

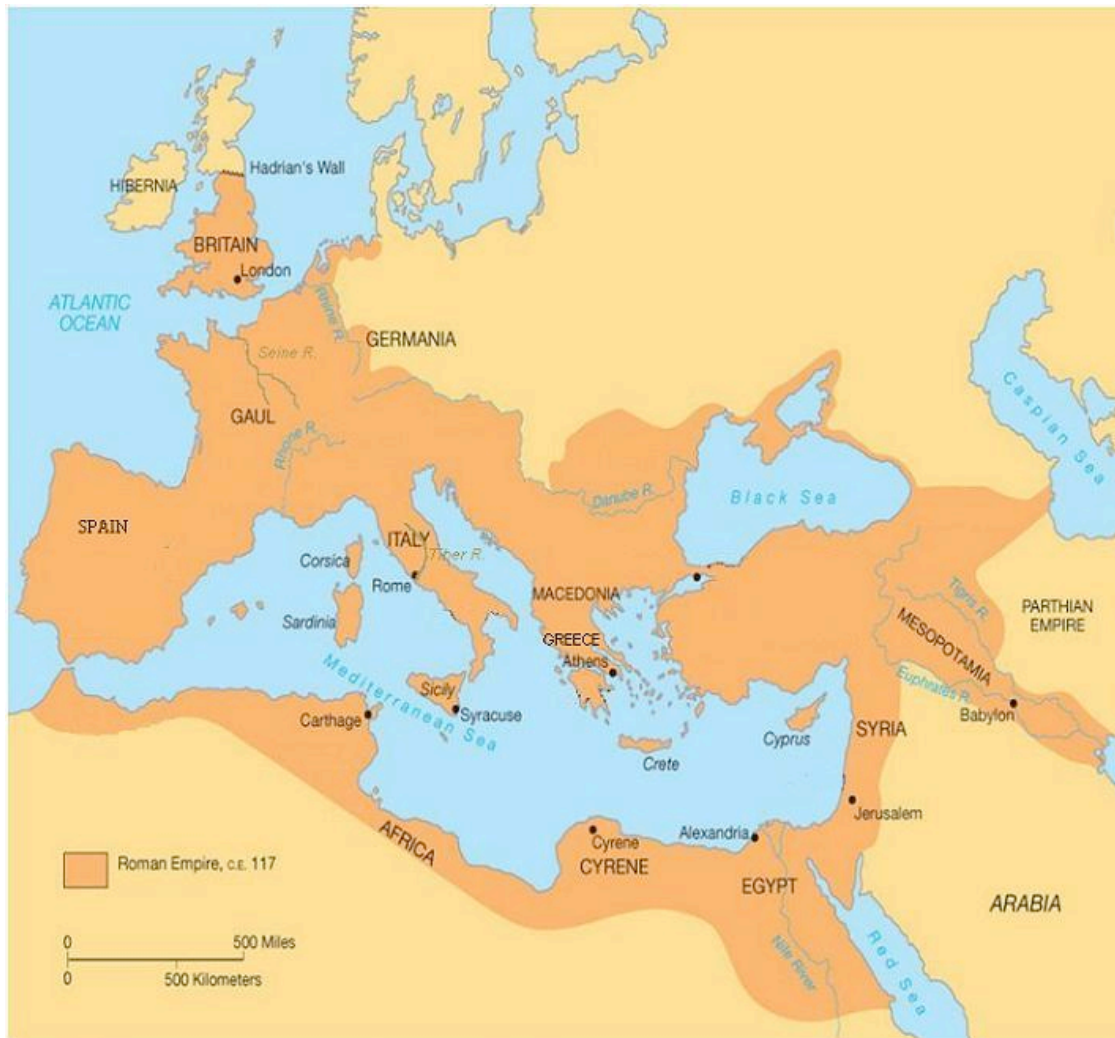
Ancient Rome Study Guide



Table of Contents

Location of Rome.....	3
Early History.....	4
The Roman Republic.....	5
Patricians and Plebians.....	5
Expansion and Wars.....	7
The Fall of the Roman Republic.....	11
Rise of the Roman Empire	12
The Rich and Poor.....	15
Family Life.....	17
School.....	19
Clothing.....	20
Religion.....	22
Entertainment.....	24
Architecture.....	28
Roman Numerals.....	33
Roman Language.....	34
Roman Achievements.....	35
Famous People.....	36
Famous Chemists and Physicsts	38
Questions for Further Thought....	47
Resources.....	48

*The Location of Rome (geography)



 Geographical Tour: A Tour of Empire

Ancient Rome developed along the **Tiber River** in what is now Italy. Rome's location offered four advantages (good things). First, Rome was built on several **hills**, so it was difficult for enemies to attack. Second, the **Tiber River** allowed food and goods of inland areas to be brought to Rome. It helped commerce flourish in ancient Rome by providing a travel route to the sea, as well as shallow water near Rome that merchants could cross easily. Third, the **Mediterranean Sea** is only fifteen miles away, so Rome is near enough to the sea for trade, but far enough from the danger of enemy ships. If anyone tried to attack by travelling up river, they

would have to deal with strong sea currents. Lastly, soil in the area was **fertile**, and there were also pastures and **materials** good for building.

*Early History

Nearly 3000 years ago, a tribe of people called the **Latins** lived in a small village on the Tiber River. This village grew to become the famous city of Rome.



A mythical folktale tells a story about twin boys, named **Romulus and Remus**, who were raised by a wolf. The story says that the boys grew up and built a city on the banks of the Tiber. The brothers fought, and Remus was killed by Romulus, who became king. The new city was named "Rome" after him.

Early Rome was greatly influenced by the **Etruscans**. The Etruscans arrived on the Italian peninsula around 900 BCE. The Etruscans must have known the *Greeks*, as their alphabet was based on the *Greek* alphabet. In addition, their gods looked like humans, just like the *Greek* gods. From the artifacts they left behind, scientists are fairly certain that, in the Etruscan culture, women and men were fairly equal in status, and this was certainly not the *Greek* way of life.

The Etruscans organized their towns into city-states, each ruled by a king. The city-states worked together in a league - **the Etruscan League**. The league began to trade with people in the east and people along the African coastline. Their trade routes included the tiny village of Rome on the Tiber River. Even in very early times, Rome was a busy place. The early Romans (the Latins) learned a great deal from the Etruscan traders.

While the Etruscans were building their own civilization, the city of Rome grew more powerful. Soon, Rome was a center of trade and commerce. Some of Rome's early kings were Etruscans. Romans did not like Etruscan kings



Etruscan Bronze Helmet

ruling them, so legend says that a fearless Roman soldier, **Horatio**, fought them off and saved Rome. Rome became an independent republic in about 510 BCE.

*The Roman Republic

After the people of Rome had chased away the last of the Etruscan kings, the people declared Rome to be a republic. **What is a republic?** A republic is a government run by elected officials.



Under the Republic, the state was composed of the Senate and the People of Rome. The new government of the Roman Republic ordered the letters SPQR to be chiseled on public buildings, armor, coins, and even park benches. The letters SPQR were chiseled on anything that belonged to the state. **SPQR** stood for - '**Senatus Populus Que Romanus**' (the **Senate and the People of Rome**).

It was a publicity campaign, and it worked! Every time the people saw the letters SPQR, they were reassured that things had changed. The kings were gone. It was a time of new leadership and new government. It was the time of the Roman Republic.

*There were three main classes of people in ancient Rome - the **Patricians**, the **Plebeians**, and the **slaves**. A Roman was born into his or her class.



Patricians (puh TRISH uhns): The patricians were the upper class, the nobility, and wealthy land owners.



Plebeians (plih BEE uhns): The plebeians were the commoners. Nicknamed "plebs", the plebeians included the majority of the population -workers, shopkeepers, and peasants.

Slaves, which were war captives, were owned by citizens and had no rights.

As **citizens**, both patricians and plebeians had the right to vote. However, only patricians had the right to hold any political, military, or religious offices. All power was in the hands of the patricians.

For example, by around 509 B.C.E., the government was headed by two **consuls**, both of whom were patricians. The consuls had the same power as early kings, but with two limitations: they could serve only one year, and each consul could **veto** the other's decisions. Our word **veto** is from the Latin word "I forbid". So, one consul could forbid the decision of the other! The consuls took care of the daily business of the government and of the army. They were also advised by a **senate** made up of 300 citizens (also patricians).

Some plebeians were quite wealthy. They believed that they should have the same rights as the patricians. Poor plebeians, too, believed that the system was unfair. When a poor plebian had to borrow money from the rich to survive, he and his family were forced into "debt bondage." A man in debt bondage became a servant of the man to whom he owed the money. He was treated almost like a slave, and, without getting paid, he could never get the money he needed to buy his freedom. The patrician government did nothing to end this cruel practice.

By 494 B.C.E., the plebeians had suffered long enough. They left Rome and formed their own assembly, which was known as the **Council of Plebeians**. They also elected their own leaders, who were called **tribunes**. Tribunes protected plebian rights. Patricians knew that Rome could not survive without plebeians. Who would do the work? Who would protect the Republic from



enemy attacks? The patricians had no choice but to let the plebeians keep their tribunes. The plebeians could vote against any unjust law passed by the Senate.

The plebeians also believed that patrician judges took advantage of the fact that Rome's laws had never been written down and ruled unfairly against plebeians. Finally, about 50 years after the Roman Republic was formed, the leaders of the Republic wrote down many of the old laws, to make sure everyone understood them. History refers to this group of laws as "**The Twelve Tables**" because the written laws were organized into twelve sections engraved on bronze tablets. They set down the basic rights of the Roman citizens. These laws talked about property, crime, family, theft, marriage and inheritance. It does not really matter what they said, although the laws did try to be fair. What matters is that these laws were *written down*. They were engraved on tablets of metal and put on display at the **Forum** (an open area in the center of town, used as a marketplace, and a place where men would come to discuss politics and business) in the city of Rome, so that everyone could see them. Each law applied to every Roman citizen, whether rich or poor. That was a huge change for the better! (*Our own law that states that a person is innocent until proven guilty came from this group of laws!!*)



By 367 B.C.E. one of the ruling consuls **had** to be a plebeian. Some citizens making up the senate were also plebeian. Finally, in 287 BCE, patricians agreed to everything the plebeians wanted, making both groups equal under Roman laws. As the plebeians gained power, Rome became more democratic.

