Session 9

A Solution Taking Shape

Thinking Creatively

In This Session:

A) Invitation to Invent (45 minutes)
- Student Handout

B) Patents (60 Minutes)
- Student Handout
- Student Reading

C) How Stuff Works (45 Minutes)
- Student Handout

Home Improvement
- Student Handout

This session involves online research using computers with Internet access. It is ideal for each student to have his or her own computer to use during this session. If you do not have access to computers, try to arrange a visit to the local library where students can use computers. In this session, students plan out one of their design solutions by following Steps 5 and 6 of the design process.

The first activity of this session, *9A: Invitation to Invent*, exposes students to inventors and inventions throughout history, to see how others applied creative thinking to solve problems. In the second activity *9B: Patents*, students use the U.S. government's official patent Web site to dig into the world of patents, looking for products that might be similar to their idea. This helps them refine their solution. In the third activity, students visit the Web site, *HowStuffWorks*, which provides them with online tutorials about the inner workings of things.

The Home Improvement activity, *Project Analysis*, provides students with guiding questions and encourages them to talk to others about their project idea before making a final decision about their solution.

Supplies

- Computer with Internet connections
- Optional: Parts Catalogs

A Solution Taking Shape

Key Concepts: Session 9

In Session 9, students concentrate on the improvement and refinement of their design solutions by gathering information about inventors and inventions through the research of **patents**. The session concentrates on the improvement and refinement of students' design solutions by gathering information about inventors and inventions. The use of the Internet is critical in making this research process effective. As students begin to explore the development of inventions on various Web sites, they may think of new ideas that will further refine their design solutions. Key to this session is the idea that designers and inventors take many different approaches to solving problems, and the result is a wide variety of design solutions.

Key Concepts
A **patent** is granted to the inventor by a country's government, and it gives the inventor the right to make, use, and sell an invention for a set period of time. In the United States, this time period is up to 20 years from the date the patent application is filed. Patents cannot be renewed. They may be extended through a special act of Congress under certain circumstances. You can search patents at the U.S. Patent and Trademark Office www.uspto.gov* to see if an invention has already been patented by someone else.

Gaining a patent can be a costly and involved process. A patent attorney or agent is often sought out when applying for a patent, due to the complexity of the procedure. A patent application needs to be completed and submitted to the U.S. Patent and Trademark Office. A patent application consists of several parts: (1) the abstract; (2) the specification; (3) the claims; and (4) drawings. A brief abstract summarizes the invention. The specification describes the method and process of making and using the invention. Claims conclude the specification section and legally define the boundaries of patents. The claims describe any unique features of the invention that need to be protected. The final piece of the patent application is drawings which illustrate the invention.

Trademarks protect words, names, symbols, sounds, or colors that identify goods and services from those sold by others. Trademarks can be renewed indefinitely. Some trademark owners use a TM (trademark) or SM (service mark) symbol to indicate that they are claiming rights to the use of the trademark. The Nike® swoosh is a familiar trademark symbol. The ® designation is used once a trademark is registered in the U.S. Patent and Trademark Office.

Copyrights provide the right to reproduce, distribute, perform, display, or license original writing, music, and works of art. Copyright covers the expression of ideas and not the idea itself.

More Information on Patents and Inventions
Kid Primer, www.uspto.gov/go/kids/kidprimer.html*
The U.S. Patent and Trademark Office publishes a Web site for kids, and it offers a great question-and-answer section on patents, trademarks, and copyrights.

Enchanted Learning, www.enchantedlearning.com/inventors/us.shtml*
This site proudly depicts U.S. and Canadian inventors and inventions categorized by time period, type of invention (food, science/industry, medicine, etc.).

Key Concepts: Session 9 (continued)

The Great Idea Finder, www.ideafinder.com/history/of_inventions.htm*
Investigate invention facts and myths at this site.

The Lemelson Center, http://invention.smithsonian.org/home/*
This site is an exploration of the world of invention. Explore the playful side of invention with virtual exhibits and tools.

