

# Technology

## STEM Challenge

BC Program Committee  
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# Chapter 1

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## Introduction

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- [About This Challenge](#)

Welcome to the new, updated Science, Technology, Engineering and Math Challenge from the BC Program Committee. This is a four-part challenge: one booklet, and one ribbon crest, for each of Science, Technology, Engineering and Math. Do just the parts that interest you, or tackle all four and proudly display the complete crest on your camp blanket.

The STEM Challenge is an update of the Science in a Box and Girls Exploring Technology (GET) challenges that were launched by the BC Program Committee several years ago. In the STEM Challenge booklets, you will find two or three categories of activities:

- **Replacement Activities.** Some of the activities in the original challenges are too complex for many groups to actually do; some require specific equipment that is difficult to find or no longer available; some are just so great that you've done them over and over. The Replacement Activities in the new STEM challenge provide fresh, new approaches to these activities.
- **New Activities.** Because you just can't get enough STEM, these activities provide a whole new set of things for you to experiment with.
- **Obsolete Activities:** In some cases, activities outlined in the older resources are just no longer workable for one reason or another. In these cases, we'll give you some suggestions for other things you can do instead.

As you work on the challenge, please remember: We'd love to hear from you! Please feel free to let us know what activities you've done and what you thought of the STEM Challenge.

Sincerely,

The BC Program Committee

BC Council



## About This Challenge

### Objectives

To have fun learning about computers, electronics and modern communications technologies.

### What's In the Technology Challenge?

One of the biggest challenges we faced in putting together this new STEM challenge was figuring out what should go into each part. There is a lot of overlap between science and technology, technology and engineering, and engineering and science—and of course, math is fundamental to all the other three. In desperation, we resorted to dictionary definitions to help us out: according to Merriam-Webster, technology is "the practical application of knowledge, especially in a particular area" or "a capability given by the practical application of knowledge". If you've read the Engineering booklet of this STEM challenge, you might notice that this definition is very much like the one Merriam and Webster gave us for engineering. The line between technology and engineering is very fuzzy indeed. So how did we decide what should go into this Technology booklet and what should go into the Engineering booklet?

Our rationale is largely arbitrary. In this Technology booklet, we've decided to focus on those aspects of technology that are commonly referred to as high technology: "scientific technology involving...sophisticated devices, especially in the fields of electronics and computers" (thanks again to Merriam-Webster for that definition). This part of the challenge therefore contains activities related to computers and other electronics, software, the Internet and modern communications technologies. Although several of these activities necessarily require the use of a computer, we have tried very hard to make it possible for a unit to earn the Technology crest without finding a laptop for everyone in the group. Several activities don't require computers at all; many of those that do can be done individually or in small groups, so girls can do them on a computer at home or school.



**Note:** A word about safety: if you (or your girls) are doing any of the activities that involve the Internet, make sure you are following the rules about privacy. Make sure parents are aware of and okay with what you're doing, remind the girls never to give out personal information, and be very careful not to publish details of where you are going for meetings, excursions, camps, etc. Remember that nothing on the Internet is ever private!

We hope you enjoy this Technology challenge. And if you're disappointed that it doesn't include space exploration, robotics, medical technology or any of the myriad other "capabilities given by the practical application of knowledge", just step on over to the Engineering booklet once you've finished this part of the STEM challenge!

### Earning the Crest

To earn the ribbon crest for this part of the STEM Challenge, you need to complete a specific number of activities, depending on your branch of Guiding. You can select these activities from this booklet, or you can choose activities from the original Science in a Box and GET challenge materials that are related to this part of the STEM Challenge. However, you are not limited to the activities in these resources! Feel free to use ideas from the Internet, books or magazines, other Guiders or people in your community, or any other resources.

The Program Committee has produced a variety of program resources that include STEM activities. Look for these resources in your District or on the [BC Girl Guides website](#):

- Eco-Pak booklet and CD
- CSI Challenge booklet
- Branch-specific Instant Meeting booklets

As long as the activities are challenging for your group and fit the objectives of this part of the STEM Challenge, go ahead and use them. (And if you come across something really cool, please let us know so we can add it to any future STEM-related challenges!)

## Required Activities

Branch	Number of Activities Required
Sparks	3
Brownies	4
Guides	5
Pathfinders	6
Rangers	8
Adults	8

## Ordering the Crest

When you have completed this portion of the challenge, you can order the crest by sending an email to the BC Program Committee at [program@bc-girlguides.org](mailto:program@bc-girlguides.org). Please specify which portion of the challenge you have completed and the number of crests you need. Please allow four to six weeks for delivery.

## A Word About Program Connections

Each activity in this booklet includes a list of program connections--areas of the girls' regular program that the STEM challenge meets the requirements for. These program connections are intended as guidelines to help you fit the STEM challenge into your regular program planning. In some cases, the challenge activity is very similar to an activity in the program area; in other cases, the challenge activity could be used as an alternative to activities mentioned in the program area. In all cases, remember that the girls' program is intended to be flexible: if an activity meets the objectives of the program area, and if it is interesting and challenging for the girls, by all means give them credit for it as part of their program requirements.

The lists of program connections is also not exhaustive. If you find another program area that is covered by an activity in this booklet, don't hesitate to give the girls credit for it.

You may notice that very few of the activities include explicit program connections for Rangers. The Ranger program encourages in-depth exploration of topics of interest. Many of the activities in this booklet, on the other hand, are relatively short and simple—so that busy Guiders can easily incorporate them into unit meetings—and offer only a very superficial taste of the subject matter. That makes it difficult to draw direct connections between these activities and the Ranger program. However, because the Ranger program is also very flexible and self-directed, Rangers can certainly take any of these activities and expand or combine them to meet the objectives of one of the program areas. Rangers who are working in units can also plan and lead any of these activities for younger girls.

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# Chapter 2

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## Replacement Activities

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- *Cyber-Safety*
- *Computer Jeopardy*
- *Dissect a Cell Phone*
- *Squeaky Clean*
- *E-cycling*
- *Hard Drive Maintenance*

The activities in this section are intended as replacements for or updates to activities in the Girls Exploring Technology (GET) and Science in a Box challenges.



# Cyber-Safety

This is not a new activity—it's an old activity that is so important to do that we've repeated it. If you haven't already discussed Internet safety with your group, we strongly recommend you do so before you jump into any of the Internet-related activities in this booklet. Pick the one(s) that appeal to you and your girls, or use them as suggestions for inventing your own activities.

