

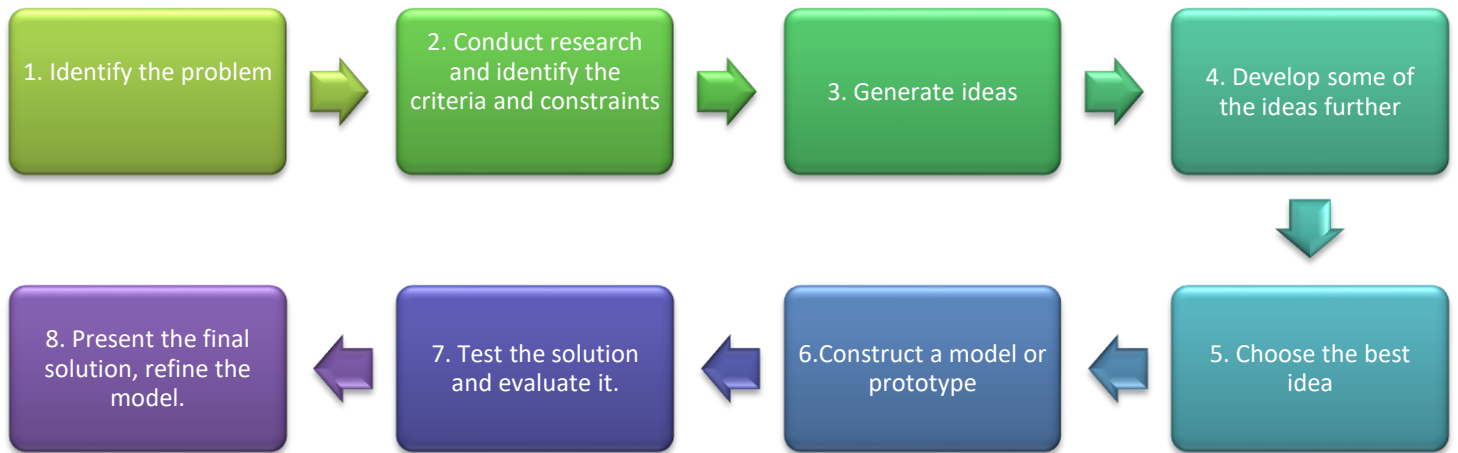
Technological Design Process

Guided Notes – Student Edition

All equipment, irrespective of the field that they are used in will undergo changes over time. These changes come about as scientists learn about and develop materials that are _____ or more user-friendly, more _____, or more cost-effective than the ones which were previously used. The process which oversees these new developments in equipment is called the technological design process.

The technological Design Process

The technological design process is a series of steps that scientists and engineers follow to _____ a problem. The solution may be to design an entirely new product which meets a certain set of _____ or accomplish a particular task, or, alternatively, it may be to modify to a _____ - _____ design. There are eight steps in the technological design process, some of which may need to be repeated several times to fine-tune the product and make sure that the solution is going to meet the _____ of the user. These eight steps are as follows:



Case Study: The Optical Microscope

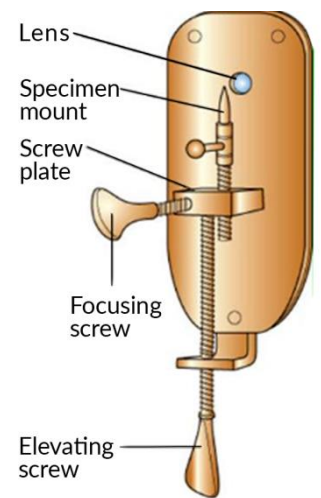
The first microscope was invented in the 1300's when two glass lenses were placed at either end of a tube. This design was very limited due to the poor quality of glass that was available which affected the microscope's magnification quality, limiting it to a power of 10. However, this development would begin centuries of progress which would uncover an entire world which was previously unknown to man.

