INVENTORS OF NEW ENGLAND

(Narrator)
When you think of cutting-edge inventions, you don't usually think of Maine, Vermont and New Hampshire…

From the next wave of human transportation to valuable products made from waste, inventors in Northern New England are coming up with some surprising innovations for the 21st century.

QUEST OPEN

(Segway Rep)
All right, and then to go ahead and turn what I am going to have you do is you can turn the steering grip either to the right or to the left. It is progressive so when you start turning, just turn it a little bit.

(Linda Greenlaw)
All right, so start slow.

(Segway Rep)
Exactly, exactly.

(Linda Greenlaw)
Well, let's try it.

(Segway Rep)
There you go.

(Linda Greenlaw)
Wow, this is really neat.

Hi I'm Linda Greenlaw. How do people come up with inventions? And how does something like this, go from an idea in the inventor's head to being something people can use?

On this QUEST, we're going to see some modern day Yankee ingenuity at work, as we follow a few famous and not so famous inventors in Maine, Vermont & New Hampshire.

(Narrator)
Whether is working in New England or anywhere else in the world, most inventions start the same way: observing a problem

(Narrator)
Dr. Habib Dagher, at the University of Maine in Orono, has taken on a big problem: hurricanes and earthquakes, and the damage they do to buildings.

(Habib Dagher)
Inventions are kind of difficult to describe. It's like connecting the dots. Having a certain amount of background in a particular technical issue or area and knowing some of the problems and trying to connect the dots. So in this particular case, we know that hurricanes and earthquakes have taken a large toll on a lot of buildings, we're talking about 50 billion dollars a year in the U.S. So we've investigated how panels typically fail in hurricanes

and earthquakes and thought maybe we have a way to fix them, and that's how the invention came. It didn't really, it wasn't a planned event, it was more of a connecting the dots when you know there's a need and you know you have some technology and 'can you put the two together?'

(Narrator)
Nestled in the White Mountains of Northern New Hampshire is the town of Littleton, population 5,800.

(Bill Church)
Actually your group, along with the manifold needs to decide how to…

(Narrator)
At Littleton High School, the students in Bill Church's physics class joined the MIT Invent Team program and received a grant to invent something to solve a problem in their community.

NAT. SOUND teacher talking to class.

(Bill Church)
We have a snowy environment here and the town needs to clear the roads some how.

Natural Sound Main St. Littleton New Hampshire

(Erin Lorenz, student)
We get a lot of storms up here.

(Henry White, student)
It gets pretty nasty if you looked at Main Street a few days ago, it was horrendous. People falling down everywhere, sliding down main street, that's not my idea of fun.

(Erin Lorenz)
Our problem was that we had to use salt to get the ice off of Main St. For each storm it costs about three grand. We had this idea that we could heat Main St. in some innovative way…

(Bill Church)
So the students are working on a new way to keep Main Street cleared.

MUSIC shift '60's

(Narrator)
It's the 1960's, but it's a problem if you are a kid in Vermont without a surfboard.

(Jake Burton Carpenter)
I've been exposed to surfing all my life, but I've never really had an opportunity to get a surfboard, but I've skied and had experience with that. So I think I was about 13 or 14 years old and I got a product called a snurfer, which was the complete toy-like version of the snowboard. It was sold in the late 60's early 70's, but the minute I got on it I just knew that there was a sport there.

(Narrator)
John Todd was featured in MIT's list of the top 35 inventors of the 20th century. He's dealing with what some people call the most basic problem of human existence, waste.

(John Todd)
What I do is I try to harness the genius of nature and then as a designer or inventor, try and direct that genius toward a particular problem that humans need solving. So here the genius of nature might go towards growing foods, or cleaning up sewage.

(Narrator)
Approximately five out of every one thousand pregnant women miscarry during their first month of pregnancy. In fact, there has been an increase in pre-term births over the past 15 years. Most doctors, midwives and parents welcome new technologies that allow them to monitor the health of the fetus.

Janet Eugley never pictured herself as an inventor. As a lab supervisor at a clinic in Midcoast Maine, she runs blood tests and works with pregnant women on a daily basis. It was when she became pregnant herself, that she wanted a way to hear the baby's heartbeat sooner than usual.

(Janet Eugley)
I have worked here in this field for twenty years and then became pregnant myself with my first pregnancy and was very interested in hearing the heartbeat as early as I possibly could. And I knew that typically they don't hear until about 12 weeks in a normal pregnancy the heartbeat. And really until you hear it you don't know everything is [is] ok.

