

Engineering Innovation and Entrepreneurship

Diane Amanti: Hi. My name is Diane Amanti, and I'm studying economics and management here at the Massachusetts Institute of Technology in Cambridge, Massachusetts.

Every great inventor is constantly aware of and questioning what's going on around them. This constant observation allows them to recognize all the potential for innovation that the world has to offer. Today, I'm going to challenge you to look at the world with a fresh perspective for innovation. Let's see all the opportunities for innovation that we can find driving around Cambridge, the home of MIT.

Whoa! That was a close call. Did you see how that car nearly backed into me? I'm going to take a second and catch my breath while this car continues to back out. We're going to pause this video. But in the meantime, I have a question for you first. What does that near accident have to do with inventiveness? Talk with your teacher. Talk with your classmates. And I'll be back soon to continue our discussion.

****First Break****

Diane: Welcome back. I hope that you had a nice class discussion. Imagine how many people get into accidents every single day because they have to back out of a blind driveway, just like that one. What if these people had some sort of device in their driveway that could rotate the car 180 degrees? Then they wouldn't have to back out into the street. Imagine all the accidents and aggravation that could be avoided if there existed such a car turntable device.

Huh...so that near accident was actually an opportunity for innovation. I challenge you to look for more opportunities for innovation just like that one. As Marcel Proust said, "The real act of discovery consists not in finding new lands, but in seeing with new eyes."

As we've been driving around, I've seen lots of dangerous and inefficient situations that pose great opportunities for invention. Now it's your turn to talk with your classmates about some of the opportunities for engineering innovation that you noticed. You don't have to limit yourself to things that you just saw. Look around your classroom, or think about your everyday life. The opportunities for invention are everywhere! See you soon.

****Second Break****

Diane: Welcome back. In addition to my coursework here at MIT, I'm also involved in MIT's Society of Women Engineers. I'm actually the co-chair of the Women in Science and Engineering program, or WiSE, for short. WiSE is a year-long outreach program that provides high school girls with opportunities to explore science and engineering. I'm here with two past participants in the WiSE program, Torie Muse and Priyanka Ram. We call them the WiSE girls!

During the break, we were discussing all the everyday opportunities for innovation that we noticed. Torie was actually just mentioning some green opportunities for innovation.

Torie Must: Right. I walked down the street and see how wasteful people can be in terms of keeping their cars running, or letting heat and AC out of windows.

Priyanka Ram: Maybe windows could be better reconstructed or newly shaped to promote insulation.

Torie: I also often think of green oriented technology to be created or iPod apps, since I'm young.

Diane: Those all sound like great ideas. The WiSE girls and I also noticed a person struggling to maneuver their wheelchair in the clip before the break. A group of students from Staten Island Technical High School recognized this wheelchair insufficiency as an opportunity for innovation. Inspired by their motto, 'There are no problems, only solutions', this group of students set about developing a wheelchair that can meet the unsatisfied needs of the wheelchair bound.

Innovators see problems as an opportunity for advancement and invention. They have the courage and vision to tackle problems that no-one knows the answers to. By looking at challenges through the lens of possibilities, you are well on your way to creating the next great invention.

Can you think of any other inventions for those with physical limitations? Inventions that you might want to be a part of developing? The WiSE girls and I are going to discuss this, while you also discuss in your classroom. We'll be back soon.

****Third Break****

Diane: Welcome back. The WiSE girls and I had a nice discussion, and I hope you had a nice discussion in your classroom as well. Please share with us your invention ideas for those with physical limitations on the Blossoms website. Let's start a great discussion on the topic.

Torie: I know I often take for granted the innovative thinking behind everyday items. It is easy to forget the innovation this light bulb embodies.

Diane: There were years of experimenting that went into developing the light bulb. The first time that Thomas Edison tried to create the light bulb, he failed. After making several changes, he tried again, and failed again. But what made Thomas Edison different from other people is that he stuck with it. And after nearly ten thousand more attempts, he finally successfully created the very first light bulb.

