A great deal can of course be said about the period from 450-1450 AD, but we will by and large pass it over (see however COURSE NOTES).
The Lifeline from Arab Civilisation

In spite of the turbulent history of the Arab world in the middle ages, they nevertheless preserved a great deal of the Greek work (and even extended the mathematics). This was transmitted back to Europe later on (see COURSE NOTES).

Above: the Alhambra in Granada (this is Christian corruption of ‘Al-Qala Al-Hamra’). Construction of modern Alhambra: 1238 AD et seq).

Lindaraja garden (Alhambra)

Maimonides (1135-1204 AD)

Ferdinand & Isabella (c. 1470)
The Italian Renaissance

In the 14-th century, a complex process of re-emergence began in Mediterranean Europe. Influences from the Arab world, and from the slow accumulation of economic change, all had their effect. One of the most important slow changes came about through the development of crop rotation and the invention of metallic farming implements (like ploughs). Other important innovations were clear window glass, and various precision instruments for, eg., time-keeping and navigation. Europe’s population then grew, along with trade.
The renaissance is usually said to have begun in Firenze (Florence). It was marked by an intense interest in classical (Greek/Roman/etc) ideas, & by new ‘humanist’ ideals (articulated by many, most notably Erasmus in Holland). Those involved included intellectuals, artists and their wealthy patrons, who included powerful princes like Lorenzo de Medici of Florence, and even some popes.
The Catholic Church (I)

By the 15th century Italian wealth and power was concentrated in the Vatican, and in powerful city states like Firenze (Florence), itself run by the Medicis. Attempts to fight this (such as that of the fanatic Savonarola (1542-98)) were quelled ruthlessly. The sheer decadence of the Church in this period had been building for at least 2 centuries, and reached its height during the reign of Pope Alexander VI (Rodrigo de Borgia, r.1492-1503).

At that time very few people doubted the basic tenets of Christianity, and the dominant theme in art and architecture was the glorification of God. The humanist ideal was shaped by many people, from writers such as Petrarch (1304-74) to artists such as Brunelleschi (1379-1446), Leonardo (1452-1519), and Michelangelo (1475-1564).

St. Peters dome, which Michelangelo completed (1546-64)  
Dome interior
Many of the things which figured large in the thoughts of people at this time can be seen in their art—sin, redemption, myths and magic, good and evil. Education was geared to the training of the clergy, and covered grammar, rhetoric, and logic—a hangover from the Greco-Roman system, but now dogmatic. Literature and music were devotional. The renaissance brought a growing conviction that Man could control his own destiny, and admiration for ‘l’uomo universale’.

Scenes from the Sistine Chapel (Michelangelo, painted from 1508-11).
The REFORMATION

Great dissatisfaction with the cynical behaviour of the Catholic church (which had accumulated enormous power and wealth during the middle ages) led eventually to the Reformation in Northern Europe—beginning with Luther (1483-1546) who in Wittenberg in 1517 proclaimed his 95 ‘theses’, against the Catholic system of indulgences. The Lutheran movement was supported by many northern states and cities— it was not a revolt against them. Quickly many other brands of Protestantism arose, including Calvinism in 1541 in Geneva, which stressed self-restraint, thrift and hard work, and abhorred pleasure & frivolity—to a Catholic sense of sin, was added a sense of duty.

Above & right: ‘Garden of Delights’, H. Bosch (c. 1500-10)
The COUNTER-REFORMATION & Suite (I)

The reaction of Rome to the reformation was not long in coming, in the form of a new ‘Holy Office’ to supervise the Inquisition (along with an Index of banned books- just in time for the invention of the printing press by Gutenberg), the formation of the Jesuits in 1540, and church reform at the 3 councils of Trent. Unfortunately these reforms were reactionary, and the result was violent war across Europe. Catholic strength lay in the Holy Roman & Spanish Empires.
Spain attempted to subdue Britain and the Netherlands, but by the end of the 16th century had been humiliated— a ‘golden age’ of cultural & economic development then began in both. Civil war raged across Sweden, France (1562-98), Poland, and in the worst fighting, in the 30 yrs war (1618-48) in the Germanic regions. Refugees from war and the Inquisition flocked to places like Amsterdam.

During this period it was dangerous to speak too freely. The aftermath was a continent exhausted by war, with a more liberal atmosphere often prevailing in many areas. Intellectual and artistic activity did not cease by any means in southern Europe, but the initiative slowly passed to the north—with the new centre of scientific activity moving to the Netherlands and England.
The first cracks in the Aristotelian Dogmatic cosmology appeared far from Rome, in Poland, where Nikolaus Copernicus gradually put together a heliocentric theory of the solar system. This was more difficult than it looked—the eccentric nature of the planetary orbits meant that the usual picture of the Copernican system (below right) is oversimplified. The astronomical Instruments of the 15th century were of high enough quality to make this a big problem.

If the orbits are taken to be circular, then it is easy to see that the apparent motion of the Planets seen from the Earth (as well as the Solar motion) would be identical in the old Ptolemaic system and the new Copernican System.
Tycho Brahe & Uraniborg

The ideas of Copernicus were slow to catch on. Curiously, one of the principal architects of the changing views was strongly opposed to them. Tycho Brahe was a remarkable pioneer in observational astronomy, whose opinions now seem a bizarre mix to us— he believed that events were determined by the stars and the motion of the planets relative to them (i.e., in astrology), but he was shaken by the appearance in 1572 of a new very bright star in the sky—this contradicted Aristotelian dogma about the immutability of the stars (and Tycho exploded the prevailing opinion that the star was a comet by careful observation). Soon thereafter the King of Denmark gave Tycho his own island to build the observatory of Uraniborg, & over the next few decades he developed instruments to record the motions of the moon, comets, & planets more accurately than ever before. On his death bed he begged Kepler not to use these against Aristotle’s system.
Kepler was an assistant to Tycho, who spent years analysing the data he had amassed at Uraniborg. He concentrated on trying to understand the orbit of Mars, albeit with an initial belief in a variant of Eudoxus celestial spheres, which he tried to fit between solid geometrical shapes. It is probably fortunate this was such a bad idea, and that he chose Mars, which has a rather eccentric orbit. Hundreds of pages of mathematical analysis led him slowly but inexorably to a picture which he eventually summarized in the form of his 3 laws (next page). He also wrote the 1st science fiction novel (below left) and set the planetary motions to music.

J. Kepler (1571-1630)
With great creative insight Kepler realised that he could understand the planetary motions to very high accuracy by starting from 3 hypotheses, which came to be known as Kepler’s 3 Laws:

(1) Each planet moves around the sun in an elliptical orbit, with the sun at one of the foci.

(2) The radius vector of the orbit (from the sun to the planet) sweeps out equal areas in equal times- as shown in the figure.

(3) If $T$ is the orbital period of a planet, and $a$ is the length of the semi-major axis (ie., half the length of the ‘long diameter’), then

$$T \sim a^{3/2}$$

ie., $T^2 \sim a^3$, or, to put it in words, the square of the orbital time period increases in proportion to the cube of the size of the orbit.

These laws were not completely accurate but they were FAR more accurate than anything before- with his combination of mysticism and respect for the astronomical facts, Kepler had broken the Aristotelian mold. However he had no EXPLANATION for his laws- they were just a way of understanding the data.