(Narrator)
While still an undergraduate student, Dean Kamen invented the first infusion pump, that freed up patients taking medications. Since then, he has received over 150 patents including several other pioneering medical devices. From portable dialysis and insulin pumps, to a stint to reduce blockage in arteries. Several years ago, he turned his attention to the disabled.

(Dean Kamen)
The disabled community can't stand up, they can't look their colleagues in the eye, they can't go up and down stairs, or even up a curb. We decided that's inappropriate. So we worked at solving that problem. That's typically what we do with all our projects, here's the problem let's see if we can find a radical new way to dramatically improve upon the current solutions, if any.

NAT. SOUND robotics team

(Narrator)
As Dean Kamen began recruiting bright young scientists to his company DEKA, he recognized another problem: the lack of students entering the fields of science and technology. He took a unique approach, solving the problem, by giving the students a problem.

What if students were given rules to a game, a crate full of parts and six weeks to build a robot. Would they get excited about science and technology?

(Dean Kamen)
To me an invention is a way to look at a situation, an abstract problem and approach it differently than everyone else. And a lot of people, our government and various agencies from the national science foundation, to the presidents office, recognize that getting more kids, particularly women and minorities, involved and interested in careers in science and technologies is a really big issue.

(Student)

Oh wait, is this one Anderson Power Products?

(Advisor)
Nope.

(Student)
That's not one is it. Are there more boxes in there, Ben?

(Student)
No, there isn't.

(Dean Kamen)
I looked at it and said it's unlikely that it's a problem of either our education system, or supply, because we spend 600billion dollars a year on K through 12. So I said if it's not an education problem and it's a culture problem and if it's not a supply problem, it's a demand problem. How can we create demand, among all these kids. To put their time and their energy and their passion into learning things that matter. How can we stimulate them to do with their time what is in their own long term interest.

(Narrator)
Whether the inventor's problem is how to transport the disabled or, how to inspire kids to learn about science, the next step in the invention process is to come up with an idea.

MUSIC STING

Dean Kamen's idea was to start an organization, called FIRST, dedicated to motivating the next generation of students to understand, use, and enjoy science and technology. Each year students would enter a robotics competition. Like their counterparts from schools all over the country, the students at Bonnie Eagle High School in Standish, Maine formed a robotics team and found a sponsor, Eagle Industries. With the help of professional engineers, they have 6 weeks to get a robot ready for the competition.

(Janet Eugley)
This is basically a fetal doppler that all doctors use, and this is basically an abdominal probe only at this point, for hearing the heartbeat. You put a gel on this to provide an air tight seal and then you wave this over until you find the heartbeat.. If someone is very large or their uterus is tipped far back sometimes it can even take longer to hear the heartbeat. So you're sometimes well into the second trimester before you hear the heartbeat. So I basically purchased a doppler and reshaped it with my husband to allow vaginal insertion, steriley again, with a gel and a condom over it and with a little finagling I was able to hear the heartbeat very early. And it immediately just came to me that I had to do something with this, that this was probably a very valuable instrument and I proceeded right then with a patent.

(Habib Dagher)
In hurricanes, one thing we have seen often times is that the nail stays in the framing member whereas the panel is actually pulled off the wall, and the nail head pulls through the thickness of the panel. So the thought that we had was could we reinforce the panel, strengthen the panel, such that the nails no longer rip through the edge, or the nails no longer pull through the panel. The technology we developed strengthened the panels with synthetic fibers. By strengthening the panels we prevent some of those premature nail failures that we had with the edge tears and nail head pull throughs.

(Narrator)
The Intervale is a community of farms right in the center of Burlington Vermont. Here farmers provide a large

portion of fresh produce to the city. But they are limited by the short growing season of the summer.

John Todd looks at the Intervale as a natural system like a forest, where the waste created by plants and animals cycles back into their eco-system, sustaining their growth. He calls his invention an "eco-park," envisioning the Intervale as a community that recycles waste from its farms, its heating plant, and its brewery to create even more crops and products.

(John Todd)
It is basically an ecology of enterprises that have the potential to mutually assist each other, very much the way an eco-system works.
So, you might have in our case, a power plant producing not only electricity but excess heat. Ordinarily that heat would go into the atmosphere but in this case the idea is to capture the heat and move it into a series of buildings and greenhouses where we have a bunch of allied businesses ranging from breweries to bakeries, to food processing to food productions, and allow for the development, in this case, an eco-park for urban food production.