Torie: But Edison did not think any of his failures were actually failures. Edison said,

Priyanka (as Thomas Edison): If I find ten thousand ways something won't work, I haven't failed. I'm not discouraged. Because every wrong attempt discarded is just one more step forward.

Diane: Do you turn your mistakes into learning opportunities? Adopt the same attitude as Edison did. Learn from your mistakes and be persistent.

Priyanka (as Thomas Edison): The light bulb wasn't the only thing I invented. I also invented the telegraph, batteries, cement, and the phonograph, among many other things.

Torie: Edison, you're always so practical and observant.

Priyanka (as Thomas Edison): Well, the classic marketing philosophy says to fill the unmet need. So I invented useful items that a majority of the population could use.

Diane: Every one of us has practical skills that we can offer the world. The world needs your talents and ideas just as the world needed Edison's. More often than not, a great idea takes time, effort and perseverance in order to develop into a successful invention. You have to learn from your mistakes, but sometimes mistakes can be inventions in themselves. Sometimes inventions are simply stumbled upon.

Torie: Did you know ice cream was originally exclusively for the wealthy?

Priyanka: Yeah, but by the early 1900s, ice cream became affordable and vendors begin to sell it on street corners from glass dishes for only a penny. Unfortunately, sanitation became an issue. And many people would accidentally walk off with the glass dishes or break them. Eventually, paper cups and biscuit cups replaced these glass dishes.

Torie: My favorite way to eat ice cream is from a cone, though.

Priyanka: I wonder who thought of that.

Torie: Well, in 1904, at the World's Fair in St. Louis, Missouri, an ice cream vendor named Arnold Fornachou ran out of paper dishes at the fair. A friendly Syrian waffle vendor nearby named Ernest Hamwi rolled some of his pastries into a cone and give them to Arnold to hold the ice cream in.

Priyanka: I'm sure word spread quickly throughout the fair.

Torie: It sure did. Many other vendors began constructing their own waffle cones to sell ice cream in. Everyone wanted to take credit for the new delicious invention.

Diane: That just goes to show you that you never know when or where innovation may occur. By constantly looking for problems and opportunities for innovation, you greatly increase your invention potential.

So, girls, how are you going to increase your awareness of everyday opportunities for innovation?

Torie: I'm going to watch and read the news to look for opportunities for new safety oriented inventions, inspired by real life accidents and tragedies. By keeping up with the news, I can be aware of trends in inventions as well as concerns.

Priyanka: I'm going to deliberately take alternate routes to school and to my different activities so that I can always be witnessing new things.

Torie: I'm also going to use social networking sites to post links in progress in the engineering field. As well as things that excite me.

Priyanka: Yeah, like on Facebook and Twitter. That would be a great way to promote engineering in your own community.

Diane: Those all sound like great ideas, girls. I'm sure you're going to be overflowing with new invention ideas soon.

So, the WiSE girls and I are working to increase our awareness of everyday opportunities for innovation. What are you going to do to increase your awareness?

****Fourth Break****

Diane: Welcome back. I hope that you had some nice discussions with your classmates during the break.

Torie: I'm excited to keep looking for opportunities in innovation. But right now I can't stop thinking about that near accident you had while driving around earlier.

Priyanka: Me too. I really think we should pursue some sort of driveway car turntable device. I think it has so much potential. But I have no idea where to begin.

Diane: Well, girls. There certainly are lots of stepping stones and hurdles throughout the innovation process. But thankfully, there are also lots of great resources out there that can help us along the way. Let's see if my friend Lou Goldish can help us out.

Lou Goldish: Success as an entrepreneur doesn't just happen. Sure, you need an idea, but you also have to be willing to work hard, to face challenges, and to persevere. And if that's OK with you, you can start at any time. Even in high school. How do I know? Because I work with many entrepreneurs, who started in high school! I'm Lou Goldish, senior adviser in the venture mentoring service at the Massachusetts Institute of Technology. We provide experienced businesspeople to mentor students and other starting ventures at MIT.

