or for economic stability, but rather to allow at least some citizens the possibility to live a good life, and to perform beautiful acts: "The political partnership must be regarded, therefore, as being for the sake of noble actions, not for the sake of living together." This is distinguished from modern approaches, beginning with [social contract](#) theory, according to which individuals leave the [state of nature](#) because of "fear of violent death" or its "inconveniences".[146]

In *Protrepticus*, the character 'Aristotle' states:[146]

For we all agree that the most excellent man should rule, i.e., the supreme by nature, and that the law rules and alone is authoritative; but the law is a kind of intelligence, i.e. a discourse based on intelligence. And again, what standard do we have, what criterion of good things, that is more precise than the intelligent man? For all that this man will choose, if the choice is based on his knowledge, are good things and their contraries are bad. And since everybody chooses most of all what conforms to their own proper dispositions (a just man choosing to live justly, a man with bravery to live bravely, likewise a self-controlled man to live with self-control), it is clear that the intelligent man will choose most of all to be intelligent; for this is the function of that capacity. Hence it's evident that, according to the most authoritative judgment, intelligence is supreme among goods.[146]

As Plato's disciple Aristotle was rather critical concerning democracy and, following the outline of certain ideas from Plato's *Statesman*, he developed a coherent theory of integrating various forms of power into a so-called mixed state:

It is ... constitutional to take ... from oligarchy that offices are to be elected, and from democracy that this is not to be on a property-qualification. This then is the mode of the mixture; and the mark of a good mixture of democracy and oligarchy is when it is possible to speak of the same constitution as a democracy and as an oligarchy.

—Aristotle. *Politics*, Book 4, 1294b.10–18

Economics

Main article: [Politics \(Aristotle\)](#)

Aristotle made substantial contributions to [economic thought](#), especially to thought in the Middle Ages.[147] In *Politics*, Aristotle addresses the city, [property](#), and [trade](#). His response to criticisms of [private property](#), in [Lionel Robbins](#)'s view, anticipated later proponents of private property among philosophers and economists, as it related to the overall [utility](#) of social arrangements.[147] Aristotle believed that although communal arrangements may seem beneficial to society, and that although private property is often blamed for social strife, such evils in fact come from [human nature](#). In *Politics*, Aristotle offers one of the earliest accounts of the origin of [money](#). [147] Money came into use because people became dependent on one another, importing what they needed and exporting the surplus. For the sake of convenience, people then agreed to deal in something that is intrinsically useful and easily applicable, such as iron or [silver](#). [148]

Aristotle's discussions on [retail](#) and [interest](#) was a major influence on economic thought in the Middle Ages. He had a low opinion of retail, believing that contrary to using money to procure things one needs in managing the household, retail trade seeks to make a [profit](#). It thus uses goods as a means to an end, rather than as an end unto itself. He believed that retail trade was in this way unnatural. Similarly, Aristotle considered making a profit through interest unnatural, as it makes a gain out of the money itself, and not from its use. [148]

Aristotle gave a summary of the function of money that was perhaps remarkably precocious for his time. He wrote that because it is impossible to determine the value of every good through a count of the number of other goods it is worth, the necessity arises of a single universal standard of measurement. Money thus allows for the association of

different goods and makes them "commensurable".^[148] He goes on to state that money is also useful for future exchange, making it a sort of security. That is, "if we do not want a thing now, we shall be able to get it when we do want it".^[148]

Rhetoric

Part of [a series](#) on

Rhetoric



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Main article: [Rhetoric \(Aristotle\)](#)

Aristotle's *Rhetoric* proposes that a speaker can use three basic kinds of appeals to persuade his audience: *ethos* (an appeal to the speaker's character), *pathos* (an appeal to the audience's emotion), and *logos* (an appeal to logical reasoning).^[149] He also categorizes rhetoric into three genres: *epideictic* (ceremonial speeches dealing with praise or blame), *forensic* (judicial speeches over guilt or innocence), and *deliberative* (speeches calling on an audience to decide on an issue).^[150] Aristotle also outlines two kinds of rhetorical *proofs*: *enthymeme* (proof by *syllogism*) and *paradeigma* (proof by example).^[151]

Poetics

Main article: [Poetics \(Aristotle\)](#)