(Narrator)
The eco-park is an innovation not only in new technology, but in economics as well.

(John Todd)
The advantage should the eco-park work as well as I believe it can, is that small companies can successfully compete with larger ones. They gain their efficiency though cooperation with other companies not from growing larger all the time. And for communities where the populations are not large, that's a terrific asset.

MUSIC

(Jake Burton Carpenter)
Starting the company was something that I thought about for years. From the time that I got on a snurfer when I was probably 13 or 14 till I was 23 and I started the company. I had this idea, had a little bit of entrepreneurial experience, and I just wanted to get it rolling.

(Todd King)
A good analogy for Jake is like Henry Ford and the automobile. Jake doesn't proclaim to have invented the snowboard, but what he did was to refine the art of surfing on snow and then introduced manufacturing. Then just the whole evolution of bindings and attachment mechanism to the snowboard, and then the evolution of shapes, edges, flex. Jake was a big pioneer in this.

(Jake Burton Carpenter)
Getting the company off the ground was a nightmare, and it was just incredible. That's what I'm proudest of, I mean not so much having this vision, because I never had any idea that it would grow, or get as big as it has, but I think the perseverance and sticking through the tough times, which were continuous.
I knew nothing about woodworking, but there I was designing a product that basically was with a woodworking type procedure. In the early days or learning woodworking type machinery, you know, getting a pin router and shooting boards through walls, and almost killing myself on several occasions, and it was just a long process of learning things the hard way. I think that's a lot of Burton's heritage, getting there first, and making the mistakes associated with getting there first, but learning those mistakes and not making them again. I think that's a big part of what we are all about.

(Narrator)
Today in corporation like Burton Snowboards, the invention process continues to be built into the company

structure. Although it differs from the more intuitive leap and incredible perseverance that Jake first went through, working on his own.

(Todd King)
The invention process at Burton comes from various sources, anyone can contribute. We have an internal team, riders which bring us ideas and they ride the product, give us testing feedback. We also have a team of R&D engineers. They come out with wild and crazy ideas, what they think the next generation or the next evolution of snowboarding will be and they throw it out there and give it to the team and say what do you think about this? Sometimes the ideas stick and sometimes the team says you know I think you better to go back to the drawing board on that one.

(Dean Kamen)
The problem statement is clear, people that can't walk deserve to have the same freedom of mobility and dignity as everyone else. That was a clear statement. How you accomplish that was a very, very messy process. And we tried every wrong way to solve that problem, until we decided that the solution has to involve balance, mobility is only half of the solution. A wheelbarrow can move somebody around, but a human being is not a sack of potatoes.

(Bill Church)
The Main Street heating project actually came from the town. Jason Hokart, assistant town manager has pointed out to me several times, I can't go to the town, he says, and ask for a budget to heat Main Street. When this MIT grant came into view for us, and the thought of having the students invent a system powered by renewable energy sources, he doesn't have to go to the town to ask for this budget. And if we can keep the total cost less than what it currently costs to clear the sidewalks and street, then we have a winning system. The town will save money, and from my goal as a teacher, I'll have facilitated a real life project where the kids can use the physics they're learning (1:31:44)

MUSIC STING

(Narrator)
In order to test out your ideas, you need a prototype, or a model of your invention.

(Michelle Doucette)
This is to represent a furnace, or a chimney flue that are located downtown with the businesses. We have a torch, which represents the heat and it goes up the chimney, and then we have a fan which will takes room temperature air it goes through and travels down and comes out here and goes through the pipes and ends up over there.

(Narrator)
Mr. Church divided the Littleton Invent Teams into research groups.

(Mentor)
You see the manufacturing lines

(Narrator)
Who worked with mentors, to explore their ideas from solar, wind and fire power, to waste heat and geo-thermal heat.

(Student)
We got a hundred degrees up top

(Bill Church)
Our phase now is bringing those ideas to real life. We'll start on the smaller scale, and just gradually get them to the full size that we can test outside.

More Nat. Sound brainstorming

(Narrator)
Without the resources of a classroom, university, or a corportation, how does an individual inventor like Janet Eugley, create a prototype?