## Replacement or update for:

- Science in a Box Experiment #24: Cyber-Sense Poem

## What you should know before you start:

If you need help starting a discussion on Internet safety, there are lots of resources available:

- The Science in a Box booklet includes an activity using the Cyber-Sense poem, which is appropriate for younger girls.
- The Cybercitizen Challenge on the national Girl Guides of Canada website ([www.girlguides.ca/challenges\\_and\\_activities](http://www.girlguides.ca/challenges_and_activities)) contains several activities that focus on online safety and privacy. It has activities that are appropriate for all age groups.

## What you need:

- As required for the activities you have chosen to do.

## What to do:

1. Select one or more activities from the resources available, or invent your own.
2. Make sure girls understand what personal information is, how to protect their privacy when online and what information is okay—and not okay—to put online.

## Program connections:

- Sparks: Exploring and Experimenting Keeper
- Brownies: Key to STEM (Information Technology is "IT" interest badge)
- Guides: Computer skills badge
- Pathfinders: Exploring a Theme (Web Surfin')

# Computer Jeopardy

This activity uses a Jeopardy-like game format to reinforce the girls' knowledge of the basic parts of a computer. No computers required for this game!

## Update for:

- GET Challenge activity #1: Getting to Know Your Computer

## What you should know before you start:

This game assumes the girls already have some basic experience with computers. If this is not a valid assumption for your group, you might want to plan a session beforehand to learn about the parts of a computer (perhaps with a guest speaker), then use this game as a fun way to review what the girls have learned.

You will need to create the questions for this game ahead of time. Use the questions in the tables below, or create your own. Write each question on one side of a sheet of paper (cardstock or construction paper work well); on the other side, write the point value of the question. Add an extra sheet for each category name. Don't put the answers on the sheets; keep them separate for reference when you are playing the game.

The standard Jeopardy game has 25 questions, five in each of five categories. You can use more or fewer questions or categories as needed to fit the time available.

## Computer Jeopardy Questions

### Category: Input Devices (Things We Use to Put Information Into a Computer)

Point Value	Question
100	You can use this input device to point and click. (A: mouse)
200	This input device can be connected to a computer to download photos you have taken. (A: digital camera)
300	Use this input device to record sounds, like your voice reading a story. (A: microphone)
400	This input device is used mostly for playing computer games. (A: joystick)
500	Use this input device to create an image of a paper document and save it on your computer. (A: scanner)

### Category: Output Devices (Things We Use to Get Information Out of a Computer)

Point Value	Question
100	This output device looks kind of like a TV screen (A: monitor)
200	You might use this output device to listen to music.

Point Value	Question
	(A: speakers)
300	You can use this output device to create a paper copy of your work. (A: printer)
400	A shiny circular output device that you can burn movies or music onto. (A: CD or DVD)
500	You might connect your computer to one of these to show a movie on a screen or white wall. (A: projector)

**Category: Computer Hardware (Components of a Computer System)**

Point Value	Question
100	This type of computer is small and lightweight, designed to be portable. (A: laptop)
200	This component is used for reading data from a CD. (A: CD-ROM drive)
300	This component sends information from a computer over a telephone line. (A: modem)
400	Often referred to as the computer's "brain", this component performs most of the computer's functions. (A: central processing unit, or CPU)
500	This type of connector, often used on printers, cameras and memory sticks, makes it easy to plug external devices into your computer. (A: USB, or Universal Serial Bus)

**Category: Computer Software (Programs that Run on a Computer)**

Point Value	Question
100	If you wanted to write a story for your English class, you could use this kind of program. (A: word processing program; e.g., Microsoft Word)
200	This kind of program is handy for sending electronic letters to your friends (A: email; e.g., Microsoft Outlook, Mac Mail)
300	If you wanted to surf the Internet, you could use this kind of program. (A: web browser; e.g. Internet Explorer, Firefox, Safari)
400	This kind of program is very useful if you have a lot of data that you need to do calculations on.

Point Value	Question
	(A: spreadsheet program; e.g., Microsoft Excel)
500	If you have a lot of information that you need to keep track of, you might want to use this kind of program.  (A: database program; e.g., Microsoft Access, Filemaker Pro)

**Category: Computer Abbreviations**

Point Value	Question
100	CD  (A: Compact Disc)
200	PC  (A: Personal Computer)
300	LOL  (A: Laugh Out Loud)
400	ROM  (A: Read-Only Memory)
500	LCD  (A: Liquid Crystal Display)

**What you need:**

- Question sheets.
- Tape
- Stopwatch or egg timer
- Two buzzers, bells or other noisemakers
- Extra paper and pen for keeping score

**What to do:**

1. Tape the question sheets, question side down, onto a wall or similar surface at your meeting location. Arrange them by category and point value as in the table above.
2. Divide the group into two equal teams. Give each team a buzzer or other noisemaker, or ask them to choose a noise they will make when they have figured out the answer to a question.
3. Flip a coin to see which team goes first. That team picks a category and point value (e.g., "Abbreviations for 500").
4. Turn over the chosen paper, read the question, and start the timer. Both teams try to figure out the answer to the question; when they have it, they sound their buzzer/noisemaker.
  - The first team to buzz gives their answer. In TV Jeopardy, answers must be in the form of a question (e.g., "What is a Liquid Crystal Display?"). It is up to you if you want to enforce this rule or not.
  - If the first team gives the correct answer, they win the point value of the question. If they answer incorrectly, the other team gets a chance to answer and win the point value of the question. Keep a running tally of each team's score.
  - The team that answers correctly gets to pick the next question.
  - If neither team answers correctly, nobody gets the points, and the team that picked the question gets to pick the again.

5. The team with the most points when all the questions have been answered wins.

**What else you can do with this:**

This activity can be easily adapted for younger girls, or girls who have little experience with computers, by using fewer questions and selecting questions that fit with the girls' level of knowledge.

**Program connections:**

- Sparks: Exploring and Experimenting Keeper
- Brownies: Key to STEM
- Guides: Computer Skills badge
- Pathfinders: Exploring a Theme (Computer Whiz)

## Dissect a Cell Phone

Ever wondered what's inside a cell phone? If you have an old one hanging around, try taking it apart!

### Replacement for:

- GET Challenge activity #2: Dissecting a Disk

### What you should know before you start:

Make sure the cell phone you are planning to take apart is an old one that nobody wants to use. It's theoretically possible to put it back together again, but let's not take the chance.