Aristotle writes in his *Poetics* that *epic poetry*, tragedy, comedy, *dithyrambic* poetry, painting, sculpture, music, and dance are all fundamentally acts of *mimesis* ("imitation"), each varying in imitation by medium, object, and manner.^{[152][153]} He applies the term *mimesis* both as a property of a work of art and also as the product of the artist's intention^[152] and contends that the audience's realisation of the *mimesis* is vital to understanding the work itself.^[152] Aristotle states that *mimesis* is a natural instinct of

humanity that separates humans from animals^{[152][154]} and that all human artistry "follows the pattern of nature".^[152] Because of this, Aristotle believed that each of the mimetic arts possesses what [Stephen Halliwell](#) calls "highly structured procedures for the achievement of their purposes."^[155] For example, music imitates with the media of rhythm and harmony, whereas dance imitates with rhythm alone, and poetry with language. The forms also differ in their object of imitation. Comedy, for instance, is a dramatic imitation of men worse than average; whereas tragedy imitates men slightly better than average. Lastly, the forms differ in their manner of imitation – through narrative or character, through change or no change, and through drama or no drama.^[156]



The Blind Oedipus Commending his Children to the Gods (1784) by [Bénigne Gagneraux](#). In his *Poetics*, Aristotle uses the tragedy *Oedipus Tyrannus* by [Sophocles](#) as an example of how the perfect tragedy should be structured, with a generally good protagonist who starts the play prosperous, but loses everything through some *hamartia* (fault).^[157]

While it is believed that Aristotle's *Poetics* originally comprised two books – one on comedy and one on tragedy – only the portion that focuses on tragedy has survived. Aristotle taught that tragedy is composed of six elements: plot-structure, character, style, thought, spectacle, and lyric poetry.^[158] The characters in a tragedy are merely a means of driving the story; and the plot, not the characters, is the chief focus of tragedy. Tragedy is the imitation of action arousing pity and fear, and is meant to effect the *catharsis* of those same emotions. Aristotle concludes *Poetics* with a discussion on which, if either, is superior: epic or tragic mimesis. He suggests that because tragedy possesses all the attributes of an epic, possibly possesses additional attributes such as spectacle and music, is more unified, and achieves the aim of its mimesis in shorter scope, it can be considered superior to epic.^[159] Aristotle was a keen systematic collector of riddles, folklore, and proverbs; he and his school had a special interest in the riddles of the [Delphic Oracle](#) and studied the fables of [Aesop](#).^[160]

Legacy

Further information: [List of writers influenced by Aristotle](#)



Preface to [Argyropoulos's](#) 15th century Latin translation of

Aristotle's *Physics*

More than 2300 years after his death, Aristotle remains one of the most influential people who ever lived.^{[161][162][163]} He contributed to almost every field of human knowledge then in existence, and he was the founder of many new fields. According to the philosopher [Bryan Magee](#), "it is doubtful whether any human being has ever known as much as he did".^[164] Aristotle has been regarded as the first [scientist](#).^{[165][166]}

Aristotle was the founder of [term logic](#), pioneered the study of [zoology](#), and benefited future scientists and philosophers through his contributions to the scientific method.^{[40][167][168]} Taneli Kukkonen, observes that his achievement in founding two sciences is unmatched, and his reach in influencing "every branch of intellectual enterprise" including Western ethical and political theory, theology, rhetoric, and literary analysis is equally long. As a result, Kukkonen argues, any analysis of reality today "will almost certainly carry Aristotelian overtones ... evidence of an exceptionally forceful mind."^[168] [Jonathan Barnes](#) wrote that "an account of Aristotle's intellectual afterlife would be little less than a history of European thought".^[169]

Aristotle has been called the father of logic, biology, political science, zoology, embryology, natural law, scientific method, rhetoric, psychology, realism, criticism, individualism, teleology, and meteorology.^[171]

The scholar Taneli Kukkonen writes that "in the best 20th-century scholarship Aristotle comes alive as a thinker wrestling with the full weight of the Greek philosophical tradition."^[168] What follows is an overview of the transmission and influence of his texts and ideas into the modern era.^{[172][173]}

Ancient

Hellenistic period

Further information: [Peripatetic school](#) and [Alexandria School of Medicine](#)



Frontispiece to a 1644 version of Theophrastus's *Historia Plantarum*, originally written c. 300 BC

