

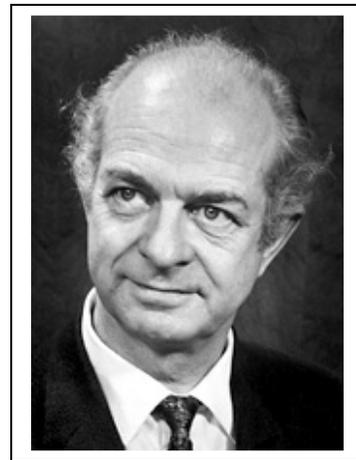
Linus Carl Pauling

1962

“I am constantly asked by students how I get ideas. My answer is simple. First, I have a lot of ideas. Then, I throw away the bad ones.”

Biography

Linus Carl Pauling (1901 – 1994) has been described as a 20th century Renaissance man, a person of great talent and accomplishment whose breadth of interests spanned many disciplines. He remains the only individual to have been awarded two separate and unshared Nobel Prizes – Chemistry in 1954 and Peace in 1962. He fully grasped the ability of science to improve the conditions of life for human beings and he also understood the potential for the misuse of science for violent, fatal, or evil purposes. He was dedicated to unlocking the secrets of nature while at the same time placing full confidence in the ability of human reason to settle individual and national difficulties short of violence, war, and perhaps, nuclear holocaust.



Linus C. Pauling was born on February 28, 1901, to German immigrant parents, in Portland, Oregon. His self-taught pharmacist father encouraged his son's innate curiosity and superb talent for reading and scientific analysis. The elder Pauling even wrote to the Portland newspaper, *The Oregonian*, requesting reading suggestions for his nine-year old son and indicating that the Bible and Darwin's *Origin of the Species* not be included because he had already read them. Unfortunately, his father died shortly thereafter, leaving his mother with three young children and leading Pauling to a sense of obligation to support his family. The tremendous work ethic he evidenced throughout his life and his dogged determination can be linked to the struggles of his early years.

At age sixteen, Linus Pauling left high school and began working at a machine shop and then as a paving inspector for a construction company. He never lost sight of his dream to study chemistry, a dream inspired by watching his father at the pharmacy and by his neighborhood friend with whom he dabbled in adolescent “chemical experiments”, often for harmless pranks. Pauling attended Oregon Agricultural College (now Oregon State University) and graduated in 1922 with a degree in chemical engineering. By 1925, he received his doctorate from the California Institute of Technology and this was followed by a fellowship grant to study in Europe with physicists Arnold Sommerfeld, Erwin Schrodinger, and Niels Bohr. Returning to the United States in 1927, Pauling began a thirty-seven year career as a professor and researcher at the California Institute of Technology.

Linus Pauling's work added much to the body of knowledge in the physical sciences, especially in chemistry and biochemistry. The Nobel Prize for Chemistry he received in

1954 was the result of his numerous achievements especially his “research on the nature of the chemical bond holding molecules together and its use in understanding the structure of complex substances such as protein and antibodies.” Dr. Pauling’s interest in the activity of matter at the molecular level seemed to naturally branch out into other arenas where he saw his expertise could be of value. He undertook experimentation on such topics as magnetism and oxygen exchange in hemoglobin, providing proof that sickle cell anemia is a genetic fault in the hemoglobin molecule, the biochemical nature of mental retardation, proteins and vitamins, and more. Toward the end of his career, he was controversial for his belief in the value of mega-doses of vitamin-C to improve human health.

While controversy characterized some aspects of his professional scientific life, it seemed to lurk consistently around his work related to peace issues. During World War II, Linus Pauling worked on war-related projects as a consultant for the National Defense Research Commission and as a member of the Research Board for National Security. His projects included work on rocket propellants, an oxygen meter for pressurized spaces such as in submarines and aircraft, and a synthetic human plasma for medical treatment. Ironically, though his national defense efforts earned him the Presidential Medal of Merit in 1948, it was the military’s use of atomic weaponry that turned him in a new direction. He had hoped to return to a concentration on protein research but the start of the Atomic Age created an ethical dilemma for him, and many other scientists, that could not be ignored.