*Expansion and Wars

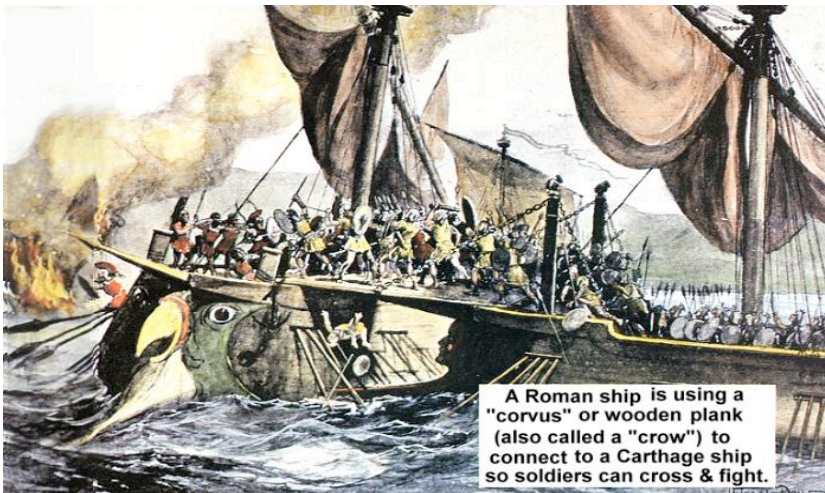
Year after year, the Roman army marched off to war against its neighbors in order to control more and more land and people. By 275



B.C.E., Rome ruled all of Italy. In 270 B.C.E., Rome had more citizens and well-trained soldiers than any other group in the Mediterranean area. During the next 100 years, Rome used those soldiers to conquer the Mediterranean world.

Rome was successful because it made the defeated people **allies**, or friends of Rome. As allies, they had to fight for Rome in any future wars. In return, Rome promised them protection and a share in the profits from future victories (part of the loot Rome stole would be given to them). In some cases, Rome even gave conquered peoples citizenship (the right to be called a Roman and to vote in elections).

In the 200's B.C.E, Rome was conquering the area now known as Italy. Another power, **Carthage**, existed on the opposite side of the Mediterranean. It was a wealthy Phoenician city, located on the coast of



North Africa, that traded with cities all around the Mediterranean. Carthage and Rome became fierce enemies and fought three long and bloody wars over who would get to control the Mediterranean. Rome feared Carthage would gain complete control of the

island of Sicily and then move against Rome itself. In 246 BCE, the two powers went to war in what is known as the **First Punic war**. "Punici" was the Roman word for "people of Carthage".

The Romans invented a device called a "crow," which was a kind of wooden walkway with a sharp spike at the end. The crow was held upright until the Romans pulled their ship up next to an enemy ship. Then, they quickly lowered the crow so the spike stuck on the enemy ship's deck. The crow served as a bridge for the Roman soldiers to get on to the enemy ship easily.

After Carthage lost the first Punic War, the Carthaginian general, **Hamilcar**, took his son, **Hannibal**, to Spain with him and taught him to be a soldier. He made Hannibal swear to be the enemy of Rome. Twenty years later, Hannibal honored his promise to his father and became a brilliant general



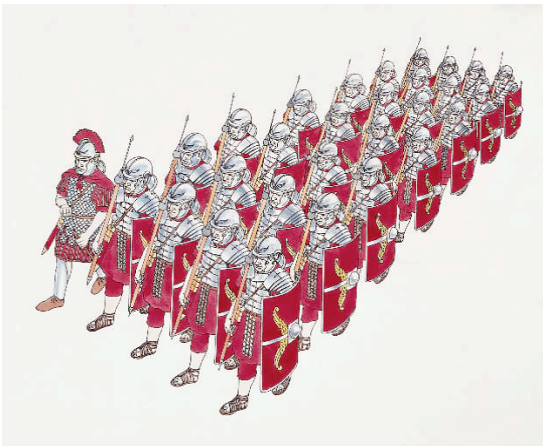
A statue of Hannibal

and one of Rome's greatest enemies. They began the **Second Punic War**.

After Hamlicar was killed in the Second Punic War, Hannibal took over. He fought a good fight, but Rome was stronger. Carthage's empire was over. Carthage was forced to give up its territories and its ships, and to pay Rome huge amounts of money. In 149 B.C., Carthage got tired of paying the Romans and being ruled by them. They rebelled against Rome, and began the **Third Punic War**! Rome once again defeated Carthage. This time, as punishment, Rome sold all of the surviving Carthaginians into slavery and completely destroyed the city.

With Carthage out of the way, Rome became the most important power in the western Mediterranean. Next, Rome turned to the east. By 146 B.C.E., they had conquered Greece as well as the country to the north of Greece called Macedonia. By 50 B.C.E., Rome controlled all the land around the Mediterranean Sea.

***How was it possible for Rome to conquer so much so quickly?**



First, because of their strong and balanced government, the Roman people were stronger than the power of any one opposing leader, and they were proud of their accomplishments. Even Hannibal could not defeat the determination of the Roman people.

Second, Rome treated conquered peoples as friends and, in several cases, made them citizens. In this way, Rome was able to raise a large army. Also, Rome's friends were usually loyal to Rome because they shared in the profits (loot and stolen property) from Roman wars.

Third, Rome's army was highly disciplined by years of war. Few other armies could match its strength.

Fourth, Romans greatly valued military success. In fact, military success was needed if a man hoped to become powerful in the Roman government.

Fifth, wars brought a lot of money and treasure. Conquered lands were often given to Roman soldiers who retired. Valuables seized from the

enemy made the government and individual leaders rich. Prisoners from the conquered lands became slaves. For all these reasons, Roman leaders were ready to go to war year after year

However, **farmers** were not able to work their farms if they were off fighting as Roman soldiers. Wars were being fought farther away and many farmers were dying in battle. The Second Punic War had destroyed many Roman farms. Returning from war, farmers often did not have the money needed to begin farming again. Consequently, wealthy Romans bought up the land, and created plantations run by slave labor. Farmers lost land and moved to cities, but were unable to find work with so many **slaves** as cheap labor. There were more and more **unemployed people**, and they were angry! Roman leaders were afraid the violent mobs would demand a solution to their troubles.



Some Roman leaders wanted the government to help the poor, but they were stopped by wealthy senators who didn't want to spend money to help them. In fact, two tribunes (elected by the plebeians) who tried to help the poor were murdered by the rich politicians! Rome's large population of slaves caused other problems. Most slaves, who were free in their own homelands, were treated brutally by their Roman masters. Desperate for freedom, the slaves rebelled. In 73 B.C.E., a slave named **Spartacus**, who was being trained to be a gladiator, gathered an army of more than 100,000 escaped slaves. They fought and defeated the Roman army for two years. In 71 B.C.E., the Romans surrounded the slave army, killed Spartacus, and crucified 6,000 slaves.



*The Fall of the Roman Republic

By 50 B.C.E., Rome ruled an area the size of the United States, but there were conflicts between the rich and poor. **Power-hungry generals** fought for control of the government. One of these generals was **Julius Caesar**, who came from an old patrician family and wanted to rule all of Rome. He became consul and took command of the Roman army. Senators were afraid that Caesar was becoming too powerful, so they got the Senate to declare that Caesar was a public enemy. Caesar came into Rome with his army, even though he was told not to. This led to a three year war between Caesar and General Pompey's army, sent by the senators. After defeating Pompey in 46 B.C.E, Caesar declared himself dictator. A **dictator** is a ruler who has absolute (total) power. Julius Caesar ended the republic system and planned on being the ruler for life. *As ruler, he made the Roman calendar fit the seasons of the year by adding three months. This was a good thing, so the Senate named the month of **July** after him.



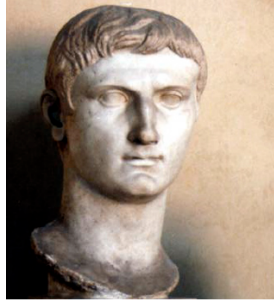
Caesar seemed to have little respect for Roman laws. He was supposed to share power with senators, but he acted as if he did not have to obey the law. In 44 B.C.E., with many afraid he would make himself king, Caesar was assassinated by **Brutus** (a friend of Caesar's). The famous saying, "Et tu, Brute?" came from the assassination scene of William Shakespear's historical play, *Julius Caesar*.



Caesar was the first to print his own bust on a Roman coin.

Many Roman citizens were angry about Caesar's murder. The Roman people liked Julius Caesar because he made their lives better. For example, he made the government work better and he lowered taxes. He conquered new lands and gave Roman people that land to farm. He had new temples and public buildings built and allowed more people to become Roman citizens. The murder of Caesar did not save Rome. Instead, it caused 13 years of **civil war** as various groups struggled to control Rome.

Rise of the Roman Empire



Augustus Caesar

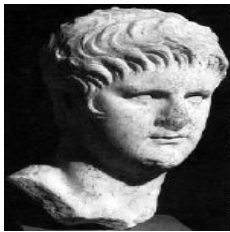
Before Julius Caesar died, he adopted his grandnephew **Octavian** and made him his son. Octavian was the leader of one group that was fighting to control Rome. He defeated Caesar's murderers and brought peace to the Roman Empire. He became a popular leader. In 27 B.C.E., the senate voted to give him the name "**Augustus**," meaning "respected one." From then on Octavian was known as Augustus Caesar. He ruled the Roman empire until 14 CE. Romans didn't like being ruled by a king, but an emperor was accepted. They were proud of their conquests, and proud of Augustus - **the first Roman emperor**.



During the 41 years of his rule, Augustus built or restored 82 temples. Most of them were covered in smooth marble which came from the rock quarries (open mines) north of Rome. Augustus once bragged, "I found Rome built of sun-dried bricks. I leave her covered in marble." Augustus improved life in the city of Rome. Before he took office, people were hungry and poor. Rome had nearly one million people. Violence, disorder, and crime were major problems, and fires often swept through the city, so Augustus created a **police force** and a **fire department**. He also made a **Welfare Department** to supply food to the city's poor people. By 117 C.E., the Roman Empire had a population of about 60 million. This was more than one-fifth of the total population of the world at that time!