In the process of creating a business out of your idea, you need to do three things: thinking, analyzing and doing.

So far, you've been thinking. Noticing needs and coming up with ideas. Now, you might say, OK, I thought of something, I'm ready to start a business. But wait. Does anyone want your product or service? Can your product or service be sold at a price which you could make a profit? Now you have to start analyzing.

So what do we mean by analyzing? Or, to use business terminology, market analysis? You can't just Google the people-- how many people want to buy my product and can I make a profit? Here's where the analyzing comes in.

You look for information that you can Google. Or that you can look up in the library, or in reports or magazines. You ask potential customers questions they can answer easily.

Then you analyze all the information you've collected, so that you can determine do people want to buy my product and can I make a profit?

Here are some of the issues you may want to look into. What am I enabling people to do that they couldn't do before? Or can now do better? How many similar products are sold annually? How much are people paying for those products? What do people think of my product when I describe it to them?

From analyzing that information, you can then answer questions such as: Whom should I sell to? How much should I charge? How much can I sell over time? What will my profit be?

Pay attention to that word profit. The measure of your business success is not how much you sell, it's how much money is left over after you make your sales. Remember, you have to pay the cost of building your product. You have to pay the cost of running your business. Unless you're doing charity or social service, you're in business to make a profit.

So, you've done your thinking and decided on an idea. You've done your analyzing and concluded that your idea is worth pursuing. Now you're ready to start doing.

Diane: There's certainly lots of steps to go through in the invention process. But if we approach them methodically, then the whole process seems a lot less daunting. So, you want to pursue this driveway turnaround device? Well, what specifically is the problem that you want to solve? Or the device that you want to create? You want to have a clear idea of exactly the problem in mind.

Torie: Well, the near accident occurred because the car was backing out of a long skinny driveway that was too narrow to turn a car around in.

Priyanka: So we want to develop a device that can safely rotate a car 180 degrees and can fit in a narrow driveway. Kind of like the cable car turnarounds in San Francisco.

Torie: The device has to also be affordable, so that it's feasible for the general public to purchase it.

Diane: Now that we have in mind precisely the problem that we want to tackle, it's time to evaluate the potential of this innovative idea. This is the second step in the invention process. Novelty alone may mean nothing if your idea does not have good commercial potential. People will buy a product only if they have a use for it and prefer it to competing products.

Torie: Aren't there professional research companies that can conduct a market analysis for us?

Diane: Well, professional research companies are often much too expensive. Since your idea is still in the concept phase, this is a very risky investment to make. It is best that you start by doing a market analysis all on your own. Thankfully, there are lots of great resources out there that enable you to conduct a thorough initial market analysis entirely on your own.

Priyanka: I know. How about I start by researching on the internet.

Diane: That's a great idea. The internet very well may be your main source of information. You have to be careful, however. Much of the information that you find on the internet may be outdated or even inaccurate. When researching on the internet, try to use as primary a source as possible, and always make sure that you evaluate the reliability of every website that you use.

Torie: While you're doing research on the internet, I think I'll go to the library and see what I can find there.

Diane: That's another great idea, Torie. The library is another great and completely free resource for you to conduct your market potential analysis. Many academic and large public libraries have business information departments that are staffed by helpful librarians. Let's get to the research, girls.

Diane: So, how did all your research go? What did you find out?

Torie: When researching driveway accidents, I came across lots of child safety initiatives for the prevention of child backovers, which is when a child is backed over by a vehicle in their own driveways. In the US alone, 50 children are backed over each week, and 30% of deaths involving a motorist and a child occur when a vehicle backs over a child.

It's not just children being harmed, though. In my research, I found lots of lawsuits for wrongful deaths involving inattentive motorists backing out of their driveway and striking pedestrians walking on the sidewalk. Our driveway turntable device could potentially really reduce these tragedies. Based on my research, there's a great need and definite market for a driveway turntable device.

Priyanka: There definitely is a market. However, it was quite obvious to me after a little research that there are already a lot of competitors out there. The competitors range in products offered. There are high-end, built-in driveway turntable devices that go for upwards of \$20,000. There also economy class devices that cost around \$6-8,000.