1901 – 1994

- Professor at California Institute for Technology for thirty-seven years
- Also received Nobel Prize for Chemistry in 1954
- State Department denied him a visa for two years
- Awarded the Nobel Peace Prize on October 10, 1962, the same day the Nuclear Test Ban Treaty was signed
- “...war must be abolished if the human race is to survive.”

In 1946, together with his friend, Albert Einstein, and a group of eminent scientists, Linus Pauling formed the Emergency Committee of Atomic Scientists whose task was to publicize the gravity of the change in the nature of war and international relations that would come about due to the new atomic technological capabilities. As a molecular specialist, Pauling was not only concerned about the inherent carnage of a nuclear war, but the long term effects of radiation on human DNA and of massive amounts of air-borne particulates which would be unleashed into the atmosphere. Seeing the mostly negative side-effects of any policy of nuclear proliferation led Pauling to become an active and very vocal supporter of peace organizations and a leader in the drive to ban nuclear testing as a first step toward the elimination of war as a viable choice for settling international difficulties.

Linus Pauling’s ethical abhorrence of war found support in the scientific empiricism of his research. As he stated quite plainly, “We have come to the time when war ought to be given up...It no longer

makes sense”. He felt strongly that the cost of war materiel would continue to escalate as

would international arms competition, the threat of mass destruction, and the danger to all life on Earth. In his mind it was vital to work toward a climate in international relations in which war was simply not an option. His outspoken views brought him notoriety and, in the early years of the Cold War, accusations of Communist and Soviet affiliation. Having to appear before congressional committees, threats of criminal charges, and plentiful media interest did not dampen his dedication to the cause which he saw as a top priority for the future. Pauling believed the testing of nuclear weapons must be limited or ended completely. Proliferation of nuclear weaponry would only add to the already dismal data being collected concerning the negative environmental effects of such testing.

In 1957, Linus Pauling, with the assistance of two colleagues and his wife, Ava (whom he credits for encouraging, collaborating in, and inspiring his peace efforts), circulated a petition among American scientists to end nuclear weapons testing. Eventually, the petition spread around the world and, in January 1958, he presented U.N. Secretary-General Dag Hammarskjold the petition signed by 11,021 prominent scientists from 49 countries. This was followed by the publication of his popular and influential book, *No More War!*, in which he supported his theory of war as obsolete by laying out the stark realities of a major war in the nuclear age with its horrific toll in human suffering and devastating long-term effects. The book also reiterated the call for banning nuclear testing and envisioned the creation of a World Peace Research Organization, as part of the U.N., to study and propose ways to build a just and sustainable peace. The petition, his book, and his undaunted activism garnered much attention in the United States and abroad.

Linus Pauling's celebrity and his cause once again led to a Congressional inquiry. Twice he was summoned to appear before the Senate Internal Security Subcommittee in 1960 to answer questions about the origin and circulation of the test ban petition. In addition, he had to confront the specter of Communist sympathies which he clearly denied. However, when pressed to provide the names of individuals who worked with him to collect signatures, he refused, fully aware that he could face charges of contempt of Congress. His reasoning for the denial was that he could not, in conscience, render anyone vulnerable to losing his or her job or reputation simply by being called before the subcommittee. Pauling attempted to acquire a court ruling against the pressure he was receiving but was not successful. Eventually, the sub-committee dropped the matter.

The movement to ban nuclear testing and end war continued to energize Linus Pauling and his wife as well as many loyal followers and, in 1961, he spearheaded an international Conference against the Spread of Nuclear Weapons in Oslo, Norway. However, difficulties began to surface at the California Institute of Technology. Federal funding for his scientific research began to dry up and his academic career seemed to be in jeopardy. Recognizing that some saw him as a liability to the Institute, a university he served for thirty-seven years, he resigned in 1963 to take a position at the Center for the Study of Democratic Institutions. Pauling completed his teaching career as a professor of chemistry at the University of California at San Diego (1967-69) and Stanford University (1969-73).

There was much to discourage Linus Pauling in the early 1960's as the Cold War increased tensions between the East and the West. Indeed, the Soviet Union reversed its self-imposed ban on nuclear testing in the atmosphere in September, 1961, followed by the resumption of American testing in March of 1962. Yet, there were discussions taking place behind the scenes and Pauling's courageous leadership helped to effect a change. On June 25, 1963, the United States, the Soviet Union, and Great Britain signed an agreement that created a Limited Test Ban Treaty, prohibiting nuclear tests in the atmosphere, space, or sea. This was a major achievement and the agreement went into effect on October 10, 1963, the very same day that Dr. Pauling was awarded the Nobel Peace Prize for 1962.