Augustus began a remarkable period in Rome's history. For more than **200 years**, the Roman Empire was united and strong. Although Rome had more wars and some very cruel rulers, the empire continued to be stable. This period is called the **Pax Romana** (paks roh MAH nuh), which means the "Peace of Rome." This was when Rome was at its peak and reached its highest political and cultural achievements. Augustus established a new way of choosing emperors. Each emperor chose his successor from his family or adopted someone he thought would make a good emperor.

During the 200 years after Augustus's death, four family lines (called dynasties) ruled the Roman Empire. Some emperors ruled wisely. Others were cruel or foolish. Each of the four dynasties ended with the violent murder of an unpopular or unfit emperor.



Augustus' family line ended in disgrace in 68 CE with **Emperor Nero**. Nero came to power when he was just a boy of 17. The senators and the army didn't respect him. They complained that he was more interested in being an entertainer than being an emperor. He became an actor and charioteer. He was thought to have been responsible for the burning of the city of Rome in order to build a new palace for himself! Nero blamed the Christians for the fire and cruelly murdered hundreds of innocent people, including the Christian leaders Paul and Peter. The senate declared him a criminal and, in 68 CE, Nero committed suicide. He was the last descendent of Julius Caesar.



Three Roman generals each tried taking the throne, but they didn't last long. The **Flavian** Dynasty brought ten years of peace, but some leaders were still cruel. Finally, there was the **3rd dynasty**, which became known as the dynasty of the "good emperors." It included five talented emperors. **Trajan** expanded the empire to its largest size. He gave low-cost loans to farmers and gave money to poor children and orphans. **Hadrian** (who was actually from Spain) was the first emperor to

create borders using walls. The most famous is Hadrian's Wall which separates Britain and Scotland. Towns and cities later grew up around these walls. Another emperor, **Marcus Aurelius**, protected the borders against more and more invading tribes. When he died, so did the "Pax Romana." Later emperors could not control the huge empire. They even lost the respect of the Roman army. When Emperor **Severus Alexander** was assassinated by his own soldiers in 235 CE, it was the start of 50 years of civil war within the empire, with various groups again trying to seize control of the throne.

During this difficult time, the Roman Empire also came under attack from tribes in the northeast, known as **Germani**. The Romans called these people "barbarians." In 284 CE, a general called **Diocletian** became emperor. In order to protect the Empire against the Germani, he increased the size of the army and split the Empire into the **Eastern Roman Empire and the Western Roman Empire**. It was just too big for one person to rule alone. Diocletian ruled the eastern half, and a general called **Maximian** ruled the western half.



When Diocletian retired, there were more struggles for power. Around 312 C.E., **Constantine** took the throne in the Western Roman Empire. Eventually, he took control over the Eastern Roman Empire as well and reunited the empire. Constantine moved the capital to **Byzantium** (on the Black Sea), and renamed it **Constantinople**, after himself.

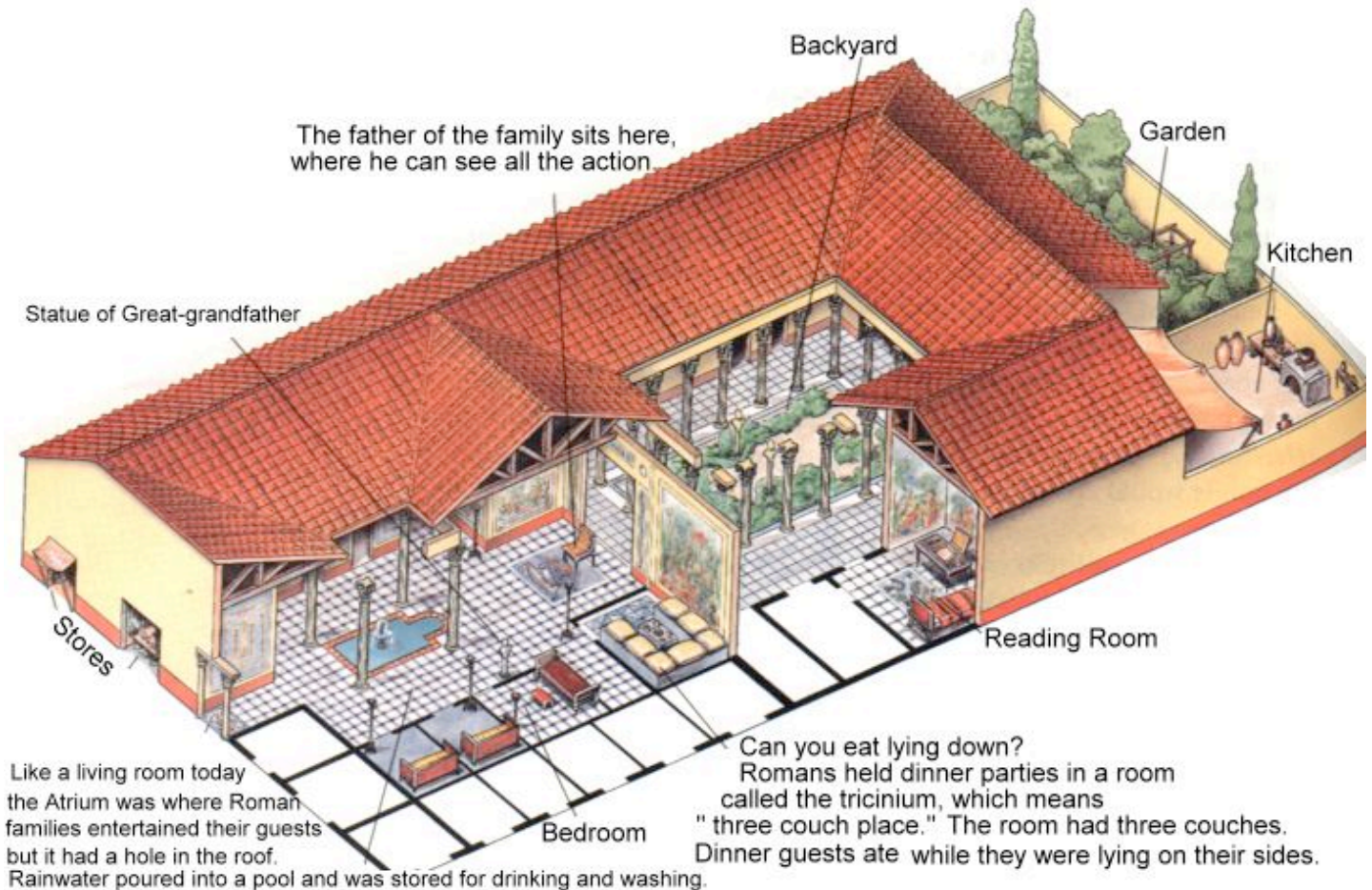
More and more "barbarian" tribes attacked the Western Roman Empire for the next century and a half - Huns from central Asia, Germani, Visigoths, and Vandals from Germania. The Roman Empire was permanently split in two in about 395 C.E., and a Visigoth chief made himself King of Italy in about 476. The Western Empire had met its end. The Eastern Empire continued for another thousand years.

Over the centuries, the Romans conquered large areas and many people. These millions of people spoke many different languages, had many different customs, and worshipped different gods. Rome unified (kept together) that empire of such different people in several ways. People in provinces that were ruled by Rome built cities that looked like Rome, became citizens, and governed their own cities. Rome also allowed some of these officials to become senators in Rome. By 200 CE, more than half of the 600 senators came from the provinces. These policies made the people who lived in the provinces feel that they were a part of the empire, so most of them did not have any reason to rebel.

*Rich and Poor (Only the rich could send their children to school and have slaves wait on them.)

The upper class Romans (patricians) lived very differently than the rest of Rome. Their homes were single family homes, which, in ancient Rome, meant the great grandparents, grandparents, parents, and kids of one family lived in a home together. Homes were made, quite often, of brick with red tile roofs, with rooms arranged around a central courtyard. The windows and balconies faced the courtyard, not the street, to keep homes safe from burglars. There were paintings on the walls and beautiful mosaics on the floor. There was very little furniture, and no carpet.

Wealthy Romans might have had a house with a front door, bedrooms, an office, a kitchen, a dining room, a garden, a temple, an atrium (entrance hall), a toilet, and a private bath. Some homes even had **central heating** under the floors, where a fire in the basement heated the floor tiles above. The Roman house shown in this picture depicts a patrician's (a



wealthy person's) home. Where would you spend the most time if you lived in this house?

A Roman House Model <http://www.sbceo.k12.ca.us/~vms/carlton/Rome/Rometext.html>

A rich family in one of these houses might own 500 slaves. Some very wealthy Roman families might own 4,000 slaves. An emperor might command a personal slave population of 20,000. Household slaves did about every job imaginable. They kept the furnaces burning in the bath houses, cooked meals in



the kitchens, served meals, cleaned, sewed, did the household and garden labor, and took care of the children. Intelligent and gifted slaves also tutored those children who studied their subjects at home, kept the accounts, and sometimes ran farm estates or ran parts of their master's business. Each slave might have only one job ---folding the master's clothes or fixing the mistress's hair, for example. In some homes, slaves were treated like valued servants. They had food to eat, jobs to do, and clothes to wear. In others, they were severely abused, but they were not free to look for a better family because they were owned.

Lower class Romans (plebians), however, lived in apartment houses, called flats, or *insulae* (IHN suh lie). In some cases, an entire family would live in a single room! Most apartment buildings were dark and dirty, with no heat or running water. The poor got water from public fountains outside. Fire was a real threat because people were cooking meals in crowded spaces, and many of the flats were made of wood. The *insulae* didn't have toilets, so people had to use public latrines (toilets). Poor hygiene spread disease. One fourth of the babies born in Rome did not live through their first year! Half of all Roman children did not live to be ten years old!



*Family Life

Before Rome was an empire, in very early Roman times, a typical Roman family included unmarried children, married sons and their families, other relatives, and family slaves. **The ruler of the family was the oldest male.** That could be the father, the grandfather, or perhaps even an uncle. His title was *pater familias*. The *pater familias* led religious ceremonies, taught the boys how to farm, and made all the important decisions. His word was law as far as his family was concerned. He owned the property, and had total authority, the power of life and death, over every member of his household.