The instructions given here are very generic. Cell phones vary greatly in their design; some come apart very easily and others need considerable coaxing. Once you've got it open, you'll also find considerable variety in number, type and arrangement of the internal components. These instructions are intended to get you started, and if you want more information, try looking on the Internet. If you type "what's inside a cell phone" or "take cell phone apart" into a search engine, you'll get all sorts of information. You might even be able to find details on your particular brand and model of cell phone.

### What you need:

The tools you use will vary greatly depending on the type of cell phone you are dissecting. As a general idea, though, you'll need:

- Old, unwanted cell phone
- Small jeweller's screwdriver, of the type that will fit into the screws holding your cell phone together
- Thin, strong prying device, like a guitar plectrum or credit card
- Computer with an Internet connection (optional, but handy for finding information about what's inside your cell phone)

### What to do:

1. Make sure the cell phone is truly unwanted. Don't just assume that your older brother never plans to use his cell phone again.
2. Turn the cell phone off and remove the battery. The battery compartment is usually at the back of the phone, under a cover that can be slid off or lifted up without removing any screws.
3. You will probably find the phone's SIM card underneath the battery (you might need to peel off a label to find it). It's shiny and gold-coloured, usually.



**Note:** SIM stands for Subscriber Identity Module. The SIM card stores a special key code that uniquely identifies the cell phone user.

4. Use a small screwdriver to remove the screws holding the cell phone together. At this point, you should be able to take the whole phone apart; you may need to do some prying. See how many of these components you can identify:
  - Printed Circuit Board
  - Microphone
  - Antenna
  - Speaker
  - LCD (Liquid Crystal Display) screen
  - Keyboard
  - Camera
5. When you are finished investigating your phone, see if you can put it back together, then wash your hands with soap and water. Recycle the remains of the phone (see [E-cycling](#)).

## What's inside a cell phone:

**Printed Circuit Board (PCB):** This is usually green, sometimes black. The brains of the phone, the PCB carries a large number of electronic devices: small, flat black packages, often with lots of silver legs called pins sticking out from them (although some have the pins hidden underneath). Can you see little gold lines criss-crossing the PCB? Those are tiny wires connecting the electronics together.

What are some of the electronics on the printed circuit board? Most of the electronics will have part numbers stamped on top. If you have a computer with an Internet connection, you can enter the part numbers in a search engine and find out exactly what each device is. You should be able to identify:

- **Analog-to-Digital Converter (ADC):** When you talk, the pattern of sounds and silence coming out of your mouth is called an *analog* signal: it is continuous, and it can be loud or soft, high-pitched or low-pitched. But most electronic devices are *digital*: they understand only two values, 1 and 0. Therefore, before your cell phone can do anything with the sound of your voice, it must first convert it to a series of 1s and 0s. This is the job of the analog-to-digital converter. It generates a complex code, using only 1s and 0s, that completely encodes all the aspects of your voice. Sound impossible? Think of Morse code. It uses only two values ("dot" and "dash"), yet you can combine those values into an infinite number of complicated messages.
- **Digital-to-Analog Converter (DAC):** This is the partner of the ADC. When you talk to your friend on the phone, her voice arrives at your cell phone as a string of 1s and 0s (thanks to the ADC on her phone). But your ear wouldn't know what to do with that—it's designed to interpret the sounds in a human voice, and a string of 1s and 0s would be gibberish. So your phone has a digital-to-analog converter that converts that string of 1s and 0s back into a human voice, so that your ear can understand it.
- **Digital Signal Processor (DSP):** Once your voice has been turned into digital form, it has to be processed so that it can be transmitted and received properly. Any interference or extra noise has to be removed; it might need to be encrypted; parts of it might need to be amplified. All this processing must be done very, very quickly—otherwise, the person you're talking to will hear pauses in the conversation. The digital signal processor is a very specialized little computer that has been carefully designed to do all this processing in a very short time.
- **Microprocessor:** This is another computer chip. Unlike the digital signal processor, it is not usually very specialized. It doesn't have to be. It handles all the computer work that doesn't need to be done quickly, like storing all the phone numbers you've programmed into your phone and remembering the ring tone you've chosen.

**Microphone:** A small round device that looks something like a button, the microphone is usually located at the bottom of the phone. When you talk, the microphone picks up your voice and sends it to the analog-to-digital converter on the printed circuit board.

**Antenna:** Depending on the model of phone you have, the antenna might be easy to spot—a long straight piece, perhaps that can be slid in and out, sticking out from the top of the phone—or it might be a tiny wire built in to the case of the phone itself. In either case, the antenna is where your voice gets sent off into the air, after it has been converted and processed into a digital signal. The antenna is also where your friend's voice gets picked up so that it can be processed and converted into an analog signal that you can hear.

**Speaker:** A small, flattish, round or oblong device near the top of the phone. After your friend's voice has been received by the antenna, processed by the digital signal processor, and converted back to an analog human voice by the digital-to-analog converter, the speaker amplifies it so that your ear can hear what she said.

**LCD (Liquid Crystal Display):** The thing you read your text messages on.

**Keyboard:** Depending on the type of phone you have, the keyboard might be just a number pad, or it might be a full text keyboard.

**Camera:** If your phone is a camera phone, see if you can identify the camera. It will be small and round, and tucked into a little hole in the case of the cell phone.

## Program connections:

- Sparks: Exploring and Experimenting Keeper
- Brownies: Key to STEM
- Guides: Beyond You (Try New Things); Engineering badge
- Pathfinders: Exploring a Theme (Everything Comes from STEM)

## Squeaky Clean

Cleaning your computer is an important part of keeping it in good working condition. Otherwise, accumulated dust and dirt can damage components or cause the computer to overheat.

### Update for:

- GET Challenge activity #3: A Clean Computer is a Happy Computer

### What you should know before you start:

When cleaning your computer, make sure you keep liquids well away from it. Put liquids onto a cloth or cotton swab, then use the cloth or cotton swab to wipe the computer—DON'T spray liquids directly onto the computer.

Although cleaning the inside of the case is important, we don't recommend you open up the case of the computer to clean inside it, unless you know what you are doing or have a knowledgeable person helping you. If you touch something inside the computer you could give it a static shock, which can damage components or cause data to be lost.

If the user manual for your computer provides any guidelines or instructions for cleaning the computer, follow them.

