Archimedes Helps Me On Math

When I was a young child, I heard a saying from Archimedes: Give me a place to stand on, and I will move the Earth. At that time, I thought it is interesting and sounded absurd. As I grow up, until I know what is lever principle raised by Archimedes, I learn the availability of this quote from Archimedes. Since then, I remembered Archimedes and considered him as a great person in the history with creative ideas. As a mathematician, an engineer, an inventor and an astronomer, Archimedes spent most of his life in Syracuse and participated in many aspects in this city. Through a detailed research on Archimedes' discoveries and inventions, I find he is good at using indirect way to solve problems. This feature of his discoveries not only in Mathematics but also in other fields like physics and weapons created. Through introducing his important creations and showing the stories behind part of them, I will illustrate how he uses the indirect method to find the final result. Moreover, his idea also gives me positive influence especially on mathematics.

Archimedes' great finding in mathematical field is the estimation of Pi. Even only short pages exist in history about his discovery on Pi, he shows an imperative contribution. "But considering that in its first proposition, Archimedes proved the famous formula for the area of a circle, and in its last, he gave a remarkable estimate for the number Pi, there is really no doubt why this little treatise had been held in such high regard by generations of mathematics, and by this criterion Measurement of a Circle stands as a genuine classic." (p99) His work on the exploration of Pi has three positions and the second one is unsatisfactory. However, his way to find how to give the estimation of Pi is greater than 3 and less than 3 is remarkable. He uses exhaustion method to find the area of the circle. "Archimedes' approach to determining ?, which consists of inscribing and circumscribing regular polygons with a large number of sides, was followed by everyone until the development of infinite series expansions in India during the 15th century and in Europe during the 17th century. That work also contains accurate approximations (expressed as ratios of integers) to the square roots of 3 and several large numbers." (website) Instead of directly exploring the exact measurement of a circle's area to find Pi, Archimedes uses estimation method which is an indirect way skillfully to give an accurate result around the true value of Pi. He uses triangle, square, pentagons and polygons with more sides step by step to show how he estimates the value of Pi and the result is convincing and correct. It is a remarkable finding with the method of estimation. When I learn mathematics and even in daily life, an indirect method like estimation helps me a lot to solve a problem.

Archimedes' idea of using indirect method is not only in mathematical field. As I mention before, he spent most of his life in Syracuse, Sicily. Archimedes participates in his city in various aspects. He helped the King to measure the density of the crown. Two objects with a same weight but different densities will have different volumes. Archimedes immerses the crown and a gold weighing the same in the water to observe different volume of water spilled out to compare their densities. It is how the famous concept, Archimedes principle, comes from. Instead of finding a method to calculate an accurate number of the density, Archimedes uses an indirect method once again to find the answer of the question. This discovery reminds me of a person in Chinese history and his story. His name is Cao Chong who lives in Eastern Han dynasty and he is the son of Cao Cao who had great power in Eastern Han dynasty and became the King of Wei dynasty. Chong is clever even in his childhood and the story of Chong named "Cao Chong

weighs the elephant” is famous in China. In ancient time, it sounds impossible to show the weight of an elephant because they don’t have a machine to measure the weight of such a big object unless they kill the elephant and make it into different parts and weigh each part one by one. However, Chong has an idea to weigh an alive elephant. He makes the elephant stand on a big boat on the river. He gives a remark on the boat that when elephants stand on it, how much the boat sinks under the water. Then he let the elephant go down the boat and order other people to move the stones inside the boat. He stopped moving stones into boat when the water reaches that remark because of the sinking of boat. At that time, the weight of sum of stones is same as the weight of that huge elephant. It is easy to weigh each stone and add them up, so the weight of alive elephant is obvious. In this story, instead of inventing the machine to measure an accurate number of the weight of elephant, Chong uses an indirect way that replace the elephant with stones and weigh the stones to find the final result. It is similar to what Archimedes did when he measured the density of crown. They both take advantages of using an indirect way to find the answer.

The most important part of Archimedes participation in his city is not that he helps the King to measure the density of crown. How he protects his city, Syracuse, through inventing various kinds of weapons is the most imperative contribution to his city. The Claw was an ancient weapon designed by Archimedes to defend Syracuse by sinking the ships of enemies. Although its exact nature is unclear, the accounts of ancient historians seem to describe it as a sort of crane equipped with a grappling hook that was able to lift an attacking ship partly out of the water, then either cause the ship to capsize or suddenly drop it. Also referred to as the burning mirror, Archimedes' death ray utilized concentrated rays of the sun to set Roman ships on fire. Archimedes arranged a series of mirrors reflecting sunlight into one concentrated stream which, in time, was said to have set fire to the Roman sails and masts. A great deal of controversy surrounds this Archimedes war machine and it is uncertain whether it actually worked. Making use of his vast mathematical knowledge, Archimedes also designed a catapult system to launch rocks, timbers, and other heavy objects over the great distance between the city walls and moored enemy ships. The most basic form of catapult utilizes a winched-down bucket into which the projectile is placed. When the bucket is released, the built-up pressure results in the launching of the projectile over great distances. Another form of catapult is the trebuchet that utilizes a weighted beam and sling which swings in an arc, launching heavy stones and timbers far enough to destroy moored enemy ships. These three weapons help Archimedes to better protect his city. These inventions also reflect his idea of using indirect method to reach the final result. Instead of attack people themselves, the claw’s purpose is sinking the ship. Once the ship is attacked and sinks, the enemies will die in the water. The death ray uses the physical concept that the mirror can reflect the ray of light and burn the enemies. Instead of using fire directly to attack enemies, Archimedes uses mirror to reflect the ray of light to get the same result.

When we do the research on a great person in history like Archimedes, we should not only focus on what he contributes but also pay attention to that his idea will improve ourselves. Archimedes has achievements in various fields and he has a significant influence on human society. Besides using his discoveries, we need learn how he succeeded in finding these creative objects. In my vision, he is good at using an indirect method to get the right answer to a specific question. We can learn from this idea and develops more innovations.