Even when his children became adults, he was still the boss, but he was also responsible for the actions of any member of his household. He

could order a child or an adult out of his house. If anyone in his household committed a crime, he could be punished for it. It was not against the law for the head of the house to put a sick baby out to die or to sell members of his family into slavery. However, the Romans expected a pater familias to treat his family fairly. There were no laws to stop him from treating them unfairly, but there was social pressure.

Although women were never considered to be citizens of Rome, they did gain more rights over time. Unfortunately, the only women to really feel the effects of the changes were wealthy women. During the time before the Republic, women were always under the care of a guardian - a father or husband. A woman was not allowed to even make a suggestion to her husband, nor could she participate in government (speak at the Forum). A woman's job was to take care of the house and to have children. Mothers who could read and write taught their children how to read and write. They taught their girls how to cook, sew, and care for a family. It was considered improper for a woman to be seen hanging around in public. However, women could leave the home to shop, see a play, or visit a temple. Women who could afford slaves used them to shop and cook. Wealthy women could leave the house, but spent a large part of their day on personal grooming - styling their hair, and dressing ornately.

During the Roman Republic, women were allowed to make suggestions to their husbands, but only in private. Marriage laws changed to allow a woman to remain under the guardianship of her family, instead of being under her husband's guardianship. This allowed wealthy women to hire someone to manage their money and their land. The managers had to follow the instructions of the women.

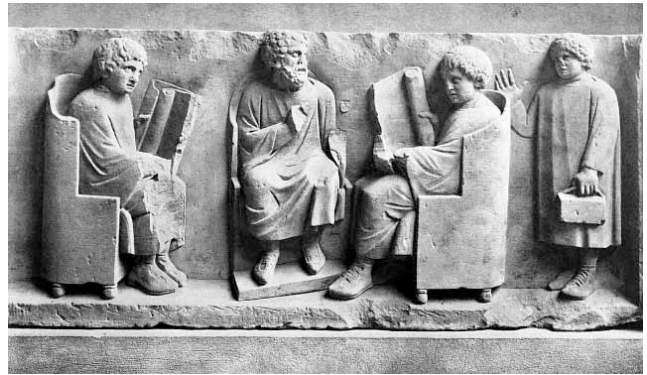
Under the rule of the Empire, it became legal for women to own land, run businesses, free slaves, make wills, inherit wealth, and get a paying job. However, women were still considered to be under the guardianship of either a husband or father, and they still could not freely address the Forum.

Children were trained to obey their elders and be loyal citizens. You couldn't talk back. If you talked back, you could find yourself out the

door. You could try to go to a friend's house, but the odds were good that they would not take you in.

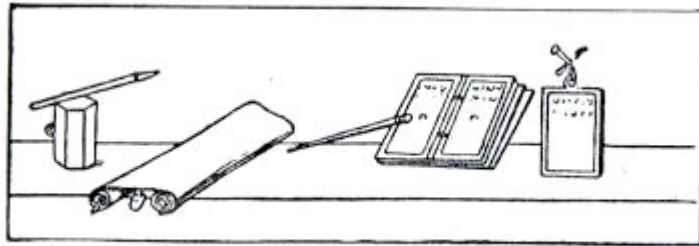
*School:

Rome as a Kingdom: In early Roman days, kids *did not* go to school. A Roman boy's education took place at home. If his father could read and write, he taught his son to do the same. The father instructed his sons in Roman law, history, customs, physical training, and preparing for war. Reverence for the gods, respect for law, obedience to authority, and truthfulness were the most important lessons to be taught. Girls were taught by their mothers. Girls learned to spin, weave, and sew. The rich had tutors for their children, but mostly, the kids were taught at home.



When Rome was a Republic: About 200 C.E., the Romans borrowed some of the ancient Greek system of education. Although they did not add many subjects, they did begin sending their boys to school outside the home, at age six or seven. They also began sending some of their girls to school, with their father's permission. Children, educated outside of the home, were sent to the house of a tutor, who would tutor a group. Children, educated in the home, were taught by intelligent and gifted slaves. School children had their own goddess. She was called **Minerva**, and she had her own festival in March. After the festival, the school year began on the 24th of March.

The goal of education in ancient Rome was to be an effective speaker. The school day began before sunrise, as did all work in Rome. Kids brought candles to use until daybreak. There was a rest for lunch and the afternoon siesta (nap), and then back to school until late afternoon. No one knows how long the school year actually was; it probably varied from school to school.



ROMAN WRITING MATERIALS.

The children studied reading, writing, and counting. They read scrolls and books. They wrote on boards covered with wax, and used pebbles to do math problems. They were taught Roman numerals and recited lessons they had memorized. At age 12 or 13, the boys of the upper classes attended "grammar" school, where they studied Latin, Greek, grammar, and literature. At age 16, some boys went on to study public speaking at the rhetoric school, in order to prepare for life as an orator (speaker or spokesperson).

*Did the kids of the poor go to school? No. Sending your children to a tutor was not free, and children in poorer homes did not have slaves to teach them. Poor children were taught by their parents, as they were in early Roman days.

When Rome was an Empire: During the empire, the Senate lost most of its power. The emperor was all-powerful. Still, education continued as it did during the Republic. Kids studied reading, writing, counting, literature, and how to be an effective speaker.

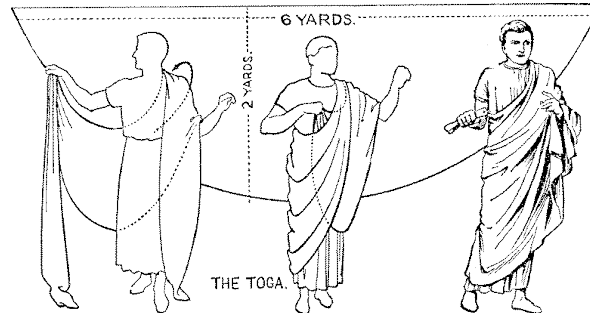
Old Age: The ancient Romans greatly respected and cared for their elderly. When the older members of a family became too tired for other activities, they could always play with their grandchildren and great grandchildren, all of whom had all been born under their roof, and would one day be honoring them at the *Parentalia*, the festival of the dead.



*Clothing

The very early Romans wore **togas**. A toga was a long piece of fabric around nine feet long. Togas were arranged very carefully, in a stylish way. Togas fell out of style rather early, however, because they were inconvenient, and people felt the cold

when they wore them. Early emperors tried to make at least the senators wear togas, but eventually, the emperors gave up. The Romans switched to comfortable **tunics**, which looked like long tee-shirts. They were far more practical. Tunics were made of cool linen, for summer wear, and warm wool, for winter wear. Sometimes, they wore things like pants.



How to wear a toga



Rings were the only jewelry worn by Roman men, and good manners dictated only one ring. Of course, some men did not follow "good taste", and wore as many as sixteen rings. Hairstyles and beards varied with the times. In early Roman times, men wore long hair and full beards. For a while, they were clean-shaven with short hair.



Women enjoyed gazing at themselves in mirrors of highly polished metal (not glass). The ancient Roman women loved ornate necklaces, pins, earrings, bracelets and friendship rings. Pearls were favorites. Women often dyed their hair, usually golden-red. They used false hairpieces to make their hair thicker or longer. Sometimes, Roman women wore their hair up, in carefully arranged styles, held with jeweled hairpins. Sometimes they wore it down, curled in ringlets. Parasols (umbrellas) were used, or women might carry fans made of peacock feathers, wood or stretched linen. Women's street shoes were made of leather, like a man's. In the house, most Romans (men and women) wore sandals. Women's sandals were



Sandal and foot from Roman statue

brightly colored. Some were even decorated with pearls.

Replica of bulla



Each child wore a special locket around his/her neck, given to them at birth, called a **bulla**. It contained an amulet as a protection against evil and was worn on a chain, cord, or strap. Girls wore their bulla until the eve of their wedding day, when their bulla was set aside with other childhood things, like her toys. Boys wore their bulla until the day they became a citizen. Boys' bullas were put aside and carefully saved. A boy's bulla could be worn by the owner again, if he won special honors. For example, if he became a successful general, and won the honor of triumph, he would wear his bulla in ceremonial parades, to protect him from the evil jealousy of men or gods.

Boys wore a tunic down to their knees. It was white, with a crimson border. Once a boy became a man, he put aside his childish clothes and bulla, and wore an all-white tunic. A boy became a citizen at age 16 or 17. The year was selected by choosing the date which came closest to March 17th. Coming of age, and becoming a citizen, was quite a celebration. On a boy's sixteenth or seventeenth birthday, the boy dressed in a white tunic, which his father adjusted. The day ended with a dinner party, given by the father, in honor of the new Roman citizen. Girls wore a simple tunic with a belt at the waist. When they went outside, they wore a second tunic that reached their feet.



*Religion

Many Romans believed that they were successful because they had kept their gods happy. Like many other ancient peoples, the Romans had

gods for every act and event in their lives.



Jupiter was the supreme god. He controlled the thunder and lightning and was the special guardian of Rome. **Juno** was his wife. She was the queen of the gods and the protector of women. **Minerva** was the goddess of wisdom and guardian of craft workers. The Romans joined together on specific days to worship these gods showing their common beliefs and their loyalty to Rome.

In their homes, the Romans worshiped household gods such as **Vesta**, **Lares**, and **Penates**. Vesta guarded the hearth, where people cooked and kept warm. Lares guarded the land, and Penates watched over the stored food (remind you of the Spanish word Piñata ?). People made daily offerings to these gods, asking for protection. Many Roman gods were borrowed from the Greeks. Jupiter was the Greek god Zeus, and Juno was the Greek goddess Hera. **Mars**, the Roman god of war, was the Greek god Ares.

In 26 CE, the Romans built a magnificent temple called the **Pantheon** to honor all the Roman gods and goddesses.

It was in the shape of a drum, with a dome rising fourteen stories above the ground, covered with gleaming brass so that people could see it shining all over the city. Between 26 CE and 125 CE three pantheons were built; the first two were destroyed by fire. The 3rd Pantheon is still standing today. It is the oldest building in the world that is still being used for its original purpose.