The immediate influence of Aristotle's work was felt as the [Lyceum](#) grew into the [Peripatetic school](#). Aristotle's students included [Aristoxenus](#), [Dicaearchus](#), [Demetrius of Phalerum](#), [Eudemos of Rhodes](#), [Harpalus](#), [Hephaestion](#), [Mnason of Phocis](#), [Nicomachus](#), and Theophrastus.^[174]

Aristotle's pupil and successor, [Theophrastus](#), wrote the *History of Plants*, a pioneering work in botany. Some of his technical terms remain in use, such as [carpel](#) from *carpos*, fruit, and [pericarp](#), from *pericarpion*, seed chamber.^[175] Theophrastus was much less concerned with formal causes than Aristotle was, instead pragmatically describing how plants functioned.^{[176][177]}

Under the [Ptolemies](#), the first medical teacher at [Alexandria](#), [Herophilus of Chalcedon](#), corrected Aristotle, placing intelligence in the brain, and connected the nervous system to motion and sensation. Herophilus also distinguished between [veins](#) and [arteries](#), noting that the latter [pulse](#) while the former do not.^[178]

Early Roman empire

See also: [Commentaries on Aristotle](#)

In antiquity, Aristotle's writings were divisible into two groups; the "[exoteric](#)" works, intended for the public, and the "[esoteric](#)" treatises, for use within the [Lyceum](#) school.^[179]^[180] However, all of the [works of Aristotle](#) that have survived from antiquity through medieval manuscript transmission are the technical philosophical treatises from within Aristotle's school,^[181] which were compiled in the 1st century BC by Andronicus of Rhodes out of a series of smaller, separate works into the more cohesive, larger works as they are known today.^{[182][183]}

The primary way that ancient philosophers in the Roman empire engaged with Aristotle's technical work was via [philosophical commentary](#); interpretation and explication of the text

of Aristotle along with their own synthesis and views on the topics discussed by Aristotle. The peripatetic commentary tradition began with [Boethus of Sidon](#) in the 1st century BC and reached its peak at the end of the 2nd century AD with [Alexander of Aphrodisias](#), who was appointed to the official Imperial chair of Aristotelian philosophy established by [Marcus Aurelius](#), many of whose commentaries still survive.^[184]

Late antiquity

In the 3rd century, [Neoplatonism](#) emerged as the dominant philosophical school. The Neoplatonists saw all subsequent philosophical systems after Plato, including Aristotle's, as developments on Plato's philosophy, and sought to explain how Plato and Aristotle were in agreement, even on subjects where they appeared to disagree, and included Aristotle's logical and physical works in their school curriculum as introductory works that needed to be mastered before the study of Plato himself. This study program began with the *Categories*, which the Neoplatonist philosopher [Porphyry of Tyre](#) wrote an introduction to, called *Isagoge*, which went on to influence subsequent philosophy in late antiquity and the medieval period. Later Neoplatonists in Athens and Alexandria including [Syrianus](#), [Ammonius Hermiae](#), [Olympiodorus the Younger](#) and [Simplicius of Cilicia](#) wrote further commentaries on Aristotle from a Platonist perspective which are still extant, with Simplicius compiling many of the lost works of his predecessors into massive commentaries that survey the entire Neoplatonic tradition.^[184]

With the rise of Christianity and closure of the pagan schools by the order of [Justinian](#) in 529,^[185] the study of Aristotle and other philosophers in the remainder of the Byzantine period was primarily from a Christian perspective. The first Byzantine Christians to comment extensively on Aristotle were Philoponus, who was a student of Ammonius, and Elias and David, students of Olympiodorus, along with [Stephen of Alexandria](#) in the early seventh century, who brought the study of Plato and Aristotle from Alexandria to Constantinople.^[186] [John Philoponus](#) stands out for having attempted a fundamental critique of Aristotle's views on the [eternity of the world](#), movement, and other elements of Aristotelian thought.^[187] Philoponus questioned Aristotle's teaching of physics, noting its flaws and introducing the [theory of impetus](#) to explain his observations.^[188]

Medieval

Medieval Byzantine empire

See also: [Byzantine Aristotelianism](#)