### What you need:

- A PC in need of cleaning
- Clean, lint-free cloths
- Rubbing alcohol
- Cotton swabs (such as Q-tips; don't use cotton balls)
- Can of compressed air (available from electronics shops or family department stores)
- Small brush
- Warm soapy water
- Spray bottle of clear water

### What to do:

1. Turn off the computer and unplug all the cords. You might want to make a note of where everything is connected, so that you can put it back together again when you are finished.
2. Gently wipe away any dust that has gathered on top of the computer case and in the vents or cooling fan.
3. Dip a cotton swab in the rubbing alcohol so that it is damp; if it is very wet, give it a little squeeze to squeeze out the excess rubbing alcohol. Carefully wipe it around all the openings on the back of the computer case. Go around them all again with a dry cotton swab.



**Note:** Rubbing alcohol is poisonous. Don't drink it, and don't leave it where pets or small children might get into it.

4. Turn the keyboard upside down and gently shake out any crumbs, dirt and accumulated dust.
5. Using a can of compressed air or your lungs, blow all around the keys to remove any additional dust. If you have a small brush, use it to gently sweep dust away from the keys.
6. Dip a clean, lint-free cloth in rubbing alcohol and wring it so that it is only slightly damp. Wipe the outside of the mouse clean.
7. If you have a mechanical mouse (the kind with the ball inside) open it up by turning the plastic ring on the bottom counter-clockwise. Take out the ball and wash it in warm soapy water. You might need to use your fingernail to scrape off any really stubborn gunk. Dry the ball thoroughly.
8. Moisten a cotton swab with clear water and clean the rollers inside the mouse. Dry all the parts of the mouse thoroughly and put it back together.
9. To clean the monitor, gently wipe off any dust that has accumulated on the top and sides of the monitor. Gently wipe the screen with a clean, soft, dry lint-free cloth.



**Note:** DON'T use any alcohol or ammonia-based cleaners on the screen, unless your owner's manual specifically says it is okay to do so.



**Note:** Don't use paper towels or coarse cloths to clean the screen—you could scratch it.



**Note:** LCD screens (flat-screen monitors/TVs, laptop screens) are very sensitive. Be very gentle when cleaning these screens. If a dry cloth doesn't get all the grime off, look for special LCD cleaning solutions at your local computer shop.

**10.** When all the components are completely dry, plug everything back in the way it was when you started.

**Program connections:**

- Brownies: Key to STEM
- Guides: Computer Skills badge
- Pathfinders: Exploring a Theme (Computer Whiz)

## E-cycling

We go through a lot of electronic devices. Many people replace cell phones, laptops, TVs, gaming consoles and personal music players pretty frequently, and all that electronic waste in landfills is a big problem. The components inside those electronic devices often contain serious pollutants, like lead; incinerating them releases heavy metals, dioxins and toxic acids into the environment.

So what can a Girl Guide do to help solve the problem? The first step, of course, is not to replace things if you don't have to. Do you really need a new cell phone or a bigger TV? Can you get by with the one you already have, or even with none at all? The less you buy, the less you need to dispose of. Secondly, if your electronics really do need dumping, don't just pitch them into the landfill—recycle them!

### Update for:

- GET Challenge activity #4: Computer Recycling

### What you should know before you start:

For information on electronics recycling in your community, check your local phone book or contact your City Hall/regional district. You can also try the following resources for information on dropping off used electronics as well as general information about reusing and recycling electronics and other items:

- Electronic Recycling Association ([www.era.ca](http://www.era.ca))
- Encorp Return-It! Electronics ([www.encorp.ca/electronics](http://www.encorp.ca/electronics))
- Computers for Schools ([www.ic.gc.ca/eic/site/cfs-ope.nsf/eng/Home](http://www.ic.gc.ca/eic/site/cfs-ope.nsf/eng/Home))
- Recycle My Cell ([www.recyclemycell.ca/overview.php](http://www.recyclemycell.ca/overview.php))
- Recycling Council of BC (<http://rcbc.bc.ca>)
- The website of the manufacturer of your electronic device; many major ones have some sort of recycling program

### What you need:

- Community resources information (phone book, computer with an Internet connection, knowledgeable person)

### What to do:

There are a variety of activities you could do to learn about the need for recycling electronics and how and where to do it in your community. These are suggestions; pick and choose or add your own to plan a meeting that fits your needs.

1. Find out where in your community you can recycle electronics.
2. Learn about how electronics are recycled. Consider taking a field trip to a recycling facility or bringing in a guest speaker. Can you find someone who can break down a computer or other electronic device at your meeting and talk about all the components and how they are recycled?
3. Collect old cellphones and donate them to a charity of your choice (e.g., Red Cross, Canadian Diabetes Association; check out Charitable Recycling ([www.charitablerecycling.ca](http://www.charitablerecycling.ca)) if you need suggestions.)
4. Collect old cellphones to raise funds for a Guiding project (e.g., camp maintenance, international trip, etc.) Be sure to follow the guidelines for fundraising and financial management. Check out Charitable Recycling ([www.charitablerecycling.ca](http://www.charitablerecycling.ca)) or CellCycle ([www.cellcycle.ca](http://www.cellcycle.ca)) for information.

### Program connections:

- Sparks: Exploring and Experimenting Keeper; In My Community Keeper
- Brownies: Key to STEM; Key to My Community
- Guides: You in Guiding (Be Involved in Your Community); Recycling badge
- Pathfinders: Exploring a Theme (Our Environment)
- Rangers: Environment, Outdoors and Camping (Reduce, Reuse, Recycle)

# Hard Drive Maintenance

The hard drive is one of the most critical components in your computer—that's where all your programs, your security software, your school projects, your photos and music are stored. But it needs help to do its job properly. Without regular maintenance, your hard drive will run more slowly than necessary, and it might even crash. Fortunately, there are some simple steps you can take to help keep your hard drive in peak operating condition.

## Replacement or update for:

- GET Challenge activity #8: Maintaining Your Hard Drive

## What you should know before you start:

The instructions given here are for computers running Windows 7 and Windows XP. The procedures are very similar for other versions of Windows, but if you need help, try the built-in help for your operating system or look for directions on the Internet.

## What you need:

- A computer running Windows

## What to do:

### Step 1: Clean Up Your Hard Drive

Over time, your hard drive collects all sorts of things you don't really need: temporary files downloaded from the Internet, optional Windows components that you never use, stuff in the recycling bin, and so on. Every so often you should clear out all this junk so that you have plenty of space for the things you do use. Windows provides a Disk Cleanup utility to make it easier.

1. Click the **Start** menu (at the bottom right corner of your screen; in Windows 7 it is the four-colour Windows logo).
2. Click **All Programs**, then **Accessories** and **System Tools**; select **Disk Cleanup**.
3. If you have more than one drive, a dialog box appears so that you can select the one to clean up. The Disk Cleanup utility calculates how much space you can clear up on that drive, and shows a list of files that can be removed.