Romans also began to worship their emperors. The emperor was not a god like Jupiter, but he was so powerful that people believed he was divine.

*Entertainment



The ancient Romans loved **chariot racing**. In early Roman times, young nobles used to race their chariots around the hills of Rome. People had to scatter to get out of the way, since they stopped for no one.

Statuette of chariot racer



Scale Model of the Circus Maximus in Ancient Rome

In the 6th century B.C.E. (about 2,500 years ago), the ancient Romans built the **Circus Maximus** in the city of Rome. Basically, the Maximus was a race track. It was designed to race chariots. Women could attend the races. They could sit with men. That was very unusual. The original Circus Maximus was built out of wood, but it burned down a couple of times. During the Roman Empire, the Circus Maximus was rebuilt using marble and **concrete** (an ancient Roman invention).

The Circus Maximus was not the only circus in the Roman Empire. The Romans built **circuses**, or outdoor racetracks, all over the Empire. The Circus Maximus was the most well known race track. It could seat over 250,000 people! Admission was free. Anyone could attend the races, including Rome's poor. There were races every day. It was the height of success to race in the Circus Maximus.

While people went to the Circus Maximus for chariot racing, they went to the **Colosseum** to watch fighting. The events staged at the Colosseum were many. Nearly all of them involved death and destruction.

To see a violent event was very entertaining to the ancient Romans. There were the well-known gladiator fights, and battles between men and wild animals. This is where they threw people to the lions! On occasion, they flooded the Colosseum with water in order to hold naval battles. During the battles, many competitors died. Some lesser known events were animal circus acts, animals fighting animals, and animal hunts.



All sorts of animals were kept in cages below the Colosseum. Wild cats, buffaloes, bears, and elephants would all be kept and then made to fight one another. In some parts of the Roman Empire, certain animals died out because their type was in such demand by those who ran entertainment in Rome itself. It is thought that on the day the Colosseum opened, over 5,000 animals were killed.

However, animals were the secondary part of the 'show'. Those who came to the Colosseum came to see **gladiator** fights. Gladiators were most often slaves or prisoners-of-war, forced to train as gladiators. In these contests, one gladiator would fight another, usually to the death. Ancient Romans followed their favorite gladiators the way people today follow a favorite athlete. Famous gladiators had a huge following, but many gladiators were there merely to entertain the people and be killed. Since the profession called for courage, good morale, and absolute loyalty to the master, the participants' lives became models of military discipline. Gladiators were professional fighters that showed the Roman Empire's military strength, and, through courageous behavior, they could receive an honor similar to that of a Roman soldier on the battlefield. The gladiatorial tradition was a main part of Roman culture and lasted for around 700 years.

The casualty rate per 'show' was massive - nearly 50% died each show. Those gladiators who had fought well, but had not



won their fight, could be spared by the emperor if he was present at an event - a "thumbs up" meant life, and a "thumbs down" meant death. The Roman writer, Seneca, wrote that for a gladiator "the only exit is death."

These shows were usually free to the public. The emperors believed it was a good way to keep the people of ancient Rome happy and content with the way the city was being governed. The government provided free bread and free entertainment - a combination they believed would keep the many people without jobs happy,

The Romans also loved live **theatre**. The idea of drama came from ancient Greece. Plays were only performed during religious ceremonies and religious festivals. However, since the ancient Romans celebrated over 200 holidays a year, there were many opportunities for plays to be staged. Someone had to pay for the play, as actors received a small fee. Usually a wealthy noble would pay the bill, in honor of the gods, and give the play to the people as a gift.

There was a **Forum** in the center of each town. The Forum was an open area, used as the marketplace and spot for political discussions. Typically, there were buildings around the Forum, including a major temple. When it came time to stage a play, a wooden platform was built in the Forum.



The Forum in Rome, Italy



The actors were men. Each actor played several roles. They wore simple costumes that could be changed quickly and in public. The actors held up happy-faced masks and sad-faced masks to help the audience understand what was going on in the play. Over time, the masks became very elaborate.

During the play, the people in the audience would talk to each other. Since it was noisy, sometimes people would raise their voices so they could be heard. That made it even noisier. So that everyone could follow along

with the story told by the actors, no matter how noisy the crowd became, the actors would sometimes use a technique called **pantomime**. Pantomime (mime) is a play without words. The actors used dance, music, hand gestures, facial expressions, elaborate sets, and costumes to present the play.

Actors were not highly respected in ancient Rome. It could be a dangerous occupation. When the Romans saw a play they did not like, they shouted at the actors and told them to get off the stage. If they did not get off the stage, the audience might begin to throw things at them.



The public baths were another extremely popular form of Roman entertainment. Roman women and men tried to visit the baths at least once every day. The baths had hot and cold pools, towels, slaves to wait on you, steam rooms, saunas, exercise rooms, and hair cutting salons. They had reading rooms and libraries, since the majority of people who were free could also read. Slaves were not

allowed in unless they were accompanying their masters. They even had stores that sold all kinds of things and people who sold fast food. The baths were arranged rather like a very large mall, with bathing pools. The baths were packed. The people loved them. At one time, there were as many as 900 public baths in ancient Rome. Small ones held about 300 people, and the big ones held 1500 people or more! Some Roman hospitals even had their own bathhouses.

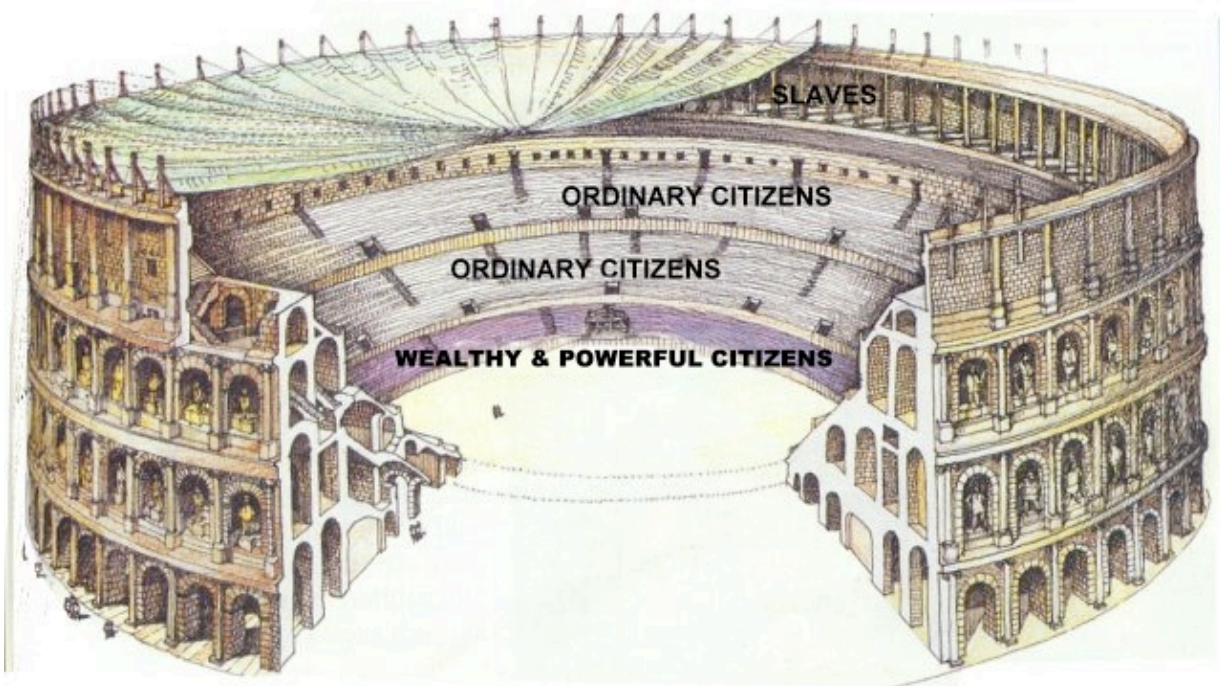
On a typical day, the ancient Romans might hit the baths first, and then wander down to the Forum (although many did prefer to get their shopping done early). In all but the largest baths, there were separate hours for men and women. The women's time slot was apparently much shorter, so that women probably had to schedule more carefully. Large baths had duplicate facilities for men and women. People would lift

weights in a training room, or exercise room. After working out, they would sit in a warm bath called the *tepidarium*. Next, they would sit in very hot water in the *caldarium*. Lastly, they would take a plunge into a cold pool in the *frigidarium*. The water and floors of the tepidarium and caldarium were heated by fires in the basement, which were tended by slaves. A trip to the bath was a very important part of ancient Roman daily life.

- Could kids use the baths? No.
- Was there an admission charge to the baths? Yes

*Architecture

Ancient Romans were known as great builders. They built things to last. Romans invented **concrete**, using sand (sometimes volcanic sand) and chalk. Concrete was used to build the famous Colosseum and the dome of the Pantheon, which even today is still one of the largest single-span domes in the world.



The **Colosseum** was a huge public entertainment center. It could seat 45,000 spectators. Some people were not lucky enough to have a seat in the Colosseum. If you didn't mind standing, the Colosseum could hold up to 70,000 spectators! The Colosseum was built of concrete, faced

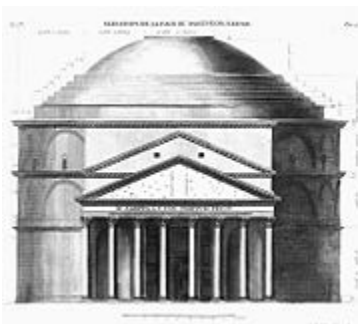
with stone, as were most **amphitheaters** (generally open-air oval or circular buildings with tiers of seats around a central open area). It was built in the early days of the Roman Empire, around 70 B.C.E. Anyone could attend the events in the Colosseum. Admission was free.

