

Lesson Plan Title:**To Be Or Not To Be: Choosing and Planning a Career****Overview:**

Students will investigate the process of making career choices and career development. Through research and analysis of the biography and oral histories of silicon luminary Gordon Moore and his process of becoming an entrepreneur, students will answer text-related questions and discuss their findings with their peers.

Objective:

To introduce students to a real life example of career development and to understand that career planning is an ongoing process that allows you to rethink and reevaluate yourself and your career options as you have experiences, and as you grow and develop.

Vocabulary Words and Key Phrases

Entrepreneur
Oral history
Semiconductor
Silicon
Transistor

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/>

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

The Accidental Entrepreneur.

http://nobelprize.org/nobel_prizes/physics/articles/moore/index.html

Abstract and link to oral history of Gordon Moore conducted in 1975

http://www.ieee.org/web/aboutus/history_center/oral_history/abstracts/mooreab.html

IEEE biography of Gordon E. Moore

http://www.ieee.org/web/aboutus/history_center/biography/moore.html

Abstract and link to oral history of Gordon Moore conducted in 2008

<http://www.computerhistory.org/collections/accession/102658233>

Teaching Strategy/Procedure:

1. Have students read Gordon Moore's biography in the online exhibition *The Silicon Engine: A Timeline of Semiconductors in Computers* and the excerpts from *The Accidental Entrepreneur* in the Materials section of this lesson plan. Students should also research the companies mentioned in the article excerpts. In a classroom discussion format, students should answer the following questions:
 - a. What professional choices did Gordon Moore make?
 - b. How did he become an entrepreneur?
 - c. In addition to Fairchild Semiconductor which company did he co-found and has been connected to since 1968?
2. Interview a family member or acquaintance about his or her own career development and report back to the class.
3. Students will write a short essay that describes what they have learned that could be applied to their own career planning.

Materials:

The Accidental Entrepreneur by Gordon Moore, 2001. (For the complete text go to: http://nobelprize.org/nobel_prizes/physics/articles/moore/index.html)

In the Beginning

"Like many other scientists and engineers who have ended up founding companies, I didn't leave Caltech as an entrepreneur. I had no training in business; after my sophomore year of college I didn't take any courses outside of chemistry, math, and physics. My career as an entrepreneur happened quite by accident.

"And it ran counter to early predictions. When I was graduating from Caltech with my PhD in chemistry in 1954, I interviewed for jobs with several companies, one of which was Dow Chemical. Dow was interested in setting up a research laboratory in California, and they thought I might be someone they could send to headquarters in Midland, Michigan, to train to come back here in some kind of managerial role. So they sent me to a psychologist to see how this would fit. The psychologist said I was OK technically but I'd never manage anything. Dow did end up offering me a job in Midland, but the transfer back to California was no longer a part of it.

"I didn't go to Midland after all, but went instead to the Applied Physics Laboratory at Johns Hopkins University, which has roughly the same relationship to Johns Hopkins that JPL has to Caltech, and where I could continue to do basic research in areas related to what I had done before. But I found myself calculating the cost per word in the articles we published and wondering if the taxpayers were really getting their money's worth at \$5 per word. Just as I was starting to worry about the taxpayers, the group I was working in was, for various reasons, breaking apart. So I decided to look for something that had a bit more of a practical bent, and at the same time see if I could get myself back to California.

“Lawrence Livermore Laboratory interviewed me and offered me a job, but I decided I didn't want to take the specter of exploding nuclear bombs, so I turned it down. Then one evening I got a call from Bill Shockley, who had gotten my name from Lawrence Livermore's list of people who had turned them down. Now, Shockley is a name that has a Caltech association. After earning his BS here in 1932 he went on to invent the transistor. He had been working at Bell Laboratories, and now he wanted to set up a semiconductor company out on the West Coast (a lot of Caltech connections here - the operation was financed by Arnold Beckman) with the idea of making a cheap silicon transistor. Shockley knew that a chemist was useful in the semiconductor business; they had chemists at Bell Labs, where they did useful things. And I was a chemist, so Shockley caught up with me. Still not an entrepreneur, I decided to join this operation.

“I was employee number 18. This was a startup operation. All of us except Shockley were young scientists, in our late twenties. I had no management experience or training. Unfortunately, neither did Shockley. He had run a research group at Bell Laboratories, but this was to be an enterprise rather than a research group, and he had no real experience in running a company. I suppose maybe I should have been suspicious when none of the people who had worked with him at Bell Labs joined his new venture, but I didn't even begin to think about that then.