As I browsed through the competitors' products, I started thinking about all the desirable and necessary features that a driveway turntable device must have. Consumers would need a product that is durable, weather resistant, capable of handling heavy loads, child safe, and adherent to local and national regulations. Customers may also like a product that is pleasing to the eye, quiet, fully automatic, easy to install, and dual rotational. Given all these features and safety controls, I'm not sure if it would be feasible to create a cheaper product than what is already available, while meeting the durability and safety requirements of the customers.

Diane: Great job with the research, girls. As you can see, it doesn't take lots of money and a professional research company in order to conduct an initial market analysis that allows you to evaluate whether your idea has true innovation potential. Our challenge-- your challenge-- is this. Might there be some innovation in designing an easy to use driveway turntable device that breaks the cost barrier of about a thousand dollars? Let's have this be another one of our ongoing projects, and let's start another shared dialogue on the BLOSSOMS website. Maybe we can invent an inexpensive driveway turntable device together, and save lives.

Let's pause now and give you a chance to discuss with your classmates possible ways of bringing down the cost of a driveway turntable.

****Fifth Break****

Diane: Welcome back. Did you make any progress on developing a cheaper driveway turntable? Once you have a concept, for the driveway turntable or whatever, take the initiative to go out and build a proof of concept prototype. This is an initial prototype that can be made of basic materials found around your house, trash piles, or in your local hardware store.

Building a prototype allows you to prove the feasibility of your solution. Your first try at a solution won't be perfect. But by testing and experimenting, you find out what works and what needs to be improved.

This is a toy prototype of a driveway turntable. But I'm sure that you can do better.

One of MIT's own, Rhonda Jordan, saw a need for energy and electricity in African households and was inspired to find a way to combat this insufficiency. Let's find out how Rhonda and her team used prototyping to turn a problem into an opportunity for innovation, and an opportunity into a growing business.

Rhonda Jordan: Hello. As Diane said, my name is Rhonda Jordan. And I'm a graduate student here at MIT. I'm also a co-founder of EGG Energy Incorporated. Now, if you were wondering what EGG stands for, it means Engineering Global Growth. We connect low income customers to electricity through a battery swapping service. We take electricity from a grid connection, a wind turbine, or a solar panel. And we package electricity into small, portable, rechargeable and affordable batteries. We rent each battery to our customer for a subscription fee, and our customers can exchange depleted batteries for fully charged ones at any time by paying a small swap fee at a charging station or a swapping station.

Each a battery is about the size of a brick and it lasts five days in a typical Tanzanian household. It's strong enough to power three lights, a cellphone charger, and a radio.

Diane: So, Rhonda, tell us how you recognized this business opportunity.

Rhonda: Well, on my very first trip to Africa I noticed that many of the residents didn't have access to electricity. Instead, they used kerosene to light their homes or to run small businesses in the evenings. I also noticed that the light was very dim, and soon found out that burning kerosene caused many respiratory illnesses. So when I returned to MIT, I found that other people had the same experience. I joined EGG Energy and we decided that we wanted to provide these residents brighter lights with fewer health issues.

But when my teammate, Yuka, went to Tanzania for the first time, he found that the residents didn't have enough money to pay for even the newest solar technology. We did not know what to do, and our business model would fail. So Yuka decided to spend time with the residents, observe how they spent money, and what energy services they were purchasing.

He observed that residents walked on a regular basis to the nearby market. They spent a total of \$125 on AA batteries and kerosene.

Diane: So then how did you come up with the solution?

Rhonda: So our team put together a business model to install and distribute solar home systems that were going to be affordable. Our product needed to cost less than \$125 a year, and we knew that the residents were OK returning to the market to purchase electricity on a regular basis. So, we decided to look into battery technologies and found the absorbed glass mat battery. We found that it won't leak lead into the environment, and was large enough to power multiple devices. So our team decided on a battery swapping service. Instead of providing homes with solar home systems, we'll use solar to charge the batteries instead.