Arches: While the arch was not born in Rome, it was perfected there. The Romans applied the arch to many of their buildings for two reasons: as a **support** and for **decoration**. Two of the first structures to use arches were **bridges** and **aqueducts**. Later, the honorary or **triumphal arch** was constructed to honor



The Arch of Constantine

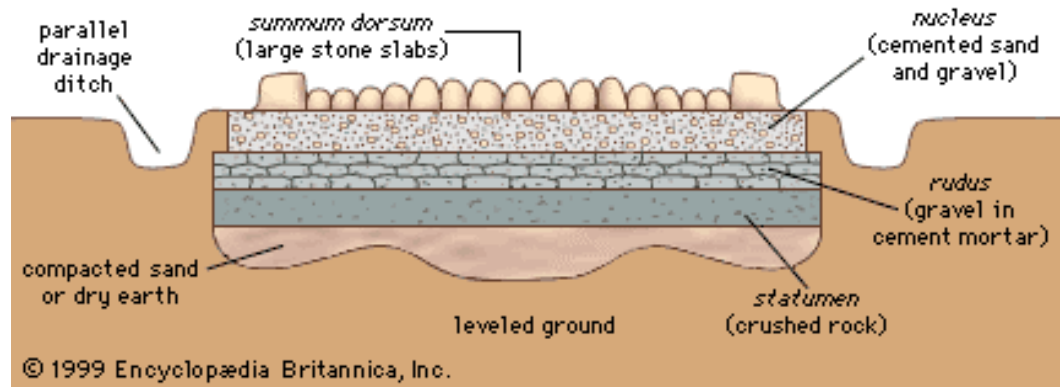
their leaders. After a victory (win), they would pass underneath a sacred triumphal gate (arch) to celebrate. At the end of the Empire, around forty such arches could be counted in Rome, built at the entrance to the Forums, along the major access roads, or in the monumental areas and squares. Several of these are still preserved in excellent condition today. The architectural element of the arch is a trademark of ancient Rome.



Domes: A **dome** is a common structural element of architecture that resembles the hollow upper half of a sphere. The **Pantheon** is the best-preserved example of an ancient Roman monumental building and of dome construction. It has greatly influenced architecture around the world. The building is circular (like a drum) and topped with a huge concrete dome that has a

central opening, or **oculus (The Great Eye)**, open to the sky. A pediment style porch opens into the drum. The pediment is supported with huge granite Corinthian columns. The exact composition of the Roman concrete used in the dome remains a mystery. A dome like this made of modern concrete would hardly stand the load of its own weight, yet the Pantheon has stood for centuries. It is the best preserved of all Roman buildings, and perhaps the best preserved building of its age in the world.

Roads: The Romans built thousands of miles of wonderful roads, to connect every part of the empire back to Rome. Up until about a hundred years ago, people were still using these roads, as roads! In recent years, instead of building new roads, modern engineers simply covered many of the old Roman roads with a coat of asphalt.



Roads were built with layers:

1. rubble
2. a layer of slabs or gravel set in mortar or a layer of concrete
3. a layer of concrete and crushed stones
4. a top layer of hard stones or blocks of lava (paving stones) - These were fitted close together so that there were no cracks or seams.



There were **gutters** on the sides so rain would run off. **Curbstones** were on each side of the entire road, as well as **footpaths** on each side. The word "**street**" is an Anglo-Saxon word derived from the Latin "**strata**" and refers to the layers of stones used in the construction of a Roman road.



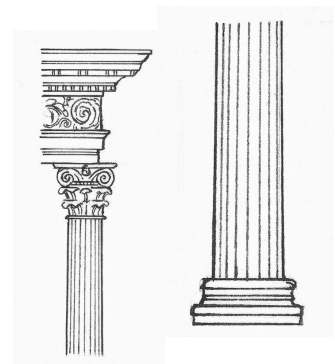
To help people find their way while traveling these roads, the Romans more or less invented the milestone which grew increasingly tall, with many words, to be easily readable from a vehicle. A **milestone**, or *miliarium*, was a circular column on a solid rectangular base. Some are six feet tall. The milestone usually gave the mileage to the nearest large city, sometimes to a midway place as well, the date of construction, and perhaps the name

of who paid for the road. The modern word **mile** derives, in fact, from the Latin *milia passuum*, "one thousand paces", which amounted to about 1,500 m.

Columns and Arcades: An **arcade** is a series of arches supported by columns or piers. An arcade may stand free or may be attached to a wall. The earliest-known arcades were in Roman architecture. The Romans copied the forms of classical Greek architecture mainly due to the beautiful styles and shaft strength. While Roman columns and Greek pillars are very similar, Roman columns usually have a slimmer shaft and some of the styles have different bases. Details between the two types of architecture can also differ slightly. It is said that two of the major types of columns (Doric and Ionic), which had reached perfection in Greece, were not appreciated and properly used in Rome. It must also be remembered that the Romans were a civilization of engineers, not artists. Their society valued rules and customs, and that is reflected in their architecture.



The **Tuscan** order of column is a uniquely Roman concoction. It is similar to the Doric, but has been changed to be simpler. It appeals to people for whom less is more.



The Romans also created the **Composite** order. It is composed of an Ionic shaft and a Corinthian capital.

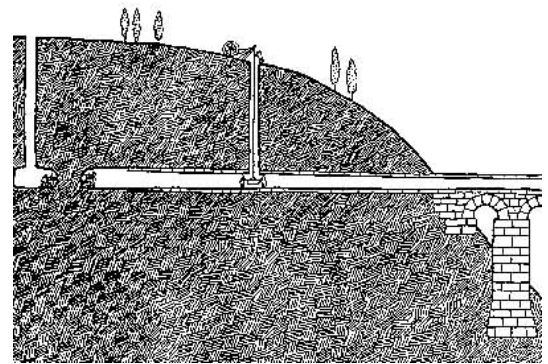
Roman Aqueducts: As cities grew, the ancient Romans needed more fresh water. To solve this problem, they built **aqueducts**, which serve the same purpose as modern day water pipes. These were massive construction projects. An aqueduct, properly speaking, is the entire conduit - from

fresh water spring into town. (CONDUIT—A natural or artificial channel through which fluids may be moved). The word "aqueduct" came from the Latin word *aqua*, "water," and *ducere*, "to lead." The aqueducts helped get water to the popular Roman baths.



What is extraordinary about the aqueducts is the planning that must have gone into their construction. Since the ancient Romans didn't use pumps,

aqueducts had to be positioned at a relatively constant slope for dozens of miles. Try building something that drops by only 100 feet in 40 miles, and you'll begin to understand why scholars refer to the ancient Romans as such great builders!



Inscriptions (writing): The ancient Romans wrote quite a bit. Much of their pottery was signed. Very often, the bricks used to



make buildings were stamped with the name of their maker. Lead pipes leading to these buildings, by law, were stamped. Scholars have found 200,000 Latin inscriptions and, incredibly, several thousands are still being found every year! There was a group of letters found in a well in Scotland that show that even men in the Roman army could read. Scholars estimate that about 30% of all adult men in Imperial times had the ability to read and write.

*Roman Numerals

The Romans developed a numeral and mathematics system similar to that of the Greeks. While the numerals themselves do not look similar, they had similar functions. The Roman numerals are as follows:

1	I	20	XX
2	II	25	XXV
3	III	29	XIX
4	IV	40	XL
5	V	50	L
6	VI	75	LXXV
7	VII	100	C
8	VIII	500	D
9	IX	900	CM
10	X	999	CMXCIX
11	XI	1,000	M
14	XIV	1,001	MI
16	XVI	3,769	MMDCCLXIX

There was no set place value in the Roman number system, as we have with Arabic numbers today. Look at the numbers 1,001 and 3,769 in the chart above. It takes four digits to show these numbers in Arabic numbers, with one digit in each place value. 1,001 written in Roman numerals only has two characters, MI; 3,769 has ten characters. Also, there is also no zero. The numbers are basically added together. For example, the Roman numeral I equals one on its own, all the time. To make four, however, it must be added to other numerals - IIII. Now let's look at the number twenty-six. We must add two tens together, add a five, and add a one - XXVI. While there are several combinations of Roman numerals that can make twenty-six, the idea is to use the fewest characters to reach the desired number. To achieve 4, we write "IV" - basically "one less than five." To achieve 9, we write "IX" - "one less than ten." Now look at 40 in the chart. It is written as XL - "ten less than fifty." 900 is written as CM "one hundred less than one thousand." How do you think 90 and 400 are written? Roman numerals today are used most frequently as list numbers (in outlines, preface page numbers, chapter numbers), movie sequel indicators, on time pieces, or in art where a classical feeling is desired.

*Roman Language - root words

The Latin language is the basis for all the Romance languages - Spanish, Italian, French, Romanian, and Portuguese for example. Many English words have their roots in Latin as well. Below is a list of root words, prefixes, and suffixes that come from Latin.

Latin Root	Basic Meaning	Example Words
-dict-	to say	dictate; dictation
-scrib- or -script-	to write	inscription, scribe
-bene-	good, well	benefactor; benevolent
-veto-	I forbid	veto
-theo-	god	pantheon
-act-	do, move	action; active
-circum-	around	circumference; circulatory

Latin Prefix	Basic Meaning	Example Words
--------------	---------------	---------------

co-	together	coauthor, cooperate
de-	away, off, undo	deactivate; defrost
dis-	not, not any	disbelief; discomfort
inter-	between, among	international; intertwine
non-	not	nonessential; nontoxic
pan-	all	pantheon; Pangaea; pandemonium
pre-	before	prevent; premature
re-	again; backward	rearrange; rebuild
sub-	under	submarine, subway
trans-	across, beyond, though	transport; transatlantic

Latin Suffix	Basic Meaning	Example Words
-able, -ible	forms adjectives, means "capable or worthy of"	likable, flexible
-ation	forms nouns from verbs	creation; dictation
-fy, -ify	forms verbs, means "to make or cause to become"	
-ment	forms nouns from verbs	entertainment, statement
-ty, -ity	forms nouns from adjectives	certainty, loyalty, similarity

*Roman Achievements (many of which influence our life today):

1. Technology: The invention of concrete, roads, aqueducts, and central heating
2. Law: Influence of Roman law (including the law from the Twelve Tablets that a person is innocent until proven guilty)
3. Language: Roman language (Latin), which is the root for the romance languages