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Galileo Galilei perfected the first compound microscope by refining his design for the telescope in 1609. This design used lenses with a shorter focal length than he had previously used in his telescope design. This was achieved by using a combination of convex and concave lenses. It was this design that was then modified by the Dutch spectacle makers, Janssen and Lipperhey who discovered that if different types and sizes of lenses were placed in front of each other, the magnification could be changed.

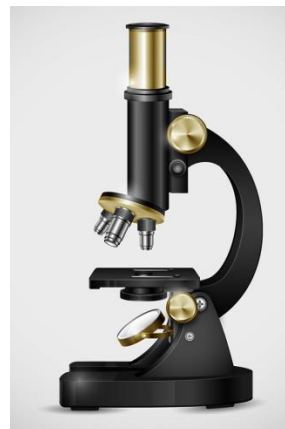


In 1676, a biologist named Antonie van Leeuwenhoek began to carefully polish, grind and shape his own lenses which lead to a magnification of up to 270 times what had previously been achieved. His design (pictured right) allowed him to study blood, yeast cells and bacteria for the first time.



Now that magnification of an object had been achieved, the development of the microscope changed to focus on the definition of the image. This was solved in 1830 by Joseph Jackson Lister, who discovered that by using several weak lenses together at certain distances he was able to produce good magnification without blurring the image that he was viewing.

As a follow on from Lister's work, in 1870, Ernst Abbe invented the condenser, which helps to illuminate the image in the microscope as well as developing the equation to calculate the resolution limit for the microscope.



Left: The monocular microscope in use from 1897.

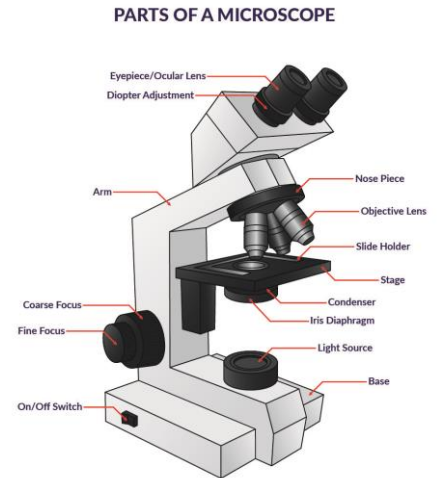
Right: The antique microscope in use from the early 1900s.

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Over time, the optical quality of lenses has increased, leading to the compound microscopes which are similar to the ones in current use. Throughout their development, the magnification of the microscope has increased and is currently at its maximum magnification of around 1500 times. The modern microscope found in many school labs is pictured to the right.

Questions:

1. Describe the prototype microscope initially developed in the 1300s. What was the limitation of this design?
2. Who perfected the first compound microscope? What did he use as the basis for his design?
3. How did the Dutch spectacle-makers Janssen and Lipperhey further develop the design of the microscope during the 1600s?
4. What improvements did Leeuwenhoek make to the microscope?
5. Who developed the condenser? What is it this instrument used for on a microscope?



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Technological Design vs Scientific Investigation

Technological design is very similar to a scientific investigation. Both processes rely on _____ and reason and follow a logical _____ of steps to solve a problem.

_____ is defined as the process of analysis and examination which clarifies the relationship between the non-living, living and designed world. Whereas, _____ is the application of scientific discoveries in order to meet human need or demand by developing certain products and processes.



The consequences of scientific investigations can advance science knowledge while the results of technological designs are to improve the standard of living. The table below compares the steps for each process:

Scientific investigation	Technological design
Identify a problem and ask questions	Identify a need or problem
Researching and gathering related information	Researching and gathering related information
Design an experiment to determine the relationship between variables	Design a system or product to improve and overcome the problem
Conducts the experiment as repeated trials	Tests the design or prototype
Analyses the trial results	Analyses the test results
Evaluate the results and verify the hypothesis	Evaluate the process or the product and its efficiency in solving the problem.