After a hiatus of several centuries, formal commentary by [Eustratius](#) and [Michael of Ephesus](#) reappeared in the late eleventh and early twelfth centuries, apparently sponsored by [Anna Comnena](#).^[189] Byzantine philosophers also filled in the gaps in the commentaries that had survived down to their time; Alexander of Aphrodisias' commentary on the *Metaphysics*, of which only the first five books survived, was completed by Michael of Ephesus, who also wrote a commentary on the [Sophistical Refutations](#), the only work of the [Organon](#) not to have a commentary, and Michael of Ephesus and Eustratius compiled a number of fragmentary commentaries on the *Nicomachean Ethics* which they supplemented with their own interpretations. Michael of Ephesus also wrote commentaries on the works of Aristotle's animal biology and the *Politics*, completing the series of commentaries on Aristotle's extant works.^[190]

Medieval Islamic world

Further information: [Logic in Islamic philosophy](#) and [Transmission of the Greek Classics](#)



Islamic portrayal of Aristotle (right) in the [Kitāb na' t al-hayawān](#), c. 1220.^[191]

Aristotle's works also underwent a revival in the [Abbasid Caliphate](#).^[192] Translated into Arabic, Aristotle's logic, ethics, and natural philosophy inspired early Islamic scholars.^[193] Aristotle is considered the most influential figure in the history of Arabic philosophy and was revered in early [Islamic theology](#).^[194] Most surviving works of Aristotle,^[195] as well as some of the original Greek commentaries, were translated into Arabic and studied by Muslim philosophers, scientists, and scholars. Through commentaries and critical engagements, figures like [Al-Kindi](#),^[196] [Al-Farabi](#), [Ibn Sina](#) (Avicenna), and [Averroes](#)^[197] breathed new life into Aristotle's ideas. They harmonized his logic with Islamic theology, employed his scientific methodology to explore the natural world, and reinterpreted his ethics within the framework of Islamic morality. Islamic thinkers embraced Aristotle's rigorous methods while challenging his conclusions where they diverged from their religious beliefs,^[198] which later influenced [Thomas Aquinas](#) and other Western Christian scholastic philosophers. Medieval Muslim scholars described Aristotle as the "First Teacher".^[195] The title was later used by Western philosophers (as in [Dante's](#) poem) who were influenced by the tradition of [Islamic philosophy](#).^[199]

Medieval Judaism

[Moses Maimonides](#) (considered to be the foremost intellectual figure of medieval Judaism)^[200] adopted Aristotelianism from the Islamic scholars and based his [Guide for the Perplexed](#) on it and that became the basis of Jewish [scholastic philosophy](#). Maimonides also considered Aristotle to be the greatest philosopher that ever lived, and styled him as the "chief of the philosophers".^{[201][202][203]} Also, in his letter to [Samuel ibn Tibbon](#), Maimonides observes that there is no need for Samuel to study the writings of philosophers who preceded Aristotle because the works of the latter are "sufficient by themselves and [superior] to all that were written before them. His intellect, Aristotle's is the extreme limit of human intellect, apart from him upon whom the divine emanation has flowed forth to such an extent that they reach the level of prophecy, there being no level higher".^[204]

Medieval Western Europe



First page of a 1566 edition of the *Nicomachean Ethics* in

Greek and Latin

Further information: [Aristotelianism](#) and [Syllogism § Medieval](#)

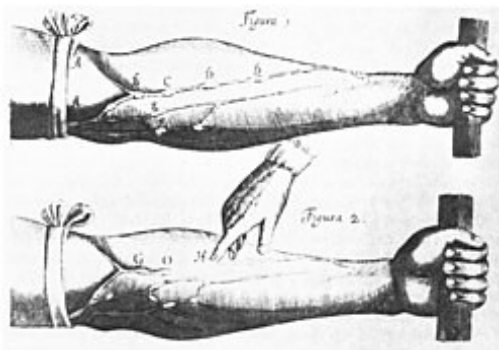
With the loss of the study of ancient Greek in the early [medieval](#) Latin West, Aristotle was practically unknown there from c. CE 600 to c. 1100 except through the Latin translation of the *Organon* made by [Boethius](#). In the twelfth and thirteenth centuries, interest in Aristotle revived and Latin Christians had translations made, both from Arabic translations, such as those by [Gerard of Cremona](#),^[205] and from the original Greek, such as those by [James of Venice](#)^[206] and [William of Moerbeke](#).^[207]

After the [scholastic](#) Thomas Aquinas wrote his *Summa Theologica*, working from Moerbeke's translations and calling Aristotle "The Philosopher",^[208] the demand for Aristotle's writings grew, and the [Greek](#) manuscripts returned to the West, stimulating a revival of Aristotelianism in Europe that continued into the [Renaissance](#).^[209] These thinkers blended Aristotelian philosophy with Christianity, bringing the thought of Ancient Greece into the Middle Ages. Scholars such as Boethius, [Peter Abelard](#), and [John Buridan](#) worked on Aristotelian logic.^[53]