Session 9, Activity A

Invitation to Invent

Goal
To "think outside the box" for creative solutions to problems.

Outcome
Students gain insight into the creative thinking process and apply these insights to their design.

Description
Students develop the ability to think beyond the obvious by exploring invention Web sites for inspiration and ideas for their own projects.

Supplies
Computers with Internet connections

Preparation
Ideally, each student will work on his or her own computer. Students can work effectively in pairs but need to take turns at the keyboard and mouse. Another option with limited computer access is to rotate students into the computer area and provide reading and discussion activities using printed materials from the patent and invention Web sites.

If no computers are available, you may print out the suggested examples from each Web site.

Procedure
Thinking Outside the Box

1. Do a quick exercise to get kids to "think outside the box." Try this exercise: Ask students what half of 15 is. Most likely they will say 7 1/2 or 7.5.

2. Encourage them to think about it in new ways and ask again, "What is half of 15?" You may want to model an answer such as "1 and 5"; write "fifteen" on the board and erase the lower half; separate fifteen by writing "fif" and "teen"; or the Roman numerals X and V; or say "siete y media" which is "7 and 1/2" in Spanish; and so on.

3. Ask the students, "Remember back when we started how you thought there were only a couple of answers to the question 'What is half of 15?' Well, now you know, there's always another answer!"

Simple Inventions That Changed Lives

1. Students may find inspiration at the Rolex* Awards for Enterprise Web site, www.rolexawards.com/*.

2. Show them *Inventions* under *Special Features*.

9A: Invitation to Invent (continued)

3. View a couple of the examples of the simple but effective solutions to problems. Discuss the inventions and what makes them successful.

4. Emphasize that students do not need to come up with complex solutions; sometimes the simpler, the better.

Why Didn't I Think Of That?

Give students a little time to explore others' inventions and how they came to be.

1. Direct them to National Inventors Hall of Fame, www.invent.org/index.asp *.

2. Have students view a timeline of inventions, www.cbc.ca/kids/general/the-lab/history-of-invention/default.html* and look for trends in inventions. Discuss: What kinds of things were invented first? Most recently? How does history affect inventions?

Wrap Up
Discuss what they learned about execution of an invention plan.

Follow With
In the next activity, *9B: Patents*, students access the U.S. Patent Web site to identify and learn from similar design solutions to their own.

Invitation to Invent

Handout: Session 9, Activity A

Have you ever thought about who invented bubble gum and how? In this activity, you will have some time to peruse others' inventions and learn about what inspired them. Let their inventions inspire the creative thinker in you!

Simple Inventions That Changed Lives

1. Go to the Rolex* Awards for Enterprise Web site, www.rolexawards.com/*.
2. Click on *Inventions* under *Special Features*.
3. Look at a couple of the examples of the simple but effective solutions to problems.
4. What makes these inventions successful?

More Inventions

1. Go to National Inventors Hall of Fame*, www.invent.org/index.asp*.
    a. In the upper left-hand corner, move your cursor to *Hall of Fame* (in light gray print).
    b. Underneath Hall of Fame, click on *Invention Channels*.
    c. Notice that you can choose from the following categories: computer; communications, agriculture, electricity, chemistry, imaging, medical, industrial, and Nobel Prize Winners.
    d. Click on *Chemistry*.
    e. Notice that within this category there are various inventions to choose from. Click on *Kevlar*.
    f. You find that Kevlar* was invented by Stephanie Louise Kwolek. Remember her?
    g. Repeat this procedure for other categories and inventions. Check out the *Imaging* category and click on *multiplane camera*: Who was the inventor?
2. Select one invention that interests you and read about how it was invented. On the National Inventors Hall of Fame, you will need to select the *Invention Channels*, and then choose a category. Consider the following:
    a. What is the invention?
    b. Was the invention accidental or intentional?

9A Handout: Invitation to Invent (continued)

c. What problem was the inventor trying to solve?

d. Was it an adaptation of something already invented or something completely new?

e. What kinds of things did the inventor need to know about or learn about when developing the invention?

f. What was the impact of the invention?

g. What other inventions can you think of that have been adapted from this invention? How are they improvements?

