Lesson Plan Title:

Japan Beyond Manga

Overview:

Though many students may associate Japan's accomplishments with fuel-efficient cars, *anime* and *manga*, the country has been a major player in the advancement of semiconductor technology. Students will learn about the absorption of technological advancements by Japan and the major companies that participated in the process. Students will compare and contrast cultural differences between the two countries and how they affected each country's technological developments.

Objective:

To investigate the contribution of Japan in the progress and advancement of semiconductor technology and the role played by the Japanese government in promoting programs to challenge the U. S. lead in technology.

Vocabulary Words and Key Phrases

64K DRAM
MOS memory
MITI
Reverse-Engineering
Tokugawa Era
VLSI (Very Large Scale Integration)

Website References:

The online exhibition *The Silicon Engine: A Timeline of Semiconductors in Computers* will provide a wealth of resources and information. See the *Timeline, People, Companies,* and *Glossary* sections at: http://www.computerhistory.org/semiconductor/

Specifically for this assignment see the Japanese company history summaries at: http://www.computerhistory.org/semiconductor/companies.html

The subject matter of the lesson plan will inspire students to expand their research on the Web. Additional suggested website links are provided below:

Short History of Japanese Technology
http://www.ied.co.jp/isan/sangyo-isan/JS7-history.htm

From Industrial Policy to Innovation Policy: Japan's Pursuit of Competitive Advantage
http://www.unescochair.ns.ac.yu/sr/docs/noland2007Japan.pdf

Teaching Strategy/Procedure:

1. Divide class into six teams. Assign each team one of the six following Japanese companies: Toshiba, Hitachi, Sony, NEC, Mitsubishi, and Fujitsu. Have each team research each company and report back to the class on its major accomplishments and contributions to the semiconductor industry.
2. Students should also research cultural differences between Japan and the US and analyze their influences on the industrial development of the two countries.

Materials:

1. Online exhibition *The Silicon Engine: a Timeline of Semiconductors in Computers*, *Companies* section: http://www.computerhistory.org/semiconductor/companies.html

2. *Short History of Japanese Technology*
http://www.ied.co.jp/isan/sangyo-isan/JS7-history.htm

After the defeat in World War II, Japan embarked in an intensive process of developing its industries. Engineers were sent to the U.S. and Europe to look for the best technology to strengthen their capacity. Thus in the 1950's there was a great rush to the introduction of technology from abroad and hundreds of licensing agreements were signed, the transistor being one of them. The initiator companies wanted to license their inventions in exchange for royalty to cover the expense of research and development. They never thought Japan might be their potential rival, for almost every licensing agreement limited the export of related products to Japan's neighboring countries. On the other hand, a number of business missions visited US factories looking for models of high productivity, in particular to learn factory management, and applied the principles and methods into the design and control of their own production.

Sophisticated craft skills and technological knowledge in machine engineering dating from the Tokugawa era helped the Japanese to copy imported products and learn through reverse-engineering.

The semiconductor race in Japan had its origin in 1948, shortly after the war when a joint study group of government, university, and corporate scientists and engineers was formed at the National Electric Research Laboratory, only two years later than the Bell Laboratory of the U.S. announced the discovery of the transistor. During the 1950's six companies, including Toshiba, NEC, Hitachi, Sony, Mitsubishi and Fujitsu signed patent licensing agreements for the transistor with Western Electric and RCA. By 1956 they had succeeded in the mass production of the transistor and its application to the personal radio set.

By 1960 the quality of Japanese transistors was said to have surpassed the U.S. made. Japan became the world's largest producer of transistors. At the same Texas Instruments and Fairchild invented the solid-state circuit, integrating thousands of transistors and other elementary parts on a silicon chip. The Japanese companies quickly changed to the research on the integrated circuit, and the National Electric Laboratory succeeded in the production of the first integrated circuit in Japan independently of foreign technology. But it was not until NEC signed the licensing agreement of planar patent with Fairchild in

1962 that large-scale manufacturing was possible. By 1966 Texas Instruments also made its patent available to the Japanese companies in exchange for the license of its own production in Japan. Thereafter Japanese companies accumulated many innovations in the processing of integrated circuit chip. By 1970 they succeeded in the manufacture of large scale integration (LSI) at the same time as the US producers.
The most important element in the success of the Japanese semiconductor industry was a rich manpower in applied physics. Since the number of physicists specialized in the field was of course restricted, graduates of engineering faculties soon joined in the R & D. Another important factor distinguishing the Japanese progress in the semiconductor development from the US was its consumer and mass market oriented focus. It reflected the difference in industrial organization of both countries. In the United States specialized venture businesses developed integrated circuit for the Government to supply miniature and reliable devices for military and aerospace use. In 1965 seventy per cent of the US-made integrated circuits were shipped to the defense market, while the consumer durable manufacturers were satisfied with the rest supplied by the specialized companies. In contrast, in Japan large electrical manufacturers took up semiconductor production for its own use, at their own risk. Common Japanese consumers enjoyed such goods incorporating semiconductor circuits as transistorized clocks and tape recorders in the 1960's, automatic cameras, electronic calculators and quartz watches in the 1970's.

For Further Study:

Discuss the concept of global economy with students and how research and development and global markets for technology products are strongly connected.