4. **Medicine:** Public health programs, including welfare programs for the poor
5. **Art:** Mosaics, jewelry, statues, rings
6. **Customs:** Including the use of rings to denote friendship, engagements and weddings, and the use of greenery to decorate during winter holidays
7. **Games:** Many board and ball games, including knuckleball (jacks) and hoops
8. **Literature:** many epics were written and structure for poetry was established
9. **Architecture:** Use of the arch, arcades, the dome, concrete, and aqueducts

*Famous People:

*Virgil: a classical Roman poet, known for his epics, especially *Aeneid* (a heroic epic that became the Roman Empire's national epic)

*Julius Caesar: patrician army general who took control of Rome, changing Rome from a republic into a dictatorship

*Augustus (Octavian): first Roman emperor who took over after Julius Caesar was killed

*Nero: became emperor at a young age and was eventually assassinated for trying to be more of an entertainer than a ruler- he is thought to have set fire to Rome

*Marius: a Roman general who was elected consul seven times- he is known for the big changes he made to the Roman army, making it easier for men to be Roman soldiers

*Trajan: emperor who expanded the Roman Empire and gave low-cost loans to farmers, as well as money to poor children and orphans

*Hadrian: emperor during the time of "good emperors" who is known for building "Hadrian's Wall" between England and Scotland

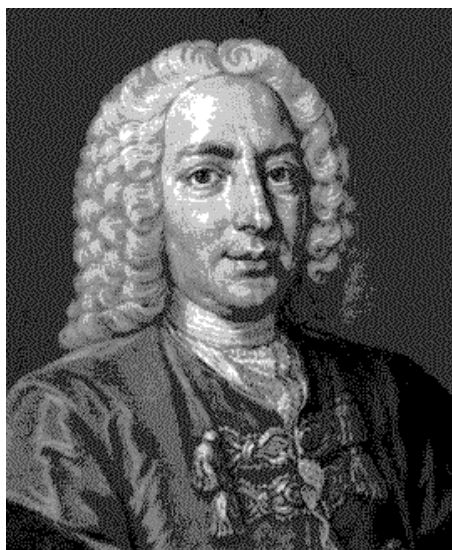
*Spartacus: slave, trained as a gladiator, who led a rebellion against the Roman army for slave freedom- he was killed after two years

*Hannibal: son of Hamilcar from Carthage, who fought hard against Rome in the Punic Wars

Notable Scientists in Chemistry and Physics



Sir Isaac Newton (1642-1727) was born the same year Galileo (a major 16th century Italian scientist) died. Newton preferred to work alone and in secrecy. When the universities had to close temporarily in 1665 because of the plague, Newton spent a year and a half at his mother's farm. During that short period, he developed a new type of mathematics (later known as **calculus**), made a breakthrough in the science of **optics** dealing with the nature of colors and light, and discovered **universal gravitation** (all bodies exert gravitational attraction on each other). Newton realized that the same laws of nature applied throughout the entire solar system, not just here on Earth. He developed the **three laws of motion**. Many of his ideas were initially disputed and ridiculed. Newton often would not publish or make his ideas widely known for many years after he formulated them. Newton also developed a new kind of reflecting telescope. In 1705, he was knighted for his services to science.



Daniel Bernoulli (1700-1782) was a member of a scientifically and mathematically active Swiss family. Daniel's father and several of his brothers taught at European universities. Bernoulli studied medicine and mathematics before going on to teach physics. He is known for his discovery of a phenomenon now known as "**Bernoulli's Principle**". This principle states that as the velocity of a fluid (a liquid or a gas) increases, its pressure decreases. Bernoulli's principle explains how an airplane moving in the air stays in the air. The surface of an airplane's wing is curved, while the bottom of it is flat. This makes the distance over the top of the wing

greater than the distance on the bottom of the wing. The air molecules that are together in the air "want" to stay together. When the wing passes through the air, the molecules that go above the wing have to travel faster than the molecules on the bottom of the wing in order to reach the back edge of the wing at the same time. The faster air on top makes a lower pressure on top of the wing and a higher pressure on the bottom of the wing. This essentially means that the air on the bottom of the wing is pushing up on the wing, creating **lift**.



Antoine Lavoisier (1743-1784) was fascinated with scientific research as a young boy in France. His family discouraged him from having science as a career, so he entered law school. However, he still dedicated himself to studying science - especially botany, chemistry, and geology. When he finished law school, he was hired to do mapping work and spent his money on weather instruments rather than clothing or wigs (which he would need to be a lawyer). He felt keeping records of temperatures, air pressure, and humidity, would enable us to predict weather. Lavoisier presented reports to the Academy of Science on various subjects including improving the water from the Seine River, fossils, a chair for invalids (very ill people), coal mines, air balloons, and more. He was visited by many other scientists, including Benjamin Franklin. Lavoisier emphasized the concept of "repeated experiment." He felt that by **repeating experiments** more than once, scientists could be sure of their results and remove any doubts about their findings. Lavoisier completed numerous experiments with **combustion** (burning) and **determined that matter cannot be destroyed**. He disagreed with Aristotle's concept of four **elements**, declaring that an element was any substance that could not be broken down into other simpler substances and a compound was a new substance formed by the combination of two or more elements. Lavoisier determined that air is a compound, and he named the "pure air" **oxygen**. He discovered the chemical composition of

water. Lavoisier insisted on a **systematic language** all chemists could understand. With his co-workers, he presented a logically arranged chart to the Academy of Science, and later wrote Elements of Chemistry in 1789. In spite of all of his contributions to science and for the welfare of the people of France, the "Father of Modern Chemistry" was thrown in jail and his wealth confiscated during the French Revolution. He was executed by guillotine and buried in a common grave.



Joseph Henry (1797-1878) was the most respected American scientist of his time. He was Professor of Mathematics and Natural Philosophy at the Albany Academy in New York for a time. In 1827, he began research in **electromagnetism** and published a paper on it four years later. He was named Professor of Natural Philosophy at the College of New Jersey, which later became Princeton University, and was the first director of the **Smithsonian Institution**, a position he held

for over 30 years, seeing it through the Civil War. At the Smithsonian Institution, Henry developed the format of the complex of museums and research facilities that we know today. Henry's pioneering work in electricity and magnetism helped lead the way to the invention of the **telegraph**, the **electric motor**, and the **telephone**. Henry was president of the National Academy of Sciences up to his death in 1878.



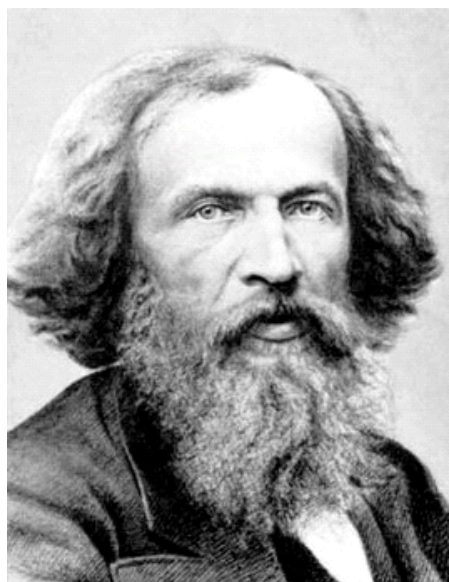
Louis Pasteur (1822-1895) made major contributions to nine different fields of science. His father (a leather maker who used to be a soldier for Napoleon) gave him the desire to set high standards. His first research was with crystals. Later, he experimented with **fermentation**, the chemical breakdown of an organic molecule into simpler substances by a

micro-organism - for example, using yeast to break down sugar into carbon dioxide and alcohol when making bread. Based on his fermentation experimentation, he determined that heating a liquid to an appropriate temperature would kill micro-organisms which cause spoilage or disease. This process, called **pasteurization**, was named after him. Pasteur also determined that **microbes** could survive nearly anywhere, under almost any conditions. Understanding that microbes cause illness, he began experimenting and discovered **vaccines** for cholera, anthrax, and rabies.



Lord William Thomson Kelvin (1824-1907) was a Scottish mathematician and physicist known for his research in **static electricity** and **magnetic phenomena**. The ability to lay underwater cables (including the one on the floor of the Atlantic) was made possible by Kelvin's research in the transmission of electric current. Kelvin was knighted for this work in 1866. Kelvin built instruments such as the amp-meter, the volt-meter and the watt-meter for his work shop. Kelvin felt a need for an absolute,

thermodynamic temperature scale, and thus, the **Kelvin temperature scale** is named after him.

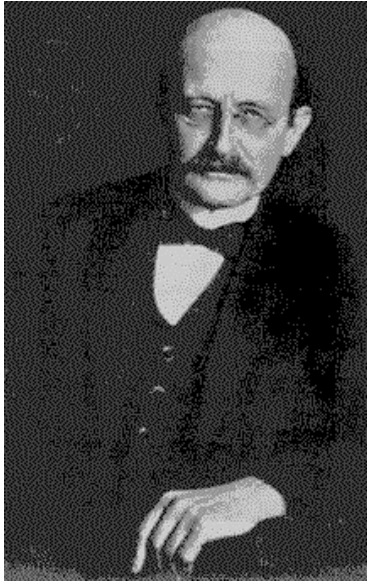


Dmitri Mendeleev (1834-1907) was born in Siberia, the youngest of at least 14 children. A talented student, he was excited by science and mathematics, but after high school he was turned down by both the University of Moscow and the University of St. Petersburg because of his common background. He was finally allowed into a St. Petersburg teacher-training school and eventually received a Master of Chemistry degree before beginning to teach. Mendeleev was puzzled by the variety of

known elements and tried to find a pattern to them. In 1861 he published an organic chemistry textbook, and two years later was named to a high position at the University of St. Petersburg which had declined his enrollment as a student years earlier. In 1868 he helped found the Russian Chemical Society and published Principles of Chemistry. He appreciated the simple use of **letters to signify elements' names**. Judging from his notes, he thought of the organization of the Periodic Table on a single day in 1869, arranging the elements by **atomic weight**. Today, the Periodic Table is based on atomic number (the number of electrons in the nucleus of an atom), but the general arrangement remains the same with metals, metalloids, and non-metals separated. Mendeleev's arrangement of the 63 known elements had blank spaces which he predicted would be filled in as new elements were discovered. He went ahead and gave them names, atomic weights, and properties, publishing his predictions in "The Journal of the Russian Chemical Society" in 1871. The correspondence between Mendeleev's predictions and the actual elements when discovered was amazing.