(Janet Eugley)
I was watching TV and having coffee and I saw a commercial for engineering Engineering Maine.com and I said to my husband, "Maybe they can help me with the next step." I really did not know what my next step would be. And through conversation with them, they directed me to Maine Technology Institute which offered seed grants and different grant packages.

(Narrator)
The Maine Technology Institute was created by the Maine State Legislature in 1999 to encourage the development of new technologies that will lead to products and job growth in Maine. Along with other organizations, like small business development centers in New Hampshire and Vermont, the institute offers grants and counseling to guide inventors like Janet through the process of getting their inventions to market.

(Janet Eugley)
And I applied. And the second time around was able to obtain funding to get a true probe, not my prototype, but a true probe made with Mick Peterson up at the University of Maine.

(Mick Peterson)
She really took the problem; women who were even in the middle of their pregnancy couldn't get a fetal heartbeat. She knew the solution. She knew where they were going. They were going into the ultrasound imaging room down the hall and they were going to have an ultrasound image and she said now wait a minute we could just be doing fetal Doppler instead of the complete image.

You would be replacing the need to go in and use a $300000 ultrasound imaging equipment with standing there with in the same office and using a $1200 fetal Doppler. Big difference.

(Narrator)
Although Janet Eugley and Mick Peterson saw eye-to-eye on the basics of her inventions, they couldn't work out a schedule for building a prototype. Janet was anxious to have the prototype out and tested in the field, so she enlisted the aid of another engineer, Dan Gagnon.

(Dan Gagnon)
So what we are doing is taking an abdominal type fetal monitor and we are re-packaging the transducer and the electronics into a different housing so it can be used to get right up close to the uterus so that we can hear the heartbeat at an earlier date.
I basically made J-peg images of the solid model, sent them to Janet, and when she and her physician were happy with it, I was able to create files that are sent out to have the model made. And what they do is they make this part in a machine that works very much like an ink jet printer, and it literally has a head that moves back and forth and it sprays out hot plastic and builds this part, and it takes about 4 hours. What you get is a fully functional part made out of plastic and you didn't have to invest in tooling.

(Narrator)
Many new technologies contribute to the possibilities of making prototypes cheaper and faster. A boom to the individuals with a one time invention. As the idea phase moves into the model, or the prototype phase, pure science intersects with technology.

(Dean Kamen)
Science is really understand. Whether it is the second law of thermodynamics or Newton's laws of motion, or what is electricity and magnetism. It's the rules of the world. It's what nature put here, how do we as humans understand that? Technology is taking that understanding, those tools, and building with those tools and in that framework of understanding, the products that we all want to use to make our lives better.

(Dan Gagnon)
Typically scientists are the people that come up with the new ideas and the new concepts, so I think that scientists are a lot like inventors, they come up with ideas that no one else has had before. Engineers, what we do is take that idea and form it using existing technology into something that can be built today.

(Narrator)
During the prototype phase of what would become the I-BOT, the inventors at Dean's company DEKA, realized they weren't just trying to move somebody around, they were trying to understand the very basis of balance.

Dean Kamen
You finally graduate after learning trying all the wrong ways to build wheelchairs, to can I make something that emulates human balance. It's non-intuitive that you should take all your mass and put it up in the air, because we all know, you do that with things, and gravity isn't just a good idea, it's the law. It always wins. But human beings not only learned to stand up, we learned to move around after we stood up, we learned how to walk, but there is a 1 to 1 correspondence between your ears and your brain and your muscles and our gyros our computers and our motors.

(Narrator)
As often happens with inventions, an inventor may see some new possibility in either a failure or an off shoot of their original idea. This was the case for Dean Kamen and the inventors who were stuck by the possibilities of the I-bot technology for the people who are not disabled. Thus the Segway Human Transporter was born.

(Dean Kamen)
The big invention in the case of Segway that we hope will go from invention to innovation in the way people live, will be that we are offering an environmentally friendly, really fun, really efficient alternative to human mobility where there is high density. The fact that for the first time in human history half the human population of this planet lives in cities or mega-cities. Places where you don't need a car, but nobody has ever brought technology to the pedestrian.

We've improved on every form of transportation. Think about jet airplanes that cross continents, think about spaceships and submarines, but in the year 2003 you slap on you sneakers and you walk around Greece or New York at 2 miles an hour. I looked at the Segway and said, what if we put these in cities and gave people the alternative for that 1 or 2 or 3 mile trip. If you look at the 20 largest cities on the planet the average speed to get from anywhere to anywhere is about 7 or 8 miles an hour, so that 40 minute walk that you wont do, takes ten minutes in a cab, but you only average 8 miles an hour.