Diane: As we saw with Rhonda, and as we learned from Thomas Edison earlier, it takes trials, vision, and perseverance in order to create a successful invention. Did you know that WD-40 got its name because there were 39 formulas before it that didn't work? You can't buy WD-27. Huh. I wonder if that's where they got the name 7-Up, too. Did they try 6-Up, 4-Up?

All right. Let's get serious. Now it's your turn to start creating your solution to your favorite problem. It could be the driveway turntable, or something completely different. During the break, take some time to start creating a vision for your solution, and maybe even start drawing some prototypes. Have fun with it.

****Sixth Break****

Diane: Welcome back. I hope that you had fun sketching your prototypes. Hopefully it's just a start, and you keep making more prototype drawings in the future as you either refine this idea or recognize new opportunities for innovation in the future.

I hope that by now you're becoming competent in your ability to becoming the next great inventor. If you follow your passions, stay determined and always be on the lookout for new opportunities, you may be amazed at what you can accomplish.

We're going to close with one more real life story. William Sanchez has inspired me, and I hope that his story can inspire you as well.

William Sanchez: Hello everyone. My name is William Sanchez, and I'm the CEO and founder of Cool Chip Technologies. My story may resonate with many of you. It's a very simple story.

I was born in raised in the Bronx. It's an inner city community in New York City, a very tough environment to grow in. But, my parents came from a dictatorial regime, out of the Dominican Republic in the mid-80s. And they were even tougher than the Bronx. And three things that they valued very highly, and instilled in me and my siblings, were stewardship, integrity, and education. Everything that I've ever done reflects those three values.

I came to MIT in 2001, and MIT was a place that I did not know existed when I was in high school. In high school, I remember the day crossing the street with a friend of mine, who mentioned that I should apply to this school named MIT. And with the application due the next day, I sort of haphazardly and as creative a way as I could, filled out an application, answering a simple question. What is, in 500 words or less, something that you really enjoy doing?

And as you know, they say a picture's worth a thousand words. And so that's what I submitted to my application. You might imagine my surprise when I got admitted to MIT.

Now, I came to MIT, again, out of a very tough community in the Bronx, and decided to pursue electrical engineering as my field of concentration. And throughout my undergraduate career, I founded my first company, a dance company. It's not what you usually think about when you think entrepreneurship. But dancing is something that I've always been passionate about. And so I wanted to share that passion with other people. So I wrapped the business around it. It was an easy way to network, meet folks, and travel, perform, dance and just share something that I enjoyed doing.

A year or two into that, I realized that I wanted to do something more impactful. And in the heart of the economic recession, realizing opportunities in clean tech and the emerging energy revolution happening amongst us today, I founded my first company, Vecarius, where we developed power and thermal management devices to address one of the pressing issues of our time: energy efficiency. I spent a lot of time looking at heat sinks and thermoelectrics and sort of ways of recovering waste heat out of the automotive industry. And that's really what paved the way to Cool Chip Technologies, what is today a company enhancing the efficiency in data centers.

So, Cool Chip started from my idea of starting a dance company, if you can believe that connection. And where we are today is, out of a pursuit of doing something that I once thought impossible, we won the MIT Clean Energy Prize, a competition sponsored by the Department of Energy, and NStar, a local utility here in the New England area. So if there's one thing that you should always keep in mind is, chase your dreams. If you believe in something, if there's something pressing inside of you, you want to chase that, and not let anybody tell you otherwise. Because there's no dream that cannot be accomplished.

Diane: Wow. It really is amazing how much William Sanchez has accomplished. He truly does follow his passions. But with all that you've learned in this video, you are right on track to follow in his successful footsteps.

To wrap up all that you've learned today, and to give you a chance to tie together all the brainstorming that you've done, I'm going to introduce you to the elevator pitch. Imagine the following scenario. You're waiting for an elevator. The elevator doors open, and there stands your ideal investor. It's the chance of a lifetime. But the chance only lasts as long as the elevator ride.