“Shockley was phenomenal from the point of view of his physical intuition. One of my colleagues claimed Shockley could see electrons. He had a tremendous feeling for what was going on, say, in silicon, but he had some peculiar ideas for motivating people. For example, the company had something we dubbed the PhD production line. One day he told a group of us: "I'm not sure you're suited for this kind of a business. We're going to find out. You're going to go out there and set up a production line and run it. You know, do the operation, not direct it." This didn't go over especially well, because the group dutifully tried to operate a production line on a product that was still in the early stages of development. Then he switched from his original idea of building a cheap silicon transistor to building a rather obscure device known as a four-layer diode. We viewed this with considerable concern, because some of us didn't understand exactly where the four-layer diode fit in. One day, when Arnold Beckman came around to talk to the group, Shockley made some closing remarks, just out of the blue, indicating that he could take his staff and go someplace else if Beckman wasn't enthusiastic about what was happening there. So, given all these problems, we decided that we had to go around Shockley to solve them. A group of us contacted Beckman and sat down with him through a series of dinners to try to work out a position for Shockley, in which he could give us the benefit of his technical insights but not of his management philosophy. We were thinking in terms of a professorship at Stanford. By that time, he had won a Nobel Prize, and Nobel Prize winners can get a professorship almost anywhere.”

“What we didn't appreciate is that it's awfully hard to push a Nobel Prize winner aside. Beckman decided (as the result of advice he had received elsewhere) that he really couldn't do this to Shockley. We were told essentially that Shockley was in charge, and if we didn't like it we probably ought to look at doing something else. We felt we had burned our bridges so badly by that time that we clearly had to leave, and we started to look at

alternatives. (Shockley's company held on for a few years, was acquired by Clevite Corporation, and died eventually.)

Setting Up Fairchild Corporation

"Each of the eight of us invested \$500 in this startup... Fairchild put up some \$1.3 million to get us going, and we started Fairchild Semiconductor Corporation. And this is where I finally became an entrepreneur. One of our group had a friend at Hayden Stone, a New York investment banking house. He wrote the friend a letter saying that there was a group of eight of us here that really enjoyed working together, but that we were leaving our current employment, and did he think that some company might like to hire all of us. The investment banker said, 'Wait a minute,' and sent one of the partners, Bud Coyle, and a young Harvard MBA named Arthur Rock out from New York to visit with us. They talked to us and said: 'You don't want to look for a company to hire you; you want to set up your own company.' That didn't sound bad. By doing that we could stay where we were. We had all bought houses by then (they were affordable in California at that time), and we wouldn't have to move. It seemed a lot easier, so we said, 'OK; fine; let's do it,' and they said they would find backing for us.

"So we sat down with The Wall Street Journal, and went through the New York Stock Exchange listings, company by company, to identify which ones we thought might be interested in supporting a semiconductor venture. We identified 30-some companies, and Arthur and Bud went out and contacted every one of them. They all turned it down without even talking to us. Then, quite by accident, Arthur and Bud ran into Sherman Fairchild, who happened to be a technology buff; he really loved new technology. He introduced them to the chairman of Fairchild Camera and Instrument, who was willing to take a shot at supporting this new company.

"Each of the eight of us invested \$500 in this start-up. That may not sound like much now, but it was a month's salary in 1957. Fairchild put up some \$1.3 million to get us going, and we started Fairchild Semiconductor Corporation. We still weren't really quite entrepreneurs, but we had learned something along the way. We had learned from the Shockley experience that none of us knew how to run a company, so the first thing we had to do was to hire our own boss - essentially hire somebody to run the company. We advertised for a general manager. Now, when you advertise for a general manager for something like this, what you find is that every salesman in the country is convinced that he can run a company. But buried among all the responses from salesmen was one from Ed Baldwin, the engineering manager for the Hughes semiconductor operation. In the mid-fifties, Hughes was making diodes and was one of the largest semiconductor companies in the world. Baldwin came and told us a lot of things we didn't know, so we decided that he was the right guy to bring in to run our company for us. We hired him, and he taught us a variety of things that we hadn't learned before - since most of us had not even worked for a successful manufacturing company.

Learning by Trial and Error

“Most of what I learned as an entrepreneur was by trial and error, but I think a lot of this really could have been learned more efficiently. There is such a thing as a natural-born entrepreneur, for whom the entrepreneurial urge drives everything, and who can make a business out of almost anything. But the accidental entrepreneur like me has to fall into the opportunity or be pushed into it. Then the entrepreneurial spirit eventually catches on. To me the opportunities to start a company are few and far between. Things have to line up right. I'm not the sort of entrepreneur who can just say, "I'm going to start a company. Let's look for an opportunity." In my entire career I think I've seen only about three ideas come by that I would consider a basis on which to try to start an enterprise. But starting a company is certainly exciting, and building a successful enterprise is satisfying and rewarding.

“Most of what I learned as an entrepreneur was by trial and error, but I think a lot of this really could have been learned more efficiently. I think a place like Caltech could offer an opportunity to avoid the need for trial and error in a lot of this. Broadening the education to include some instruction in business - a little bit about finance and organizations - would certainly be useful, and I think a course in this direction would probably be a significant addition to the curriculum. But a technical education is probably the best start for an entrepreneur in a high-tech business. “And it's important to remember one other thing that is essential for any entrepreneurial organization: do what you do well. Look at other things as incremental opportunities, but don't change the basis of what you do well.”