Linus Pauling was convinced that rational people could find ways to live and cooperate peacefully under guidelines of international law and justice. He spent the rest of his life working to advance human scientific knowledge and to further the cause of peace throughout the world. As he acknowledged, there was a great deal of work left to do but he was ever the optimist. His death on August 19, 1994 removed a vital force in the peace movement but his achievements laid the groundwork for additional agreements such as the Nuclear Non-Proliferation Treaty of 1968 and the Comprehensive Nuclear Test Ban Treaty of 1996. His life, which spanned most of the twentieth century, left a legacy of unflinching hope as summed up in Dr. Pauling's words by Gunnar Jahn in his Nobel Peace Prize Presentation Speech, "I believe that there is a greater power in the world than the evil power of military force, of nuclear bombs – there is the power of good, of morality, of humanitarianism."

Suggested Classroom Activities – Linus Pauling

Introduction/Warm-Up:

The teacher should invite students to go to (or provide them with data from) the website of the Preparatory Commission for the Comprehensive Nuclear Test Ban Treaty Organization (<http://pws.ctbto.org>). Of especial interest would be the number nuclear warheads that exist in the world and the list of nations that have ratified the treaty and the list of those which have not. Linus Pauling was instrumental in the movement which led to this treaty.

Discussion Questions:

1. List the events in Linus Pauling's early life which affected the man he became and the accomplishments he achieved in his lifetime. (Level 1)

2. Linus Pauling's life spanned most of the twentieth century. Enumerate the many national and international events he witnessed. (Level 1) How might these events influenced his work? (Level 2)
3. With regard to scientific advances in particular, describe how the twentieth century was unlike any other century in human history. (Level 2)
4. Explain Linus Pauling's opinion of the important "role of the scientist" in the modern world. (Level 2)
5. Why did Linus Pauling receive the Nobel Peace prize in 1962? (Level 1) Do you think he deserved it? (Level 3)
6. What legacy did Linus Pauling's life and work leave for the twenty-first century? (Level 3)

Vocabulary:

1. disciplines
2. innate
3. ethical
4. gravity
5. inherent
6. carnage
7. proliferation
8. empiricism
9. Soviet Union
10. rational
11. legacy

Activity:

Overview – Linus Pauling believed that the scientist was a pivotal figure in modern society. However, his views often conflicted with those of politicians.

Objectives – By participating in this activity the students will:

research the issues of the Cold War and increase their understanding of the nature of the issues

develop an empathetic approach to Cold War issues by seeing them through the eyes of Linus Pauling, the scientist and the view of the American government as expressed in the policies in place from 1946 to 1963

evaluate the relative value of science and politics as guides for the creation of national and international policies

Procedures –

Background for this exercise will have been provided by the teacher and it is assumed the students have read Linus Pauling's biography, the vocabulary has been reviewed, and the questions have been discussed.

The format for this activity will be an all-class discussion. The teacher will be making a visual list of student responses to the questions:

What were the political concerns of the super powers in the period 1946 – 1963?

What were the concerns of scientists, like Linus Pauling, in the period 1946 – 1963?

Following the class discussion, students will be asked to write homework responses to the questions:

Which group should hold greater weight in the creation of national and international policies – scientists or politicians? Why?

In the period 1946 – 1963, was there room for compromise between science and politics?

Technology Option:

Browse the website www.paulingexhibit.org.

Find information about Ava Helen Pauling, wife of Linus Pauling, whom he credits with inspiring much of his work.

What did Ava Pauling teach her husband? Why was she a good partner in the effort to eliminate nuclear arms?

Resources:

<http://globetrotter.berkeley.edu/conversations/Pauling/>

http://nobelprize.org/educational_games/peace/nuclear_weapons/index.html

<http://pws.ctbto.org>

www.achievement.org

www.almaz.com/nobel

www.harvardsquarelibrary.org/unitarians/pauling.html

www.nobelprize.org

www.orst.edu/dept/lpi

www.orst.edu/dept/special_collections/ahp

www.paulingexhibit.org