According to scholar Roger Theodore Lafferty, [Dante](#) built up the philosophy of the *Comedy* on a foundation of Aristotle, just as the scholastics used Aristotle as the basis for their thinking. Dante knew Aristotle directly from Latin translations of his works and indirectly through quotations in the works of [Albert Magnus](#).^[210] Dante acknowledges Aristotle's influence explicitly in the poem, when Virgil justifies the *Inferno*'s structure by citing the *Nicomachean Ethics*.^[211] Dante refers to him as "he / Who is acknowledged Master of those who know".^{[212][213]}

Modern era

Early Modern science



William Harvey's *De Motu Cordis*, 1628, showed that the [blood circulated](#), contrary to classical thinking.

In the [early modern period](#), scientists such as [William Harvey](#) in England and [Galileo Galilei](#) in Italy reacted against the theories of Aristotle and other classical era thinkers like [Galen](#), establishing new theories based to some degree on observation and experiment. Harvey demonstrated the [circulation of the blood](#), establishing that the heart functioned as a pump rather than being the seat of the soul and the controller of the body's heat, as Aristotle thought.^[214] Galileo used more doubtful arguments to displace Aristotle's physics, proposing that bodies all fall at the same speed whatever their weight.^[215]

18th and 19th-century science

The English mathematician [George Boole](#) fully accepted Aristotle's logic, but decided "to go under, over, and beyond" it with his system of [algebraic logic](#) in his 1854 book *The Laws of Thought*. This gives logic a mathematical foundation with equations, enables it to solve equations as well as check [validity](#), and allows it to handle a wider class of problems by expanding propositions of any number of terms, not just two.^[216]

[Charles Darwin](#) regarded Aristotle as the most important contributor to the subject of biology. In an 1882 letter he wrote that "Linnaeus and Cuvier have been my two gods, though in very different ways, but they were mere schoolboys to old Aristotle".^[217] ^[218] Also, in later editions of the book "[On the Origin of Species](#)", Darwin traced evolutionary ideas as far back as Aristotle;^[219] the text he cites is a summary by Aristotle of the ideas of the earlier Greek philosopher [Empedocles](#).^[220]

Present science

The philosopher [Bertrand Russell](#) claims that "almost every serious intellectual advance has had to begin with an attack on some Aristotelian doctrine". Russell calls Aristotle's ethics "repulsive", and labelled his logic "as definitely antiquated as Ptolemaic astronomy". Russell states that these errors make it difficult to do historical justice to Aristotle, until one remembers what an advance he made upon all of his predecessors.^[172]

The Dutch historian of science [Eduard Jan Dijksterhuis](#) writes that Aristotle and his predecessors showed the difficulty of science by "proceed[ing] so readily to frame a theory of such a general character" on limited evidence from their senses.^[221] In 1985, the biologist [Peter Medawar](#) could still state in "pure seventeenth century"^[222] tones that

Aristotle had assembled "a strange and generally speaking rather tiresome farrago of hearsay, imperfect observation, wishful thinking and credulity amounting to downright gullibility".^{[222][223]}

Zoologists have frequently mocked Aristotle for errors and unverified secondhand reports. However, modern observation has confirmed several of his more surprising claims.^{[224][225]} ^[226] Aristotle's work remains largely unknown to modern scientists, though zoologists sometimes mention him as the father of biology^[170] or in particular of [marine biology](#).^[227] Practising zoologists are unlikely to adhere to Aristotle's chain of being, but its influence is still perceptible in the use of the terms "lower" and "upper" to designate taxa such as groups of plants.^[228] The evolutionary biologist [Armand Marie Leroi](#) has reconstructed Aristotle's biology,^[229] while [Niko Tinbergen's four questions](#), based on Aristotle's four causes, are used to analyse [animal behaviour](#); they examine [function](#), [phylogeny](#), [mechanism](#), and [ontogeny](#).^{[230][231]} The concept of [homology](#) began with Aristotle;^[232] the [evolutionary developmental biologist Lewis I. Held](#) commented that he would be interested in the concept of [deep homology](#).^[233] In [systematics](#) too, recent studies suggest that Aristotle made important contributions in [taxonomy](#) and [biological nomenclature](#).^{[234][235][236]}