A great way to think of an elevator pitch is as a clear, concise, and well-practiced description of your business that a friend or your mother could quickly and easily understand. Always have your best version of your elevator pitch memorized, so that you can take advantage of opportunities whenever or wherever they may arise.

Of course, an elevator pitch isn't just restricted to only elevators. Rather, it comes in handy anytime you want a concise description of your company. The average attention span of the human being is only 30 seconds. So you have very limited time to make a powerful first impression.

So, William Sanchez, what's your elevator pitch?

William Sanchez: Well, Diane, data centers are huge hogs of electricity. More and more people are entering the computing world and those already in are demanding more computing performance. So the real problem is that there's no way to cool electronics efficiently. So at Cool Chip we found a way to do that. Ten times better than what's out there today. And so it's a very big market that we're trying to address. And pave the way forward for energy efficiency and clean tech. We're licensing the technologies out of MIT and Sandia National Labs in order to build our first products.

Diane: What do you think of his pitch? Are you sold?

I hope that this video has inspired you to always be on the lookout for opportunities for engineering innovation. Up on your screen right now is a summary of the key steps we have outlined for you. These can be printed out from the website of this video.

Now, as we close, your final challenge is to create and give an elevator pitch for your product. Assume that we're in a high-rise building so the ride is at least 30 seconds. Goodbye for now, and best of luck in all of your invention endeavors.

Video Teacher's Guide

Hello, teachers. This video lesson requires no prerequisite knowledge of engineering, innovation, or entrepreneurship. I feel that any high school student, or even advanced middle school student, can participate in this video's learning activities, and can benefit from viewing this video. I hope that you and your students enjoy watching this video and are inspired on the path to engineering and innovation.

There are many ways that this video can be used, and that the breaks can be utilized I've suggested some activities to be performed during the breaks, but I urge you to use this video as it will suit you and your students best. I hope that you will share with me the ways that you have incorporated this video into your classroom.

Prior to the first break, I challenged students to think about what my near-accident had to do with inventiveness. You can break students up into groups or have them discuss with their neighbors how problems and challenges can be looked at as opportunities rather than as problems. During this break, I hope that students start viewing problems as opportunities.

During the second break, I suggest that you give students a few minutes to brainstorm opportunities for innovation that could either be inspired by the video that they just watched, or inspired by their everyday lives. What problems and hassles do students face every day? Encourage students to look at these problems as opportunities.

The third break can be used to discuss further opportunities for invention and innovation. This break is supposed to be targeted at thinking about inventions for those with physical limitations. And we hope that you will continue your discussions on the Blossoms website in the future.

By the fourth break, students have spent quite some time brainstorming lots of innovative ideas. We hope that they will continue this brainstorming in the future, and we hope that during this break, students can discuss with their neighbors or in small groups, ways that they will continue to be mindful of innovative opportunities in the future. You could have each group, or even every student, choose one thing that they're going to focus on in order to develop their perspective for innovation.

The fifth break offers a pause for students to discuss possible ways to bring down the price of a driveway turntable. This is another one of our ongoing projects, and we hope that you will share your ideas with us on the Blossoms website.

In the sixth break, students, in groups or on their own, have the chance to focus on one innovative idea and really develop a solution for it. We hope that they think about what their actual solution is going to be, and they can start drawing prototypes of feasible solutions.

Before the final break, I challenge students to create and give an elevator pitch for their product. Some or all of the groups could then give their elevator pitch to the class. Or you could make this a homework assignment and then have an elevator pitch contest in a later class period.

If you and your students are really inspired by this video, and want to continue to develop your innovative and entrepreneurial skills, I hope that you use this video as a launching point for a more in-depth discussion and more in-depth study. If you go to the Blossoms website, you can find additional resources for a long term student project on engineering, innovation, and entrepreneurship.

Thank you for inviting me into your classroom, and I hope that you have enjoyed this video. I hope that you and your students continue your discussions in your everyday lives and on the Blossoms website in the future. Thank you.