What if we could present the Segway to the world, in such a way that it could be the answer to personal transportation in the next century.

(Narrator)
Working on inventions, in a private company devoted to innovations, Dean Kamen has a different approach to creating a prototype than someone like Habib Dagher, who works in a university setting. At the university a prototype is essential for gaining the funding to get to the next stage of testing.

(Habib Dagher)
Once you think that you have a good idea, that can solve a real problem, the next step is finding funding and to test the idea in the lab. So really, if you have some seed funding that you can work in internally, within our organization, typically we would run some seed tests to insure that the product really has some value. Once we insure that we have some value internally then we apply for the patents. And then go ahead and apply for grants, or industry contracts with some industry partners who would fund the research. So we have a team of students in the case, working on the projects and faculty as well who have expertise in different fields.

(Narrator)
The forest products industry is trying to hold on to its role as a major player in the Maine economy. At the university, Habib Dagher and the professor he works with, William Davids, have made a mandate to create jobs in Maine by finding new value added wood products

For instance, a 2x4 board that sells for 4 dollars, has the same amount of wood in it as a snowboard that sells for 400 dollars. By finding the right combination of resins and wood, Dr. Dagher and Dr. Davids can create value-added products that generate more income for the same amount of lumber -- such as their co-invention, Advanced Oriented Strand board.

One of the most recent inventions from Burton Snowboards has been to replace wood in a snowboard with a totally new material, aluminum honeycomb.

(Todd King)
The idea came looking at industries outside of snowboarding, the space industry is a great example. So the T-6 uses an aluminum honeycomb core which the same material that they use for helicopter blades, jet fighter fuselages and we saw this material as a great material to put into a snowboard. A) because it is super light, it is over 90% air, and B) because of its flex properties. It is very rigid in this direction, while it is very flexible in this direction. The basic problem with laminating anything to aluminum is that the resin wants to flow into the cells and it wants to fill up the cells and as you fill up the cells the board becomes heavier and that is one of the reasons that we use aluminum in the first place was to have a lighter board, a more responsive board. So one of the first hurdles that we had to over come was how to laminate this without filing up the cells.

Nat. Sound: JOHN TODD/JOHN ANDERSON/ERIC WELLS
3-SOME DISCUSSION WITH PLANS

(John Todd)
I would say that the biggest obstacle I faced, was that inside our organization we didn't have a person who understood two things equally powerful. One was how to ecologically design and how to be a good businessperson. When I first ran into Eric Wells I then knew we'd finally found a person who could orchestrate the dream of making ecology and economics come together. In my case, the biggest obstacle was a person. Not the money. The money's always hard to get.

(Erik Wells)
The eco-park will end up being directly behind me, adjacent to the cooling towers of the Mcneil woodfired power facility, which you can see in the background.

(John Todd)
The idea is that the heat from the power station, instead of being put under a cooling station is radiated through this growing complex, something like this only much bigger to provide this year round environment. And then inside is a new kind of agriculture, the pieces of which are assembled here.

(Erik Wells)
This is a small-scale model, a prototype for what will eventually be implemented on a much larger scale in the eco-park.

MUSIC STING

(Narrator)
At last the model leads the inventor to the moment of truth, the experiment. By putting the model through its trials the inventor gains valuable information about the invention. Will it work? Under what conditions? This stage requires a rigorous scientific approach because the inventor will want to isolate what is working and what is not working in the invention and anticipate problems.

(John Todd)
So in this building we actually take brewery waste and we combine them with litter from an organic chicken operation and some straw.

(Erik Wells)
When we mix these two products together we create an ideal sub-straight for the production of oyster mushrooms. We will pasteurize this material and place it in a bag and puncture holes in the bag and inoculate it with mushroom spores. Twenty days later there are beautiful clusters of mushrooms coming out of the holes that we punctured in the bag. So we can harvest these mushrooms and sell them at a value as a product. The cycle doesn't stop with the mushrooms, once the mushrooms are harvested we can actually take the material that is inside the bags.