Depictions in art

Paintings

Aristotle has been depicted by major artists including [Lucas Cranach the Elder](#),^[237] [Justus van Gent](#), [Raphael](#), [Paolo Veronese](#), [Jusepe de Ribera](#),^[238] [Rembrandt](#),^[239] and [Francesco Hayez](#) over the centuries. Among the best-known depictions is Raphael's [fresco *The School of Athens*](#), in the [Vatican's Apostolic Palace](#), where the figures of Plato and Aristotle are central to the image, at the architectural [vanishing point](#), reflecting their importance.^[240] Rembrandt's [Aristotle with a Bust of Homer](#), too, is a celebrated work, showing the knowing philosopher and the blind Homer from an earlier age: as the art critic [Jonathan Jones](#) writes, "this painting will remain one of the greatest and most mysterious in the world, ensnaring us in its musty, glowing, pitch-black, terrible knowledge of time."^{[241][242]}



Aristotle, mosaic from a Roman villa in [Cologne](#)



Nuremberg Chronicle anachronistically shows Aristotle in a medieval scholar's clothing. Ink and watercolour on paper, 1493



Aristotle by Justus van Gent. Oil on panel, c. 1476



Phyllis and Aristotle by Lucas Cranach the Elder. Oil on panel, 1530



Aristotle by Paolo Veronese. Oil on canvas, 1560s



Aristotle and Campaspe, [P] Alessandro Turchi (attrib.) Oil on canvas, 1713



Aristotle by Jusepe de Ribera. Oil on canvas, 1637



Aristotle with a Bust of Homer by Rembrandt. Oil on canvas, 1653



Aristotle by Johann Jakob Dorner the Elder. Oil on canvas, 1813

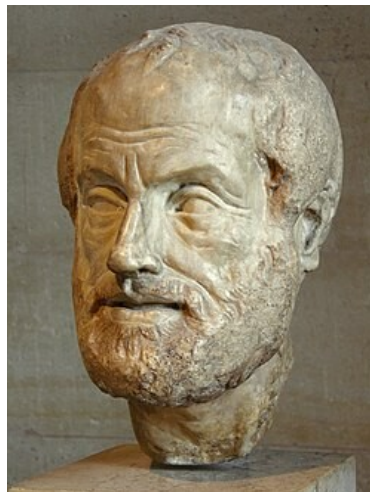


Aristotle by [Francesco Hayez](#). Oil on canvas, 1811

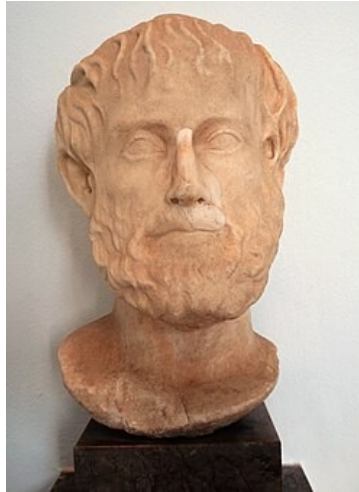


By [Charles Laplante](#) [fr] "That most enduring of romantic images, Aristotle tutoring the future conqueror Alexander".[168] 1866

Sculptures



Roman copy of 1st or 2nd century from original bronze by [Lysippos](#). [Louvre Museum](#)



Roman copy of 117–138 AD of Greek original. Palermo Regional Archeology Museum



Relief of Aristotle and Plato by [Luca della Robbia](#), [Florence Cathedral](#), 1437–1439



Stone statue in niche, [Gladstone's Library](#), [Hawarden](#), Wales, 1899



Bronze statue, [University of Freiburg](#), Germany, 1915

Eponyms

The [Aristotle Mountains](#) in [Antarctica](#) are named after Aristotle. He was the first person known to conjecture, in his book [Meteorology](#), the existence of a landmass in the southern high-latitude region, which he called *Antarctica*.^[243] [Aristoteles](#) is a crater on the [Moon](#) bearing the classical form of Aristotle's name.^[244] (6123) [Aristoteles](#), an [asteroid](#) in the [main asteroid belt](#) is also bearing the classical form of his name.^[245]

See also

- [Aristotelian Society](#)
- [Conimbricenses](#)
- [Perfectionism](#)