**Note:** You can see more options by clicking the **Clean up system files** button. This will let you remove system files and programs that you don't use. However, unless you are absolutely sure what a file or program is for, we recommend that you don't delete it.

4. Select the files you want to remove and click **OK**. You'll see another dialog box asking you to confirm that you really want to delete the files, then the Disk Cleanup utility will go ahead and remove them.

### Step 2: Check Your Hard Drive for Errors

As you use your computer, the hard drive can develop bad sectors (parts of the hard drive where data is stored). That slows down the hard drive and makes it harder to save files and retrieve them later. The Error Checking utility (called ScanDisk in earlier versions of Windows) checks the hard drive for errors, bad sectors, and misplaced files. Run this utility fairly often (once a week, if you use your computer every day). It can take quite a while, so choose a time when nobody needs the computer.

1. Close all files and applications.
2. On the desktop, double-click **Computer** or **My Computer** (different computer systems use different words). A dialog box will appear with a list of all the disk drives on your computer. The main one is usually called C:, but there may be others as well.
3. Right-click the drive you want to check for errors and click **Properties** on the pop-up menu.
4. In the **Properties** dialog box, select the **Tools** tab, then click the **Check now...** button in the Error-checking section.
5. In the Check Disk dialog box, select Scan for and attempt recovery of bad sectors.



**Note:** You should only select Automatically fix file system errors if you already think that your hard drive has bad sectors. If you select this option, you'll be prompted to schedule the Check Disk utility at a time when you can restart your computer.

6. If the Check Disk utility finds any bad sectors, choose to fix them.

### Step 3: Defragment Your Hard Drive

When you save documents, pictures, movies or music to your hard drive, you might think that each new file is placed next to the last one on the hard drive, like you would put documents into a filing cabinet. It might start out that way, but it doesn't last. Over time, as files on the hard drive are modified or deleted, blank spaces appear in between them and the hard drive starts splitting new files up and storing the pieces in different locations. This is called fragmentation, and it makes the hard drive work very hard to find all the pieces and put them together again when you want to open the file. Running the Disk Defragmentation utility regularly (once a month is usually appropriate) can help avoid problems. Like the Error Checking utility, Disk Defragmenter can take a long time to run, so choose a time when nobody needs the computer.

1. Close all files and programs.
2. Click the **Start** menu (at the bottom right corner of your screen; in Windows 7 it is a button with the four-colour Windows logo).
3. Click **All Programs**, then **Accessories** and **System Tools**; select **Disk Defragmenter**.
4. In the **Disk Defragmenter** dialog box, select the disk drive you want to defragment, then click **Analyze** or **Analyze disk** (again, different computer systems use different words).
5. The Disk Defragmenter utility will tell you how fragmented your hard drive is. If it is more than 10%, click **Defragment** or **Defragment disk** to fix it.

### Step 4: Back Up Your Hard Drive

Even with proper care and maintenance, hard drives can fail. Mechanical components break, storms cause power surges, laptops get knocked off tables, and viruses come from everywhere to infect your computer and render it unusable. When things like this happen, chances are good that you will lose everything stored on your hard drive. If you're okay with that, feel free to skip this step. If not, you must back up your hard drive regularly and often. How often? For most users, once a week, plus immediately after you make important changes to your computer (for example, after you download 300 summer camp photos from your camera).

Each version of Windows has a slightly different process for backing up the hard drive, and the process for your first backup is different than for subsequent ones. Therefore, we are not going to attempt detailed, step-by-step instructions here. However, the backup utilities are pretty easy to use. The steps given here will get you started, and the utilities themselves will guide you the rest of the way.

1. Decide where you want to store your backup. On the computer itself is not a good place. Use DVDs or an external hard drive. DVDs are cheap, but slow, and very often there is not enough space on one DVD for the entire backup. A better (but more expensive) option is to buy an external hard drive to use just for your backups. They start at around \$100, but they are much faster and easier for backups than DVDs.
2. Start the backup utility:
  - In Windows 7, on the desktop, double-click **Computer**. Right-click the drive you want to back up and click **Properties** on the pop-up menu. Select the **Tools** tab, then click the **Backup now...** button in the Backup section
  - In Windows XP, click the **Start** menu, then **All Programs**, then **Accessories** and **System Tools**; select **Backup**.
  - Follow the prompts to set up a backup and schedule regular backups.
3. When you are asked what you would like to back up, the best option is to let Windows choose and back up everything. That way, the backup will include all your installed software, your preferences, and so on, as well as your personal files. It is much easier to restore your system to the way it was if you have backed up everything.
4. Set a schedule for automatically backing up your hard drive at a convenient time. A backup is only useful if it's recent, so schedule it to run at least once a week—more often if you are doing critical work that you can't afford to lose.

### Program connections:

- Brownies: Key to STEM

- Guides: Computer Skills badge
- Pathfinders: Exploring a Theme (Computer Whiz)



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# Chapter

# 3

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## New Activities

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- *Fibre-Optic Water*
- *Start a Blog*
- *Peanut-Butter-and-Banana Transistors*
- *Logical Obstacle Course*
- *Write a Program from Scratch!*
- *Cell Phone Relay*

This is a selection of new activities for you to try.



## Fibre-Optic Water

In many areas, communication networks make use of optical fibres—thin glass "wires", or fibres, that carry information in the form of flashes of light. But how does light travel through the glass fibres? Find out in this experiment.

### What you need:

- Small glass jar (like a small olive jar, for example) with a metal or plastic lid
- Hammer
- Large nail
- Duct tape
- Small, bright flash light (e.g., mag light)
- Water
- Large bowl

### What to do:

1. Take the lid off the jar. With the hammer and nail, carefully punch two holes in the top of the lid: a small one near one side, and a larger one opposite it.



**Note:** Be careful doing this; ask an adult for help if you need it.

2. Using the duct tape, firmly tape the flashlight to the outside of the bottom of the jar, so that when it is turned on it will shine up through the jar.
3. Cover the rest of the jar with duct tape, leaving just enough room at the top to get the lid back on. You don't want any light to appear through the sides or bottom of the jar.
4. Fill the jar about  $\frac{2}{3}$  full of water, then turn out the lights in the room.
5. Turn on the flashlight and let the light shine through the open jar onto the ceiling. Notice how it is all "splasy" and disorganized.
6. Put the lid on the jar tightly. Hold the jar over the bowl and carefully tilt the jar so that water runs out of the large hole in the lid in a smooth, steady stream. (The small hole lets air in so that the water can run out smoothly.)
7. Look carefully at the stream of water. Can you see the light inside it? Do you see light spilling out of the stream of water and hitting, say, the wall? Put a finger under the stream. Do you see a tidy dot of light on your finger?