(John Todd)
Then the material from the bag is dumped into a bin, and inside that bin, there are a huge populations of earth worms and those earth worms in a matter of a couple of weeks then convert this material to a new substance again. Having passed through their bodies it's a new material and of course, the earth worms are breeding like crazy. So we remove the earthworms and blend them with aquatic plants that we grow in here and we feed them to the yellow perch and tropical fish, tilapia, which we grow in here.

You've already gotten about four products, still got the same original material but it's different…it is then converted to grow winter green salad crops.

(Erik Wells)
This is a very small bed. But you could imagine a ten-thousand square foot facility filled with this material, ready to be planted directly into with salad greens or cut flowers or tomatoes or herb crops to be grown all winter long on a floor which is being heated with waste heat from the cooling tower of the power plant.

(John Todd)
So something that started out as worthless becomes increasingly valuable, spinning products out on the way.

(Dean Kamen)
I set out to form an organization which is essentially the Olympic committee of smarts, that will inspire kids to learn about things that in fact do matter to them, to you, to me and to this country and it's working it.

(Student)
If you grab two crates with this, that piece will come back down and support it and tip it back. That's two stacks of five immediately.

(Other student)
And you could get the robot to work like that, but you would have to have one really fast robot because a robot is going to come up and smash through it and there is not going to be a chance for you. So it would be wasted.

(Third student)
And you would have to be pretty precise to get both rows at once.

(Dean Kamen)
Every school we go into we see kids attitudes change. Maybe they want to be a scientist or engineer, maybe they don't, but they all believe it's one of their options, they all think it a possibility. They all think, "I could do that." And you realize this opportunity is unique. For them to see real adults, real professionals, doing things with skill sense, called engineering, or science and it changes their perspective about what's possible. You get people involved and they stay involved, all you have to do is talk to the kids and watch what they do with their life after they have been involved. It's amazing.

(Habib Dagher)
This is the third panel that we are testing right now, so we are looking to see how this one turns out. Potentially we are putting an earthquake on a building right now. We start with a very low amplitude and the amplitude continues to increase as the test progresses until failure takes place.
Notice how the wood in the studs is failing but the nails are not ripping out of the edge of the panel, which is what we are trying to avoid. So I am very happy so far.

We have a failure mode that we would like to see here, and the failure mode is avoiding the edge tears and the nail head pull throughs. we only have one nail head, you see that edge tear near the corner of the panel. So out of all these nails only one what he wanted it to do. So that's pretty good.

(Bill Church)
Today we are installing the necessary parts of a test site. The students need to test their ideas on the real thing. You can't bring snow inside and simulate melting. The town has built for us and delivered today, these two plates, one asphalt and one concrete. They are big enough that once this test site is constructed the students can test their ideas outside on a real set of road and sidewalk.

One of the groups is working on the heating system itself. So they are exploring the idea that the iso-hermic layer of the earth stays at a constant 56 degrees about 6 or 7 feet down and if we can warm the water at that level, we can test the idea of circulating it up to the road surface. What the students are finding with their research is if we can get the road level up to 37degrees we can melt the snow.

(Narrator)
At their test site, the students use a wood burning stove as a stand in for waist heat generated from Maine street businesses. Next to the side walk test lab, a manifold allows the student to open and shut valves controlling different heat source being tested on the side walk

Janet Eugley came up with a new name for her invention, the EchoHeart fetal monitor and she sent several out to doctors for testing on their patients. As testing begins the EchoHeart works well, but it isn't successful all the

time, and under all of the circumstances. Miss Eugley goes though a difficult period, weighing in the degree of success against the time and effort put into her invention

(Janet Eugley)
It didn't work. I really don't know what happened, because I fully expected to hear it, but I think this woman was very far along and the uterus position probably changed from where we thought it would be. Not hearing the heartbeat, I inside just thought "Oh no, what are we going to do?" and those little things make you not give up, but break your spirit a little bit is how I would say it. It's very hard to stay upbeat and so energetic. I had mixed feelings about the process because had I have known what I was in for I don't know whether I would have started. It really is an incredible amount of time and energy, money and emotions, you name it its involved with it. So that has been very difficult.

(Dr. Bolander)
Right now, having this doppler be very early in its use, it is a little bit more difficult to use, because we don't have tricks of the trade of where am I supposed to look with this. So my impression is that once this instrument has been out for a period of time we will develop those techniques of where am I going to look now to find this baby's heartbeat.