3. Now view a timeline of inventions, www.cbc.ca/kids/general/the-lab/history-of-invention/default.html* and look for trends in inventions.

   a. What kinds of things were invented first?

   b. Most recently?

   c. How does history effect inventions?

Session 9, Activity B

Patents

Goal
Use research on similar design solutions to refine ideas.

Outcome
Solutions are further refined or revised after research.

Description
In this activity, students explore the U.S. Patent Web site (or choose a patent office for your country) to find and learn from patents similar to their idea.

Supplies
Computers with Internet connections

Preparation
Ideally, each student will have a computer to work on for this activity. If computers are not available, you may print out suggested examples of patents from the Web site.

Procedures
Patent Scavenger Hunt

1. Introduce patents by having students go on a short scavenger hunt around the room. Have them look at manufactured objects (furnishings, electronic devices, appliances) in the room and see if they have a manufacturer's label on them with a patent number (or the words Patent Pending.)

2. Discuss the purpose of patents. At the very basic level, according to the U.S. Patent Office, "A patent is a grant issued by the U.S. government giving inventors the right to exclude all others from making, using, or selling their inventions within the United States, its territories, and possessions." The patent system protects inventors and records new inventions.

Patent Search for an Idea or a Problem

1. A patent search can provide useful information at any point in the design process. It can be used to see if someone else has had the same idea or a similar idea and to get ideas to enhance one's design.

2. Begin by having students learn how to search the U.S. Patent and Trademark Web site, www.uspto.gov*. (Note: This site may load slowly.) For non-U.S. students, find the patent office for your country from the Worldwide Patent offices Web site, www.patentlawlinks.com/patoff.htm*.

3. Explain that students can use the patent site to search the problem that they are addressing to see what solutions others came up with for the problem, or they can

search their solution to see if there are similar solutions to theirs. Show how to conduct a search.

4. First, choose a problem, such as toothpaste getting all over everything when it is used. Ask students what key words they would search with for this problem (for example, "messy" and "toothpaste"). Conduct a search, and choose a sample patent to explain the information on the patent. Now, ask how they would conduct a search for this problem by a product, for example, someone might come up with a toothpaste cap that makes less of a mess. Search "toothpaste" and "cap" and see what patents exist. Discuss how this search would help someone designing a new type of toothpaste cap.

5. Note: If you do not have computer access for all students, it is suggested that you print a few examples of patents (the first page) and the images.

Patent Search for Your Design Solutions

1. Now that students are familiar with how to do a patent search, they can conduct a search for their own design solutions. This process helps them to see if anyone else thought of an idea like theirs, and if so, how those solutions are similar to or different from their ideas.

2. To begin, they will need to come up with key words to search. Help students come up with key words for their own search.

3. Once they conduct a search and find the results, they can explore each separate patent to find out about other inventors' approaches to problems and see that there are quite a variety of engineering solutions, materials, and design ideas for the same problem!

4. As they conduct the search, they should ask themselves the following questions:

    a. How do other inventors view the nature of the problem?

    b. In looking at the various patents that are similar, are the inventors designing for the same "user"? How do the different solutions show that inventors may consider different aspects of a user's life, environment, and behaviors?

    c. What materials have other inventors used to address the problem?

    d. What do other inventors' sketches/designs look like? What are the similarities/differences in the design solutions?

    e. What components have other people used? Have they considered similar or very different components for their design solutions? Have they used the same essential components but arranged them in a different way? Do different parts of the various inventions captivate you?

9B: Patents (continued)

f. How can you recombine their ideas to improve on the solution to the original problem?

5. Students may find themselves stimulated by the ideas on the patent site. They may want to use others' ideas to improve upon their own design ideas and solutions. Encourage them to mingle their ideas and see what new and creative ideas they can come up with.