### How it works:

If the water is coming out in a smooth, steady stream, you should be able to see light inside it, but not spilling out all over the place. This is because of an effect called *total internal reflection*: the light would like to escape from the water and go all over, but every time it gets to the boundary between the water and the air, it reflects back into the water. The water-air boundary acts like a mirror that keeps the light trapped inside the stream of water. The light bounces along inside the water until it reaches the end of the stream—where, if you put your finger there, you will see a little, bright dot of light where the light has come out of the water.

Optical fibre works in exactly the same way, except that it is made of glass, not water. Light is sent along the fibre in a series of flashes, or pulses, that carry a coded message—much like you might use a flashlight to send a Morse-code message. A detector at the other end of the optical fibre detects the pulses of light and decodes the message.

### Program connections:

- Sparks: Exploring and Experimenting Keeper
- Brownies: Key to STEM
- Guides: Physics badge; Science badge
- Pathfinders: Exploring a Theme (Everything Comes from STEM)

## Start a Blog

A blog, or "weblog", is basically an online journal: it's a place for you to write about your day, your thoughts or your interests. This can be an individual project or a unit project.

### What you should know before you start:

Remember the rules about safety on the Internet: never give out personal information, never post details of where you will be at specific times, and make sure your parents are aware of and okay with what you are putting in your blog. The blogging service providers mentioned here provide security options that let you limit who can read your blog; however, even secure sites can be hacked, and once your information is out there, you can't take it back. Never assume that something you post online is private.

Before you sign up for an account with a blogging service provider (or any other online organization, for that matter) make sure you read the Terms of Service and Privacy Statement. If you don't agree with anything in these documents, don't sign up for an account.

### What you need:

- A computer with an Internet connection
- An email address (required by most blogging service providers when you sign up for an account)

### What to do:

1. Decide what you are going to write about. Personal blogs usually follow a particular theme or subject area. You might blog about a trip, Guides, your favourite foods, whatever. Pick something you are interested in and/or knowledgeable about.
2. Choose a blogging service provider. This is an online company that provides you with webspace for posting your blog. You sign up for the service, choose a colour scheme and layout for your blog, and write your thoughts. There are several blogging providers that will provide the service for free. These ones offer security options that let you limit the people who can read your blogs to just you, just selected "friends" or the world at large.
  - LiveJournal ([www.livejournal.com](http://www.livejournal.com)). The most popular blogging provider for personal blogs.
  - WordPress.com ([www.wordpress.com](http://www.wordpress.com)). Also offers an online tutorial that walks you through the processes of signing up for an account, setting up your blog and writing your posts. Don't confuse the website with the software called WordPress, which is blogging software that you download to your computer.
  - Blogger ([www.blogger.com](http://www.blogger.com)). Another popular blogging provider for personal blogs.
3. Start writing! You might want to add new entries to your blog once a week or once a day--whatever works for you and the theme you've chosen.

### Program connections:

- Brownies: Key to STEM
- Guides: You and Others (Build Skills in Communication); Business Communication badge; Computer Skills badge
- Pathfinders: Exploring a Theme (Computer Whiz, Web Surfin')
- Rangers: Community Connections

## Peanut-Butter-and-Banana Transistors

At the heart of every electronic gadget is a special little device called a transistor--actually, millions of them, switching on and off thousands of times a second. Try this experiment to find out what a transistor looks like and how it works.

### What you should know before you start:

A transistor is a little electronic device that is used to amplify and switch electric currents. Transistors are made of *semiconductors*: materials that sort of conduct electricity (as opposed to *conductors*, like copper, which really conduct electricity, or *insulators*, like resin, which don't conduct electricity at all). Semiconductors can be made to conduct electricity reasonably well at certain times, or hardly at all at other times.

This recipe makes four transistors. Increase the quantities as required. Some bananas are straighter than others; this recipe works better with straight bananas than with really curved ones.

### What you need:

- Banana
- 8 chocolate wafers (the melting kind you use for s'mores)
- Peanut butter
- 2 graham crackers, cut in half

### What to do:

1. Cut the banana in half crosswise, then cut each half lengthwise into two pieces. Set them flat-side up on a plate.
2. Gently press two chocolate wafers, flat side up, into the top of each banana piece. They should be about 4 cm apart (or just slightly less than the length of half a graham cracker).
3. Spread a thick layer of peanut butter on the banana between the chocolate wafers.
4. Set half a graham cracker on top of the peanut butter, pressing it down gently so it sticks. The cracker should overlap the two chocolate wafers slightly. Your PB&B transistor is finished, but before you eat it, take a moment to learn how it works.

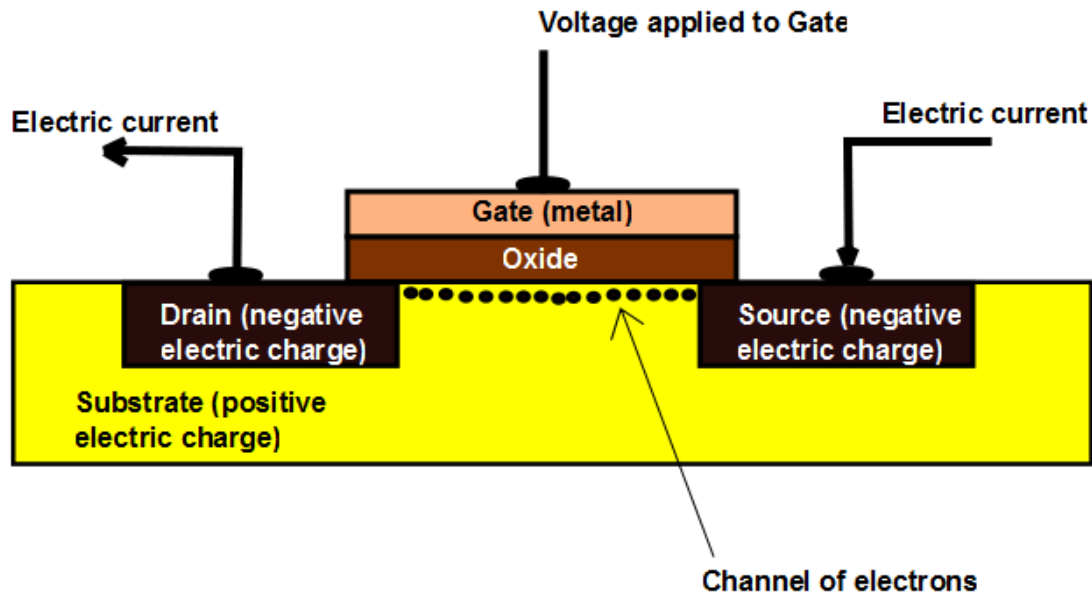
### How it works:

Your banana is a model of a particular kind of transistor. To make this kind, technologists start with a *substrate*, or base (the banana, in our model). The substrate is made from a semiconductor that carries a positive static charge. Electrons, which are little packets of electric charge, are negatively charged. So that means a positively-charged substrate is missing some of its electrons. (But not all of them—there are still some electrons in the substrate that can move around. That will be important to remember in a moment when we talk about how transistors work.)

Next, the technologists outline a couple of regions of the substrate in which to change the static charge from positive to negative. This process, called *doping*, involves shooting a different kind of semiconductor, one with a negative static charge, into the substrate. We've modelled this by pressing the chocolate wafers into the banana substrate. Then the technologists put a layer of insulator, called an *oxide*, on top of the substrate between the negative regions. That's our peanut butter. Finally, they put a metal layer (our graham cracker) on top of the oxide. This is called the *gate*. The finished transistor looks a little like an uneven sandwich: metal, oxide, and semiconductor. Consequently, this type of transistor is called a MOS transistor.

Well, that's great; now you know how it's built. But how does it work? What does it actually do?

As mentioned, transistors are used to switch electric currents on and off. In an electric circuit, a voltage is applied to the Gate. When that happens, electrons from the substrate are pulled up through the substrate toward the Gate. They can't get through the oxide layer (insulators can't conduct electricity), so they collect just below it, between the Source and the Drain. That makes a channel of electrons between the Source and the Drain. An electric current, which is really just a stream of electrons, can now flow all the way through the transistor. The Gate voltage opens and closes the transistor: when the Gate voltage is on, the transistor is open and current can flow. When the Gate voltage is off, the transistor is closed and current can't flow.



By itself, that might not seem like much. But when lots of transistors are combined in a circuit, all switching on and off at specific times, they can do all sorts of interesting things. Transistor circuits are the brains of your laptop, your cellphone, your iPod, your DS, your microwave, your car, your calculator....

**Program connections:**

- Sparks: Exploring and Experimenting Keeper
- Brownies: Key to STEM
- Guides: Beyond You (Try New Things); Engineering badge; Science badge
- Pathfinders: Exploring a Theme (Everything Comes from STEM)

## Logical Obstacle Course

Use the principles of some very simple electronic devices in an obstacle course relay race.

### What you should know before you start:

Electronic devices are made up of many (thousands, or even millions) of simple devices called logic gates. A logic gate looks at one or more inputs and, depending on whether the inputs are true or false, decides what the output should be. But what do "true" and "false" mean to electronic devices? When you make a decision, you think about all sorts of complex ideas: for example, if you are trying to decide what to have for dinner, your thoughts might run something like this: "I really like macaroni and cheese. Do we have any? Yes, there it is in the back of the fridge. Is there enough? No, there isn't very much, and I'm starving. Is there something else in here that I like? Hmm...pizza. But I had that for lunch, so maybe something different for a change."

Electronic logic gates don't think that way. For them, the only thing to consider is, "Is there an electric voltage on this input?" If a voltage is there, the input is true. If no voltage is there, the input is false. Depending on the type of gate, the conditions on the inputs determine whether the output is true (has a voltage) or false (no voltage).

Mathematically, these conditions are represented as 1 or 0: 1 is true and 0 is false. In this obstacle course game, we'll make it even simpler, using playing cards. A red card is "true", a black one is "false".

This game uses two types of logic gates: an AND gate and an OR gate. (The names are always written in capitals—otherwise, it would be too hard to tell them apart from the regular words "and" and "or" in our language.) Both of our logic gates have two inputs, A and B, and one output.

### AND Gate

An AND gate makes the output true (red, in our game) only if *both* the inputs are true. If one of the inputs is false (black), the output is also false (black).

A	B	Output
Black	Black	Black
Red	Black	Black
Black	Red	Black
Red	Red	Red

In a logic diagram or circuit schematic, an AND gate is drawn like this:



### OR Gate

An OR gate makes the output true (red) if *either* of the inputs is true. The output is only false (black) if both the inputs are false.

A	B	Output
Black	Black	Black
Red	Black	Red
Black	Red	Red
Red	Red	Red

In a logic diagram or circuit schematic, an OR gate is drawn like this:



**What you need:**

- Variety of objects for setting up an obstacle course (hula hoops to spin, beanbags to toss in a bucket, clothes to put on, balls to juggle, etc.)
- Two large sheets of poster board or construction paper
- Large marker
- Two decks of playing cards, well-shuffled

**What to do:**

1. Set up your obstacle course. It can be as long or short as you like, but you will need two paths (one for each of two relay teams).
2. Draw an AND gate on one of the sheets of poster board and place it at the beginning of the obstacle course. Draw an OR gate on the other sheet and place it at the end of the obstacle course.
3. Split each deck of cards into two equal stacks. Set two stacks at the beginning of the obstacle course and the other two at the end.
4. Select two girls (or leaders) to be the AND and OR gates. You might want to pin the pictures of the gates onto their shirts, or hang them around their shoulders with a loop of ribbon.
5. Divide the girls into two equal teams, and give each team a stack of cards. Have the teams line up at the beginning of the obstacle course with their stack of cards on the floor in front of them.
6. The first girl in each team takes the top card from her stack and shows it to the AND gate. The AND gate will only let the girls go if they both have red cards. If a girl has a black (false) card, she must take another card from the stack until she gets a red one. When both inputs are red (true), the AND gate says "True!" and lets the girls go through the obstacle course.
7. When the girls get to the end of the obstacle course, they take the top card from the stack at the end and show it to the OR gate. If a girl has a red (true) card, the OR gate says "True!" and lets her run back to her team. If a girl has a black card, she must take another card.
8. When one of the girls arrives back at her team, the next girl in each team picks a card from her stack and the relay continues.

