Important Inventions and Discoveries

1. The printing press, 1430s
The printing press was nominated by 10 of our 12 panelists, five of whom ranked it in their top three. Dyson described its invention as the turning point at which "knowledge began freely replicating and quickly assumed a life of its own."

2. Electricity, late 19th century
And then there was light—and Nos. 4, 9, 16, 24, 28, 44, 45, and most of the rest of modern life.

3. Penicillin, 1928
Accidentally discovered in 1928, though antibiotics were not widely distributed until after World War II, when they became the silver bullet for any number of formerly deadly diseases

4. Semiconductor electronics, mid-20th century
The physical foundation of the virtual world

5. Optical lenses, 13th century
Refracting light through glass is one of those simple ideas that took a mysteriously long time to catch on. "The Romans had a glass industry, and there's even a passage in Seneca about the optical effects of a glass bowl of water," says Mokyr. But it was centuries before the invention of eyeglasses dramatically raised the collective human IQ, and eventually led to the creation of the microscope and the telescope.

6. Paper, second century
"The idea of stamping images is natural if you have paper, but until then, it's economically unaffordable." — Charles C. Mann

7. The internal combustion engine, late 19th century

Turned air and fuel into power, eventually replacing the steam engine (No. 10)

8. Vaccination, 1796
The British doctor Edward Jenner used the cowpox virus to protect against smallpox in 1796, but it wasn't until Louis Pasteur developed a rabies vaccine in 1885 that medicine—and government—began to accept the idea that making someone sick could prevent further sickness.

9. The Internet, 1960s
The infrastructure of the digital age

10. The steam engine, 1712
Powered the factories, trains, and ships that drove the Industrial Revolution

11. Nitrogen fixation, 1918
The German chemist Fritz Haber, also the father of chemical weapons, won a Nobel Prize for his development of the ammonia-synthesis process, which was used to create a new class of fertilizers central to the green revolution (No. 22).

12. Sanitation systems, mid-19th century
A major reason we live 40 years longer than we did in 1880

13. Refrigeration, 1850s
"Discovering how to make cold would change the way we eat—and live—almost as profoundly as discovering how to cook." — George Dyson

14. Gunpowder, 10th century
Outsourced killing to a machine

15. The airplane, 1903
Transformed travel, warfare, and our view of the world (see No. 40)

16. The personal computer, 1970s
Like the lever (No. 48) and the abacus (No. 43), it augmented human capabilities.

17. The compass, 12th century
Oriented us, even at sea

18. The automobile, late 19th century
Transformed daily life, our culture, and our landscape

19. Industrial steelmaking, 1850s
Mass-produced steel, made possible by a method known as the Bessemer process, became the basis of modern industry.

20. The pill, 1960
Launched a social revolution

21. Nuclear fission, 1939
Gave humans new power for destruction, and creation

22. The green revolution, mid-20th century
Combining technologies like synthetic fertilizers (No. 11) and scientific plant breeding (No. 38) hugely increased the world's food output. Norman Borlaug, the agricultural economist who devised this approach, has been credited with saving more than 1 billion people from starvation.

23. The sextant, 1757
It made maps out of stars.

24. The telephone, 1876
Allowed our voices to travel

25. Alphabetization, first millennium b.c.
Made knowledge accessible and searchable—and may have contributed to the rise of societies that used phonetic letters over those that used ideographic ones

26. The telegraph, 1837
Before it, Joel Mokyr says, "information could move no faster than a man on horseback."

27. The mechanized clock, 15th century
It quantified time.

28. Radio, 1906
The first demonstration of electronic mass media's power to spread ideas and homogenize culture

29. Photography, early 19th century
Changed journalism, art, culture, and how we see ourselves

30. The moldboard plow, 18th century
The first plow that not only dug soil up but turned it over, allowing for the cultivation of harder ground. Without it, agriculture as we know it would not exist in northern Europe or the American Midwest.