6. Students should not get discouraged if they find a patent of a similar idea to their design solution. Remind them that many patents are never made and that there are often slight differences in designs that seem similar.

Wrap Up
Students should be keeping detailed records in their design notebooks; be sure that they record any changes and additions throughout the process and date everything!

Have students read *9B Reading: Meet a Student Engineer*.

Follow With
Next, students explore *How Stuff Works* by visiting a Web site.

Patents

Handout: Session 9, Activity B

In this activity, you will become familiar with the U.S. Patent Web site (or the patent site for your country) and find inventions that are similar to your own ideas. Many times another solution can help you refine your own ideas.

Patent Search for a Problem or Idea

Go to the U.S. Patent and Trademark Web site, www.uspto.gov*.

1. We'll practice with the example of finding other solutions to the toothpaste problem. Click on *Patents*.

2. Click on *Search*, under *Patents* on the left side of the Web site.

3. Under *Issued Patent*, click on *Quick Search*.

4. Come up with key words to search. For example, in term 1, enter *toothpaste*, and in term 2 enter *cap*, and click on *Search*.

5. Your results: Notice the different patent titles that address toothpaste caps.

6. If you click on one of these, you'll find information about that patent design. Click on *images* at the bottom to see sketches of the idea. Explore each separate patent to find out about other inventors' approaches to problems and see that there are quite a variety of engineering solutions, materials, and design ideas to the same problem!

Patent Search for Your Design Solutions

1. Now that you are familiar with how to do a patent search, you can use the patent site for your own research on design solutions. This process will help you see if anyone else thought of an idea like yours, and if so, how those solutions are similar to or different from your ideas. It should also help you plan your solution. Here's how to do a search:

    a. Decide if you are going to conduct your search by the problem or solution.

    b. Come up with key words to search.

    c. Once you have some results, explore each separate patent to find out about other inventors' approaches to problems and see that there are quite a variety of engineering solutions, materials, and design ideas to the same problem!

    d. As you conduct the search, ask yourself the following questions:

        - How do other inventors view the nature of the problem?

9B Handout: Patents (continued)

- In looking at the various patents that are similar, are the inventors designing for the same "user"? How do the different solutions show that inventors may consider different aspects of a user's life, environment, and behaviors?
- What materials have other inventors used to address the problem?
- What do other inventors' sketches/designs look like? What are the similarities/differences in the design solutions?
- What components have other people used? Have they considered similar or very different components for their design solutions? Have they used the same essential components but arranged them in a different way?
- Do different parts of the various inventions captivate you? How can you recombine their ideas to improve on the solution to the original problem?

2. In your design notebook, describe any revisions on new ideas you have for your solution based on the patent site research.

Meet a Student Engineer

Reading: Session 9, Activity B

Ryan Patterson: "All Technology Should Be Assistive"
While he was still in high school, Ryan Patterson invented an electronic device to improve the lives of deaf and hearing-impaired people. His Sign Language Translator uses a golf glove equipped with wireless microprocessor circuitry to translate American Sign Language into letters that can be read on a small, portable handheld display screen, eliminating the need for a human interpreter.

Patterson says the idea came to him when he was watching a group of deaf people try to place an order at a fast-food restaurant. They needed an interpreter to translate American Sign Language so that the restaurant staff could understand them. Patterson saw an opportunity to harness technology to solve a communications challenge. "All technology should be assistive, if it's worth anything," he believes.

To make his idea work, Patterson embarked on a research and engineering project that required learning several computer programming languages and overcoming technical challenges that sometimes "felt like I was hitting a concrete wall."

It's all been worth the effort, he says. The invention earned Patterson top honors and generous college scholarships at prestigious science fairs, including the Intel International Science and Engineering Fair in 2001 and the Intel Science Talent Search in 2002. It also catapulted him into the media spotlight, including coverage in *People Magazine*, interviews with CNN, and a spot in the National Gallery for America's Young Inventors.

Currently an engineering student at the University of Colorado, Patterson continues using problem-solving strategies to solve new challenges and engineer new products. As an undergraduate, he has his own research laboratory outfitted with state-of-the-art equipment. "I feel like the luckiest person in the world," he says.