(Todd King)
What we did was we invited the manufacturers from the space and the military industry in and we said look this is what we want to do is there something you can do. They built core profiles for us, using really, really expensive machinery that they use for airplanes but using these aero-space suppliers we knew hat our costs would well exceed what a person would pay for the board. So we brought the process in the house and said, we know how these guys did it, we need to make this sustainable so that we can do it in mass production for thousands of boards so that each board is exactly the same and that we can provide the consumer an amazing board with a great price.

(Narrator)
The difficulties of testing an invention, coupled with actually trying to find a practical way to produce an invention and then getting it to the consumer can be the downfall of many inventions. However, many inventors take the disappointment of the trial phase and use it to re-invent their inventions, taking into account what they have learned.

(Todd King)
Probably we did 50 boards, prototypes, that we got out to our on the snow testing team and there was definitely a ride difference with the aluminum honeycomb. It's like a Porsche the way it reacts. You think about the direction you want to go and as soon as you think about it, the board goes that way.

(Narrator)
After years in development, Burton's "T-6" becomes the first aluminum honeycomb snowboard on the market

(Dean Kamen)
I think the hallmark of DEKA is that we are very, very good at failing quickly, failing in a spectacular way, we celebrate our failures. But every once in a while they work, and they turn into something good.

(IBOT user)
The I-bot is going to allow me to do things that I have never done before. I've never been to the beach, without being carried onto the beach. I've never been able to push my five year old son in a swing.

MUSIC STING

(Dean Kamen)
A person gets on an I-bot or a Segway Human Transporter, and the bad news is they're about to do something that is the most difficult motor skill that they have every acquired, get around by balance. The good news is it turns out, it's an entirely transferable skill. If they had learned how to stand up and walk, they've learned how to do what these machines do and so people get on them, and within a few seconds they are just smiling.

(John Todd)
I agree with you, it should all be eco-park

(Narrator)
John Todd worked with Erik Wells and architect John Anderson, to finalize plans for the eco-park. They hope to break ground in 2003 on the eco-park's bio-shelter, the greenhouse structure that would house the eco-park's biological components.

(Erik Wells)
Before it gets cool , pipe it over here and then also into the green house. And that is going to take care of 30 or 40 percent of our heating arangments

(Narrator)
However, as the cost of the building and the bio-shelter increased, the construction never materialized.

(John Todd)
For me the fact that delays are inevitable, were initially, a very frustrating thing. Yes, it is going to cost more than you realized but just go for it.

(Narrator)
As delays in funding grew the tenants that were set to move into the Eco-park had to look elsewhere for space. In this case an anchor businesses like the brewery is more than just economic necessity, the brewery's spent grain is the waist fuel needed to feed this living machine. However, always having worked on the cutting edge of what's possible, John Todd takes a longer view of the success of his living inventions.

(John Todd)
The first bio-shelters that I developed was in 1971. I then went back a decade later, and then a decade later, and now it's the 21st century and I'm ready to go back and try it again.

(Narrator)
There's nothing new about heating sidewalks, but the Littleton High School Students invented a way to do it using alternative energy. They found they could use waste heat, from a building's furnace to warm anti freeze that circulates underground to take advantage of the earth's geo-thermal warming. Solar power will pump the anti-freeze to the sidewalk and back to the furnace to re-use.

With the reconstruction of the Main Street sidewalks years away, but the schools new addition under construction now, community leaders decided to let the students create a working demonstration of their finding right at school. The new school entrance could have a side walk heated by the students invention.

(Student)
These two pipes, they come from the furnace, which is inside the building. It brings the heated water all the way up here to the manifold. The manifold splits that into all the different tubes which go through the sidewalk,

then it all comes back and gets returned back down into the furnace.

(Kristin Finn)
You have proven to interstate onlookers at MIT and the Lemelson Foundation, which generously supported this project, that high school students can be highly inventive, highly committed and highly organized for the good of their communities.

(Narrator)
The groundbreaking ceremony at the school was a triumph for the physics class.

(Bill Church)
It's my hope that they can pull from this course, the problem solving process. Because that is going to be valuable no matter where they go.

(Janet Eugley)
So what did you get on yours?

(Dr. Klemperer)
I got pretty much the same, you know really encouraging stuff, 85%-90% success for me. Not quite 100%, but not bad. And really getting down, we've got 7 weeks and a half there and 8 weeks and 9 weeks, it's really good. And again, no discomfort anywhere.

Janet and I have been field testing the Echo-heart for about a year now and we've gotten pretty much uniformly enthusiastic feedback. I've had people already want to purchase one, when we are only in the prototype mode.