31. Archimedes' screw, third century b.c.
The Greek scientist is believed to have designed one of the first water pumps, a rotating corkscrew that pushed water

up a tube. It transformed irrigation and remains in use today at many sewage-treatment plants.

32. The cotton gin, 1793
Institutionalized the cotton industry—and slavery—in the American South

33. Pasteurization, 1863
One of the first practical applications of Louis Pasteur's germ theory, this method for using heat to sterilize wine, beer, and milk is widely considered to be one of history's most effective public-health interventions.

34. The Gregorian calendar, 1582

Debugged the Julian calendar, jumping ahead 10 days to synchronize the world with the seasons

35. Oil refining, mid-19th century
Without it, oil drilling (No. 39) would be pointless.

36. The steam turbine, 1884
A less heralded cousin of steam engines (No. 10), turbines are the backbone of today's energy infrastructure: they generate 80 percent of the world's power.

37. Cement, first millennium b.c.
The foundation of civilization. Literally.

38. Scientific plant breeding, 1920s
Humans have been manipulating plant species for nearly as long as we've grown them, but it wasn't until early-20th-century scientists discovered a forgotten 1866 paper by the Austrian botanist Gregor Mendel that we figured out how plant breeding—and, later on, human genetics—worked.

39. Oil drilling, 1859
Fueled the modern economy, established its geopolitics, and changed the climate

40. The sailboat, fourth millennium b.c.
Transformed travel, warfare, and our view of the world (see No. 15)

41. Rocketry, 1926
"Our only way off the planet—so far." — George Dyson

42. Paper money, 11th century
The abstraction at the core of the modern economy

43. The abacus, third millennium b.c.
One of the first devices to augment human intelligence

44. Air-conditioning, 1902
Would you start a business in Houston or Bangalore without it?

45. Television, early 20th century
Brought the world into people's homes

46. Anesthesia, 1846
In response to the first public demonstration of ether, Oliver Wendell Holmes Sr. wrote: "The fierce extremity of suffering has been steeped in the waters of forgetfulness, and the deepest furrow in the knotted brow of agony has been smoothed forever."

47. The nail, second millennium b.c.
"Extended lives by enabling people to have shelter." — Leslie Berlin

48. The lever, third millennium b.c.
The Egyptians had not yet discovered the wheel when they built their pyramids; they are thought to have relied heavily on levers.

49. The assembly line, 1913
Turned a craft-based economy into a mass-market one

50. The combine harvester, 1930s
Mechanized the farm, freeing people to do new types of work

The Copernicum System
In 1543, while on his deathbed, Polish astronomer Nicholas Copernicus published his theory that the Sun is a motionless body at the center of the solar system, with the planets revolving around it. Before the Copernicum system was introduced, astronomers believed the Earth was at the center of the universe.

Gravity
Isaac Newton, an English mathematician and physicist, is considered the greatest scientist of all time. Among his many discoveries, the most important is probably his law of universal gravitation. In 1664, Newton figured out that gravity is the force that draws objects toward each other. It explained why things fall down and why the planets orbit around the Sun.

Electricity
If electricity makes life easier for us, you can thank Michael Faraday. He made two big discoveries that changed our lives. In 1821, he discovered that when a wire carrying an electric current is placed next to a single magnetic pole, the wire will rotate. This led to the development of the electric motor. Ten years later, he became the first person to produce an electric current by moving a wire through a magnetic field. Faraday's experiment created the first generator, the forerunner of the huge generators that produce our electricity.

Evolution
When Charles Darwin, the British naturalist, came up with the theory of evolution in 1859, he changed our idea of how life on earth developed. Darwin argued that all organisms evolve, or change, very slowly over time. These changes are adaptations that allow a species to survive in its environment. These adaptations happen by chance. If a species doesn't adapt, it may become extinct. He called this process natural selection, but it is often called the survival of the fittest.