An Early Start
Patterson's interest in engineering goes way back. As a toddler, his favorite toys were extension cords and screwdrivers. By elementary school, he was asking questions about electricity that stumped his parents and teachers. A teacher recruited John McConnell, a retired particle physicist, to mentor the inquisitive young student. For the next seven years, the two spent nearly every Saturday working together in the mentor's workshop on projects that involved electronics and other technical fields.

For Patterson, those early experiences "helped me get a foundation in science." His mentor introduced him to technical concepts through hands-on activities, such as building robots and

9B Reading: Meet a Student Engineer (continued)

wiring electronic circuitry. McConnell was also modeling what it means to be a scientist, engaged in the process of asking questions and seeking answers.

By high school, Patterson was ready to work independently on his own research projects. His mentor was still there as a sounding board and supporter. For example, Patterson faced a host of technical challenges in making his glove device work. His mentor "taught me what a scientist does when he gets stuck: He researches, reads books, and consults experts. John taught me I could email experts, like the people who make chips or circuit boards, and ask them my technical questions. I went through the same cycle that a professional engineer would do."

One quality came instinctively, says the mentor. "Ryan has the tenacity to dig and dig and dig." McConnell says he could see that drive in the student the first time they met. "You could see he had that focus, that intensity. I said to myself, 'Wow! This kid is extraordinary.' I realized I had to do something to encourage him."

Value of Patience

As he has pursued college studies in engineering, Patterson has also come to appreciate the importance of patience. "It can take years of development before an idea is available for people to use," he says.

For now, work on his Sign Language Translator is on hold while Patterson tackles other problems. A current research project involves using a handheld device to assist persons with cognitive disabilities, such as brain damage, function more easily in daily life. "This could lead to an assistive technology that helps a person understand where he is, instead of having to rely on a caregiver," he explains.

What keeps Patterson motivated, whether he's studying for a tough engineering class or working on his next invention? "You do it for the love of it," he says simply. "Once you get a past a challenge, your confidence grows. It's just like being a mountain climber. Why do they keep at it? It's the same kind of thing for me."

Session 9, Activity C

How Stuff Works

Goal
Begin planning the development of the design project.

Outcome
Develop an initial idea of how to proceed on the design project.

Description
Students should now have their design solutions narrowed and begin thinking about how they are going to create their product. This activity will help them to begin to think about the systems, subsystems, parts, and components of their design. Using the Web site, *HowStuffWorks*, students learn about the parts and components of things. In an extension activity, they also examine parts catalogs that they might need.

Supplies

- Computers with Internet connections
- Optional: Parts catalogs

Preparation
None

Procedures
Sample Search on *HowStuffWorks*

1. Introduce junior engineers to *HowStuffWorks**, www.howstuffworks.com*. Explain that this Web site can help them understand how to make their idea happen, to get from "think" to "thing".

2. Walk them through an example of a mechanical toy using directions on their handout.

Your Own Search on *HowStuffWorks*

1. Students should now see that their pursuit of knowledge can be endless. Or, they can read what they need to know about torque or gears and get back to their own designs!

2. Before conducting a search, students should ask themselves the following questions:

    - What is my design similar to?
    - What are the different parts of my design?

9C: How Stuff Works (continued)

3. To conduct a search that will help them with their own designs, they can do the following:

    - If it is an adaptation to an existing product, search for the product. Learn about how the product is made, including the systems, components, and materials.
    - Search for a similar product and see how that is made.
    - If they are planning to make a change to a particular part of a product, search for the part (such as gears in the example) to learn more about that part.

4. Instruct them to search the site to learn more about how they might go about developing their design.

Optional Extension: Parts

1. Bring in some parts catalogs.

2. Have the students spend some time looking through the catalogs and identifying what parts are available for their designs. They can begin to generate a list of materials for their project.

Wrap Up
In small groups, students can share their ideas for design solutions and get feedback from one another. They should revisit their design brief and make notes and any changes necessary.