(Janet Eugley)
There it is, that's great.

(Patient)
Yeah, it was just about getting the right spot.

(Janet Eugley)
Yep can't miss it now, loud and clear, that's great.

I am so pleased with the results so far. We have probably over 80% success rate detecting the heartbeats. We have had no patient complaints as far as discomfort.

(Dr. Klemperer)
The Echo-heart has become part of my usual office routine. It's almost an extension of an early examination for me now.

(Narrator)
Janet Eugley finds that medical companies are showing more interest in her invention, now that she has had positive field tests with her prototype. she prefers to be bought out by a large company, but if necessary she is determined to manufacture and sell the echo-heart herself

(Janet Eugley)
The earliest we have detected a heartbeat is 6 weeks 3 days. And that is very early, I was hoping that we would get down around seven. So to even be earlier than 7 weeks is amazing.

(Patient)
When I was pregnant with my first baby I was about 3 to 4 months pregnant before we were even able to hear a heart beat and when we did hear it, it was very faint and very distant. I really couldn't tell that it was a heartbeat at all, verses at 12 weeks during this pregnancy when we did the echo-heart, it was very strong and very fast. We heard it almost immediately and it was very exciting.

(Narrator)
After four years, Habib Dagher and William Davids finally received their patent on advance OSB. However, they were too successful! They found that the walls they were making were too strong…Common nails used in the tests would fail before the boards would.

(Bill Davids)
And because the AOSB is so strong, essentially the fasteners that connect it to the framing, the nails or what have you, the ties that hold the entire wall down to the foundation, all of those have to be strengthened to allow you to take advantage of that extra strength that we put into the AOSB.

(Narrator)
Several graduate student have come up with new ideas about how to use what they've learnt about advanced OSB. One idea that they were exploring is to make wall systems that can be installed complete with extra strong fasteners that match the strength in the wall panels.

(Habib Dagher)
I am very excited today, a lot more excited than I was three years ago because we have developed some technologies that have some real potential applications. Of course the challenge is how to take high technologies taken from the laboratories and turn them into commercial ventures

(Bill Davids)
You know the wood industry is having some tough times, we all know that. One of the ways that we can fix this, I believe, is by better utilizing the species of wood that we have and through engineered products.

(Habib Dagher)
It's always exciting to be at the edge of discovery, at the edge of technology that allows to benefit society. I come here every day excited with the potential of what we can do, what we can discover today, and the excitement throughout the team that works here in the center

Natural sound ROBOTICS TEAM IN COMPETITION

(Narrator)
All too quickly the day of the robotics competition arrives, with over 100 wild and crazy teams from throughout New England ready to compete in Manchester, New Hampshire.

(Announcer)
… there has got to be four!, five! Oh my, what a great scrum!

(Narrator)
The Bonnie Eagle Robotics Team, or BERT as they call themselves, run into mechanical problems and have to make repairs on their robot between rounds.

(Student)

On the record, are we going to break down or are we going to be good?

(Advisor)
You got to be optimistic about it, it's not going to break.

(Other Advisor)
Their pre match is good. They will be all right, they'll bounce back

(Team cheering)

(Narrator)
In this year's game, the robots try to get the most crates onto their side of the playing field. Through a complex scoring system, the students receive points based on their opponent's score, creating a mix of competition and cooperation among the teams.

(Announcer)
the body eagle team returning to the ramp! They gt one knocked out! there is the bin! He is hitting them out!

(Student)
Hit 'em hit 'em!
Back up.

(Announcer)
All the way down, they are looking at three! Paramax parts it onto the floor. Five seconds left. Two seconds, one!

Buzzer sounds

(Students to other students)
Nice job you guys. You guys are a great team. All right.

(student)
We did all right. We could have done better, but we did our best.

(Dean Kamen)
The good news about this game is everybody wins. Everybody that comes here and has a good time, some of them win. If they don't win the points, but they develop the skills, like analytic thinking and understanding of engineering, science and invention. They walk away with very, very valuable experiences that can be useful for any career that they go into. So everybody wins.

Cheering

MUSIC STING

(Linda Greenlaw)
We may look back someday and wonder how we ever lived without these inventions, but whatever the future, the vision and perseverance of Yankee inventors is bound to help us get there.

I'm Linda Greenlaw, hope you enjoyed this Quest.