**Program connections:**

- Sparks: Exploring and Experimenting Keeper
- Brownies: Key to STEM; Key to Active Living
- Guides: Beyond You (Try New Things); Engineering badge
- Pathfinders: Exploring a Theme (Everything Comes from STEM)

## Write a Program from Scratch!

Scratch is a programming language that lets you create interactive stories, animations, games, music and art. It's a fun way to learn some basic programming concepts, and it helps you learn to think creatively, reason systematically and work collaboratively.

### What you should know before you start:

Scratch is a free software program developed by MIT that you can download from the Internet. To learn all about it, go to the Scratch website (<http://scratch.mit.edu>). There are lots of examples of projects people have created using Scratch, and lots of help for you to get started.

When you go to the download page (<http://scratch.mit.edu/download>), there is a form asking for all sorts of information; you do not have to fill in any of it to download the software. Just scroll down to the bottom of the page and click the **Continue to Scratch download** button.

If you want to, you can

### What you need:

- A computer with an internet connection

### What to do:

1. If you haven't already done so, download Scratch software (<http://scratch.mit.edu/download>) and install it on your computer.



**Note:** Check with your parents before you do this. Scratch is a well-known, non-malicious program, but it is always a good idea to make sure your parents are okay with anything you want to download.

2. Follow the instructions in the Getting Started guide ([http://info.scratch.mit.edu/Support/Get\\_Started](http://info.scratch.mit.edu/Support/Get_Started)) to create your first simple project: making a cat dance on your screen.



**Note:** The Scratch software and website give you the option of creating an account and sharing your projects with other Scratch programmers. If you want to do this, and if your parents are okay with it, go ahead. But it is optional: if you would rather not sign up for an account and share your projects, you don't have to.

3. Once you have the hang of programming with Scratch, make your own creative animation project. The Scratch website has lots of resources to help you out. For a good place to start, check out the Scratch Reference Guide on the Support page (<http://info.scratch.mit.edu/Support>)

### What else you can do with this:

If several girls in your unit are interested in creating their own projects, plan a Scratch Movie night. Each girl who wants to creates a short animation project, burns it onto a DVD and brings it in to the meeting. Make popcorn and watch all the Scratch movies (use a TV/DVD player or laptop, or try to borrow an LCD projector). If you want, nominate the best movies for your very own Scratch Oscar awards.

### Program connections:

- Sparks: Exploring and Experimenting Keeper
- Brownies: Key to STEM
- Guides: Art Production badge; Computer Skills badge
- Pathfinders: My Music, My Movies, and More! (Movie Mania, The Arts from A to Z); Exploring a Theme (Computer Whiz)
- Rangers: Explore Your Creativity

## Cell Phone Relay

This game models a cellular phone network. Several people who are making phone calls move around an area, and as they go, their phone calls are passed from one cellular tower to another. How many people can be talking at the same time before calls start getting dropped?

This game is best for larger groups, but it will work with smaller groups as well.

### What you should know before you start:

In this game, everything is a model for a something in a real cell phone network:

- Girls who are Talkers represent people talking on cell phones. In this game, as in real life, the Talkers move around while they are on the phone. The cellular network has to keep track of which phone call is coming from which Talker and of where the Talkers are.
- The batons carried by the Talkers represent the phone calls. There is one phone call for each Talker, and the Talkers have a flag that matches their batons to make it easy to match the "phone calls" up with the right Talker.
- Girls who are Towers represent a network of cell phone towers, which transmit calls from cell phones over radio waves. Each tower can only transmit over a fairly small area, represented by the arms' reach of the Tower girls. As a person talking on a cell phone moves around, her phone call is passed, or handed off, from one tower to the next. A tricky part of designing a cellular phone network is making those hand-offs without interrupting the phone call.

A key goal of any cellular network is to drop as few calls as possible. How many of the phone calls on your network are dropped? How does this compare to the number of Talkers?

### What you need:

- Batons, ribbons or bean bags in different colours
- Flags, shirts, ribbons or scarves to match the batons

### What to do:

1. Divide the girls up into two teams, "Towers" and "Talkers". Start with lots of Towers and only a couple of Talkers, but once everyone has the hang of it add more Talkers to make the game fun and challenging.
2. Arrange the Towers in a grid so that each Tower can just reach her neighbour when they both have their arms outstretched.
3. Give each Talker a baton and a matching flag. She should attach the flag to herself so that it is clearly visible and hold the baton in her hand. Position the Talkers around the outside of the Tower grid.
4. On the word "Go!", each Talker hands her baton to the nearest Tower, then starts walking through the Tower grid. As she moves, the Towers pass her baton from one Tower to another. The object is to keep each baton at a Tower that is right next to the Talker it belongs to.
  - If a Tower already has two batons and a third one is passed to her, she must drop one of the batons.
  - If a Talker gets to her destination but her baton doesn't arrive with her, it means the cellular network "dropped" her call. The goal is to drop as few calls as possible.

### What else you can do with this:

The simplest way to play is to have each Talker walk straight through the Tower grid to the other side. To add complexity, you could require each talker to go all the way through and then back, visit each corner of the grid in turn, or stand still now and then.

As the girls get the hang of the game, you can increase the challenge (and the fun) by adding more Talkers, or by suddenly removing a Tower from somewhere in the grid (simulating a cell tower that suddenly fails). Can the "failing" tower switch the calls she is carrying to another Tower without dropping any?

### Program connections:

- Sparks: Exploring and Experimenting Keeper

- Brownies: Key to STEM; Key to Active Living
- Guides: Engineering badge
- Pathfinders: Exploring a Theme (Everything Comes from STEM)



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# Chapter 4

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## Obsolete Activities

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- *Dissect a Disk*

This section outlines activities from the Science in a Box or Girls Exploring Technology challenges that have become obsolete, and gives some suggestions for alternative activities.



## Dissect a Disk

The "Dissect a Disk" activity from the Guides Exploring Technology challenge is somewhat out of date.

### **Obsolete activity:**

- GET Challenge activity #2: Dissect a Disk

### **Why it is obsolete:**

Floppy disks are pretty old technology. Most girls will have never seen one, let alone used one or wondered how it works. You can still do the experiment, of course, if you can find a 3.5" floppy disk somewhere. Just keep in mind that it might not be very relevant to the girls.

(If you need the instructions for this activity, check out this website: [www.exploratorium.edu/science\\_explorer/dissect\\_disk.html](http://www.exploratorium.edu/science_explorer/dissect_disk.html).)

### **What else you can do with this:**

To explore the innards of a more current electronic device, try [Dissecting a Cell Phone](#).