Introduce the Home Improvement activity, *Project Analysis*, where students carefully examine their solution ideas.

Follow With
In Session 10, *Bicycle Breakdown: Systems, Components, and Parts*, students learn more about parts and components as they meddle with bicycles.

How Stuff Works

Handout: Session 9, Activity C

In this activity, you will begin to plan the development process of your design. The Web site, *HowStuffWorks**, can help you learn about how things are made.

Sample Search on *HowStuffWorks*

1. Go to http://www.howstuffworks.com*.
2. Go directly to the left side of the page where it says Explore Stuff.
3. Let's say you want to build a mechanical toy, and that the toy will need wheels and gears, but at this point you know little about them.
4. Type *gear* into the *Search* field.
5. Notice that *HowStuffWorks* gives you results from the Web and from *HowStuffWorks*. For this activity, we will use results from *HowStuffWorks*.
6. At the bottom of the page, click on *Next*... and keep clicking on *Next*. You have a lot of results!
7. Perhaps you should narrow your search. But before you do, look through some of the results; the perfect link may be right on the first page, as the best matches to your search term are listed first. Even on the first page, you have quite a choice: *How Bicycles Work; How Gears Work; How Gear Ratios Work...*
8. Click on *How Gears Work*.
9. Notice the terms *gear reduction*, *power*, and *torque* link to more information. The amazing thing about the *HowStuffWorks* Web site is that you can delve as deeply as you wish into a subject area. Before you click on the next link, however, go to the end of this article and notice the *Table of Contents* area. You can click on a link related to *How Gears Work* and investigate the *Basics; Spur Gears, Helical Gears, Bevel Gears...*
10. Go back and click on *torque*.
11. What do you find here? Everything you may have wanted to know about torque, complete with illustrations. But if not, go to the end of the article and see the links.

Your Own Search on *HowStuffWorks*

1. Before conducting a search, ask yourself the following questions:
    - What is my design similar to?
    - What are the different systems or components of my design?

9C Handout: How Stuff Works (continued)

2. To conduct a search that will help you with your own design, do the following:

    - If it is an adaptation to an existing product, search for the product. Learn about how the product is made: the systems, components, and materials.
    - Search for a similar product and see how that is made.
    - If you are planning to make a change to a particular part of a product, search for the part (such as gears in the example) to learn more about that part.

3. Search the site to learn more about how you might go about developing your design.

4. Remember to take good notes in your design notebooks. Record keeping is very important in this process!

Project Analysis

Home Improvement: Session 9

Goal
To carefully examine solution ideas.

Description
Students review their solution and consider the feasibility from different angles such as safety, cost, and durability. They get feedback from other people about their solution.

Before Going Home
Tell students that they need to carefully examine their solution before proceeding to the next steps. They should be sure that their solution is feasible. It is not too late to revisit the other problems and/or solutions from the earlier sessions if they come across stumbling blocks. Encourage them to talk to as many people as possible about their idea. They will need to do testing throughout their project development to ensure that their project is safe, durable, and works the way they want it to.

Next Day
Students should be prepared to check in with the leader before moving ahead.

Project Analysis

Handout: Session 9, Home Improvement

Now that you have narrowed your design solution, you are ready for the second part of Step 5 of the design process: Refine Your Solution. Analyze the solution for cost, safety, and practicality. Give your design project more thought and answer the following questions about your design solution. You will need to do testing throughout your project development to ensure that your project is safe, durable, and works the way you want it to. Respond to the following questions in your design notebook.

1. Is my idea practical? If so, how?
2. Can it be made easily? How?
3. Is it as simple as possible? Explain.
4. Is it safe? How?
5. Is my product durable? Will it withstand use, or will it break easily? Explain.
6. Will it cost too much to make or use? Explain.
7. Is my idea really new? Explain.
8. Is my idea similar to something else? Explain.
9. Will people really use my product? How?

Now, survey your friends and family using these same questions and see what they think about your idea.