Wilhelm Conrad Roentgen (Röntgen) (1845-1923) was not an especially gifted child, but loved nature and enjoyed roaming through open country and forests. He enjoyed making mechanical contraptions. In 1895, while Röntgen was studying the movement of an electric current through a gas of extremely low pressure, he discovered rays which he called "**x-rays**" since their nature was unknown. He kept his wife's hand still in the path of the rays over a photographic plate, and after it was developed he noticed an image of his wife's hand which showed her ring and the bones of her hand. This was the first "röntgenogram" ever taken. In later experiments, Röntgen showed that the new rays were produced by cathode rays impacting a material object. The **very first Nobel Prize in Physics** ever awarded went to Röntgen in 1901 for his discovery of the rays that were later named after him.

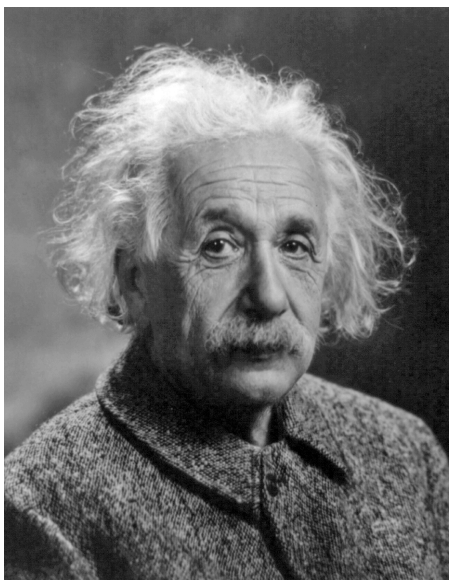


Max Planck (1858-1947) was born in Germany and entered the University of Munich to study physics when he was 16. He received a doctorate when he was 21 years old. He started out teaching at the University of Munich in 1880, before going to the University of Berlin in 1889. He stayed there for 38 years until he retired. In 1900 Planck put forth a formula, now known as Planck's radiation formula, which caused quite a stir, but gradually became generally accepted. **Planck's radiation formula** explains the amount and wavelength of electromagnetic energy coming from a particular body. It explains why infrared energy is given off by objects. It also explains why different chemical compounds burn in different colors. In 1918, Planck received the Nobel Prize for Physics. He is also credited with the development of **quantum theory**. Quantum theory explains the nature and behavior of matter and energy. Planck remained in Germany during World War II but suffered extreme personal tragedy. Two sons were executed at different times for their alleged involvement in plots to execute Hitler, and Planck's home in Berlin burned in an air raid.



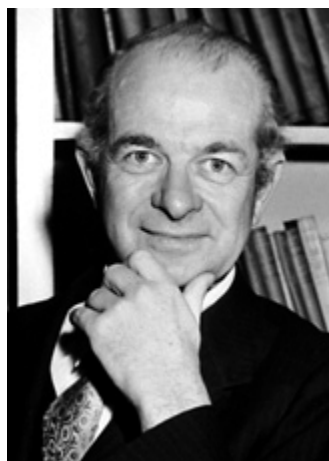
Marie Curie (1867-1934) was born as *Manya Skłodowska* in Warsaw, Poland, when it was occupied by Russia. At the age of four she secretly learned to read in Polish, while at school she was required to read in Russian. Because women were not allowed to attend universities in either Poland or Russia, she attended secret classes at a "floating" university for women. These classes were moved around the city and frequently held in small apartments at great risk to the teachers who dared to instruct the women. It wasn't until 1891 that she finally was able to further her studies openly by going to Paris. She changed her first name to Marie and diligently applied

herself to her studies. Two years later she received her Master's degree in Physics, the first woman ever to receive that degree. One year later she received her Master's degree in Mathematics. In 1895 she married Pierre Curie, a Frenchman devoted to the pursuit of knowledge for its own sake, also called "pure science". Studying for her Ph.D. in science, Madame Curie began researching a characteristic of uranium which she eventually called "radioactivity". Working together, the Curies discovered two additional elements; **polonium** was named after Madame Curie's native Poland and **radium** was based on the Latin word for "ray". People were unaware of the dangers of the radioactive material they were handling, and both Curies received slow-healing burns from the material. They believed that scientific knowledge belonged to everyone and refused to patent their process for extracting radium, which would have made them rich. In 1903 Madame Curie was the first woman in France to receive her Ph.D. That year she was also the **first woman to receive the Nobel Prize in physics**, along with her husband and the man who had initiated the research which Madame Curie had resumed. In 1906 her husband died as the result of a fall. Because she was a woman, she was not allowed to become a member of the Academy of Science, yet in 1911 she received another Nobel Prize, this time in chemistry for her discovery of polonium and radium. After World War I broke out, Madame Curie and her seventeen-year-old daughter helped set up mobile x-ray units to assist doctors of the French army. Madame Curie eventually died of a disease, most likely caused by her exposure to radiation.



Albert Einstein (1879-1955) was born in Germany and was educated there and in Switzerland. After graduating in 1901, he became a Swiss citizen. Because he could not find a teaching job, he took a position with the Swiss patent office. During this time, he produced quite a bit of his incredible work. He received his doctorate in 1905. In 1914 he took a position at the University of Berlin and became a German citizen again. Einstein's

paper on the **general theory of relativity** was published in 1916. From this theory, we get his famous and world-changing equation of $E=mc^2$ (the kinetic energy of an object = its mass x the speed of light). This equation basically means that energy can be turned into matter and matter can be turned into energy. It helps us to understand what happens inside atoms and stars, among other things. During this time, he also worked on the problems of the **theory of radiation** and **statistical mechanics**. In 1921 he received the **Nobel Prize for Physics**. Einstein remained in Berlin until 1933, when he renounced his citizenship for political reasons and immigrated to America. He took a position in physics at the institute later known as Princeton University. In 1940 he became a United States citizen and retired from his position five years later. Einstein seemed to always have an idea of the problems of physics and the desire to stay with them all the way through to the solution. He saw his major accomplishments as steps along the path to the next advance to be made.



Linus Pauling (1901-1994) was born in a small town in Oregon. As a young boy, he collected insects and rocks and built himself a laboratory in the basement. He and a good friend experimented with mixing different chemicals to see the changes that would happen. His widowed mother hoped he would get a job after high school to help support her and his sisters, but he went on to college. He still sent money home to her while putting himself through college as well.

By the time he headed off to graduate school, chemists were starting to become aware of the different ways substances reacted with each other and that these ways depended on the arrangement of the atoms within the molecules. Using x-ray **diffraction** (changes in the direction and intensity of radiation as it passes through an object), and later, electron diffraction, he eventually determined the **molecular structures** of 200 substances. Having this information would enable chemists to create many more useful materials. In 1932, Pauling was elected to the American Academy of Sciences, the youngest member ever. **World War II** interrupted Pauling's research, but his talents were put to use for the

war. He helped design explosives and propellants (chemicals), made invisible ink for secret messages, helped develop synthetic blood plasma, and in three days designed something to monitor the oxygen content in airplanes and submarines. After the war, Pauling and a co-worker researched and determined the cause of sickle-cell anemia - the first known molecular disease. Because of the devastation caused by World War II, Pauling was appalled by war and became an outspoken **advocate of peace**. He felt the U.S. Cabinet should include a Secretary of Peace and that the U.S. government should be a leader in creating a peaceful world. He understood the dangers of testing and using atomic bombs and spoke against them. In further research, Pauling focused on the **immune system and genetics** (including the structure of the DNA molecule), often spurring additional research done by others. In 1954 Pauling received the **Nobel Prize in Chemistry**. In 1962 he received the **Nobel Prize for Peace** in recognition for his work in bringing about an international treaty banning atmospheric nuclear testing. He valued the second Nobel more than the first because it was for peace. In his sixties he left his academic job, founded an institute, and then began studying the effects of vitamins and other natural substances on human health. He was convinced that Vitamin C could be used to cure many diseases. Pauling passed away at the age of 93.

To find out more about the Nobel Prize and past winners, go to <http://nobelprize.org/nobel/> .

* Questions for Further Thought

1. Describe at least four contributions of the ancient Romans. Why were they important? Do we use them today?
2. Describe how a Roman road was built. Draw a cross-section diagram of the road. Write a sentence about each part. What was the importance of roads in Roman times?
3. Entertainment was important to the Romans. Describe three major forms of entertainment in ancient Rome. Where did each activity take place? What went on? Who could go? Was there a fee? If not, why was there no fee?
4. Draw and name at least three Roman contributions to architecture. Explain how each of these features was used.
5. What were the major social groups in ancient Rome? What was life like for each group? Where did they live? What jobs did they have? What were they allowed to do or not do? Did their place in Rome change over time?
6. Describe the change in women's rights over the course of the Roman Empire. Include a description of their rights during the kingdom, republic, and empire.
7. How was Rome able to maintain such an immense empire for so long?
8. Discuss at least three famous chemists or physicists. Include name, at least two major contributions, how those contributions affected the world, any Nobel Prizes won, and what they were won for.
9. What is Bernoulli's Principle? How does it work? How does it affect the flight of airplanes?

*Resources

Roberts, Paul C. Dr. Ancient Rome: The Nature Company Discoveries Library. 1997

What is a Gladiator? www.discoverychannel.com

Ancient Rome: www.mrdonn.org

Chandler, Fiona and Sam Taplin and Jane Bingham. The Usborne Internet-Linked Encyclopedia of the Roman World. 2001

Fun Stuff

Sources for Roman clothing www.vroma.org/

A View on Cities (Circus Maximus)

<http://www.aviewoncities.com/rome/circusmaximus.htm>

Kidipede

<http://www.historyforkids.org/learn/romans/history/history.htm>

Fun Stuff

Birmingham Museum and Art Gallery: Dress a Roman Soldier

<http://www.schoolsliaison.org.uk/kids/preload.htm>

Ancient Roman Streets: What does not belong game

http://www.bbc.co.uk/history/walk/games_index.shtml