Louis Pasteur
Before French chemist Louis Pasteur began experimenting with bacteria in the 1860s, people did not know what caused disease. He not only discovered that disease came from microorganisms, but he also realized that bacteria could be killed by heat and disinfectant. This idea caused doctors to wash their hands and sterilize their instruments, which has saved millions of lives.

Theory of Relativity
Albert Einstein's theory of special relativity, which he published in 1905, explains the relationships between speed, time and distance. The complicated theory states that the speed of light always remains the same—186,000 miles/second (300,000 km/second) regardless of how fast someone or something is

moving toward or away from it. This theory became the foundation for much of modern science.

The Big Bang Theory

Nobody knows exactly how the universe came into existence, but many scientists believe that it happened about 13.7 billion years ago with a massive explosion, called the Big Bang. In 1927, Georges Lemaître proposed the Big Bang theory of the universe. The theory says that all the matter in the universe was originally compressed into a tiny dot. In a fraction of a second, the dot expanded, and all the matter instantly filled what is now our universe. The event marked the beginning of time. Scientific observations seem to confirm the theory.

Penicillin

Antibiotics are powerful drugs that kill dangerous bacteria in our bodies that make us sick. In 1928, Alexander Fleming discovered the first antibiotic, penicillin, which he grew in his lab using mold and fungi. Without antibiotics, infections like strep throat could be deadly.

DNA

On February 28, 1953, James Watson of the United States and Francis Crick of England made one of the greatest scientific discoveries in history. The two scientists found the double-helix structure of DNA. It's made up of two strands that twist around each other and have an almost endless variety of chemical patterns that create instructions for the human body to follow. Our genes are made of DNA and determine how things like what color hair and eyes we'll have. In 1962, they were awarded the Nobel Prize for this work. The discovery has helped doctors understand diseases and may someday prevent some illnesses like heart disease and cancer.

Periodic Table

The Periodic Table is based on the 1869 Periodic Law proposed by Russian chemist Dmitry Mendeleev. He had noticed that, when arranged by atomic weight, the chemical elements lined up to form groups with similar properties. He was able to use this to predict the existence of undiscovered elements and note errors in atomic weights. In 1913, Henry Moseley of England confirmed that the table could be made more accurate by arranging the elements by atomic number, which is the number of protons in an atom of the element.

X-Rays

Wilhelm Roentgen, a German physicist, discovered X-rays in 1895. X-rays go right through some substances, like flesh and wood, but are stopped by others, such as bones and lead. This allows them to be used to see broken bones or explosives inside suitcases, which makes them useful for doctors and security officers. For this discovery, Roentgen was awarded the first-ever Nobel Prize in Physics in 1901.

Quantum Theory

Danish physicist Niels Bohr is considered one of the most important figures in modern physics. He won a 1922 Nobel Prize in Physics for his research on the structure of an atom and for his work in the development of the quantum theory. Although he help develop the atomic bomb, he frequently promoted the use of atomic power for peaceful purposes.

Atomic Bomb

The legacy of the atomic bomb is mixed: it successfully put an end to World War II, but ushered in the nuclear arms race. Some of the greatest scientists of the time gathered in the early 1940s to figure out how to refine uranium and build an atomic bomb. Their work was called the Manhattan Project. In 1945, the U.S. dropped atomic bombs on the Japanese cities of Hiroshima and Nagasaki. Tens of thousands of civilians were instantly killed, and Japan surrendered. These remain the only two nuclear bombs ever used in battle. Several of the scientists who worked on the Manhattan Project later urged the government to use nuclear power for peaceful purposes only. Nevertheless, many countries continue to stockpile nuclear weapons. Some people say the massive devastation that could result from nuclear weapons actually prevents countries from using them.

HIV/AIDS

In 1983 and 1984, Luc Montagnier of France and Robert Gallo of the United States discovered the HIV virus and determined that it was the cause of AIDS. Scientists have since developed tests to determine if a person has HIV. People who test positive are urged to take precautions to prevent the spread of the disease. Drugs are available to keep HIV and AIDS under control. The hope is that further research will lead to the development of a cure.