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NCWIT Outreach-in-a-Box: Discovering IT

Outreach At-a-Glance

What is Outreach-in-a-Box?
Outreach-in-a-Box: Discovering IT is a complete set of classroom resources developed for computing professionals to use with middle-school students and educators during a class visit. Outreach-in-a-Box is an inclusive, activity-based classroom experience that gives male and female students an exciting introduction to information technology (IT): its core concepts, uses, possibilities, and career opportunities.

Why IT?
The number of students choosing to enter IT fields is diminishing just as the job opportunities are growing! Outreach-in-a-Box seeks to change students’ perceptions of IT and encourage them to apply their creativity and skills to this exciting field. Sparking girls’ interest is particularly important since they are significantly underrepresented in IT.

Imagine the Possibilities
Many adults recall an experience in youth that set them on their career path. Outreach-in-a-Box is your chance to engage and inspire young people at an age when they are excited about scientific and technical fields and respond positively to activity-based learning programs.

The Program
The class visit has three main components: Introduction to a computing professional from the students’ very own community; Exploration of how students’ interests and the world around them are shaped by technology; A “hands-on, minds-on” inquiry activity with a robotic car (NCWIT has one for you!) that helps students explore computing fundamentals.

Inside the Box
Outreach-in-a-Box provides all the components you need to deliver a successful classroom presentation at a local middle school. Simply download the “Box” from the NCWIT Web site at www.ncwit.org/outreach and follow the Program Guide as you “unpack” it, introduce it to your local school, and customize the materials for your own use.
Outreach-in-a-Box Materials List:

Advance Materials
- An introductory letter to school educators
- Set-the-stage and extension activities for the hosting educator
- Information for acquiring a robotic car, purchased for you by NCWIT Program Guide
- Preparation and presentation tips
- Ideas for engaging youth

Program Guide
- Preparation and presentation tips
- Ideas for engaging youth
- Lesson plan and extension activities that introduce computing fundamentals (no technology needed)

Presentation Template
- Slide presentation template

Extensions and Web Resources

Takeaway Tech
- A brochure that encourages students to explore opportunities, from virtual programming to camps, clubs, and competitions
- An extensive Web index of resources for students, their parents, and educators

Resources at the Ready
Visit the NCWIT Web site (www.ncwit.org/outreach) and download the materials you need for an inspired and inspiring program. Here you’ll also find ideas for preparing and customizing materials for your visit, extension activities, sample letters, and a slide presentation.

Are you a teacher?
Invite a computing professional to visit your school and share Outreach-in-a-Box with him or her. A sample letter is included in Outreach to help you extend your invitation.
Outreach-in-a-Box: Discovering IT

Sample Letter from Schools

[Please modify or remove any text in brackets.]

[This introduces the Outreach-in-a-Box program, describes the purpose and details of the program, and invites a computing professional to your school. Customize this letter and send it to individuals directly or through human resource or public relations departments at the university or company you wish to engage.]

Dear [IT Professional or Public Affairs Officer – insert names]:

My name is [NAME] from [SCHOOL]. I am a [COUNSELOR/TEACHER/OTHER of SUBJECTS]. Our school is interested in expanding young students’ awareness of computer science and information technology and would like your help. We wish to invite a computing professional from your organization to present an outreach program about computing during one or more science or math sessions at [SCHOOL].

We are aware that technical jobs are among the fastest-growing in the U.S., yet participation in these fields is dwindling. Young women and minority students continue to be underrepresented in technical fields. Together we can help turn the tide. Middle school is just the right time to engage kids, before they conclude, “that's not for me”.

May I call your attention to a resource kit a visitor can use when making a presentation on computing? Supplied by The National Center for Women & Information Technology (NCWIT), Outreach-in-a-Box: Discovering IT makes a school visit easy. Outreach-in-a-Box includes a slide presentation and activities guide the presenter uses to prepare and deliver a fun and effective program suitable for young learners. Program materials can be viewed on the NCWIT Outreach Web site at: www.ncwit.org/outreach.

By describing their personal career paths, sharing what they enjoy about computing, and introducing students to opportunities in our community and beyond, visiting professionals will make computing real and help students begin imagining the possibilities. Our intent is to help change students’ concept of what computing is; by using the Outreach-in-a-Box program, a computing professional will help students learn that computing spans many fields, such as medicine, music, design, manufacturing, conservation, and business.

The one-hour program includes a slide presentation that connects students' interests to career opportunities, a fun “programming” activity that teaches computing fundamentals, and a chance to examine how robots interpret sensory input. Time permitting, additional extension activities are available as well. I am eager to support a visitor in planning and preparation, and am happy to discuss ways to customize the program so it is personally relevant and easy to deliver.

I hope you view this invitation as an opportunity to help young people and strengthen computer science and information technology. Please share this opportunity with staff at your organization and supply them with the NCWIT Web address so they can learn more: www.ncwit.org/outreach. My personal information follows.

Thank you for your interest.

Regards,
[Name]
[Organization]
[email address]
[phone number]
Dear Educator:

Set the stage for the upcoming IT-in-a-Box presentation by completing one or both of these 20-minute activities. Each one accesses prior knowledge and prepares students for the learning ahead. Prior to her or his visit, please review the completed activity with the presenter, and discuss ways to bridge from this activity to the guest presentation. Follow the class visit with Extension Activities that take the learning further.

Set-the-Stage Activities

**Set-the-Stage Activity One: Who’s Behind the Technologies We Use?**
- **Description:**
- **Objective:**
Access prior knowledge about IT and its importance in daily life, and build awareness of technology as something people create.
- **Directions:**
1) Introduce the presentation to come. You may wish to say: We have a special guest coming from (institution) to teach us about computer science and information technologies. During the hour we will learn about the world of computing and do some fun activities that will get you thinking about opportunities ahead. To get started, let’s tap into what we already know and like about technology.
2) Have students contribute to a list of all the computing devices they can think of. Say: If it is programmable (you can control complex functions) it probably has a computer chip in it and it’s a computer! List a few devices on the board or chart pad to get juices flowing: iPod, cell phone, control panel on a microwave oven, a DVR like TiVo. Now record items as students contribute. If they are not sure an item is a computing device (which is OK!) just put a question mark beside the item. As kids run dry, suggest different settings, like a car, a hospital, the 911 dispatch office, a grocery store.
3) When you have a big list (20 or 30) ask students to write a reflection about the following: Choose any one of these devices. Think about who might have been behind its development. Imagine: What motivated them?
4) After five minutes, ask students to stop and look up. Say: Let’s see what you picked for your reflection. As I run my finger down the list, raise your hand when I get to the item you wrote about. Look around – which ones seemed to interest people? Why might that be?
5) Ask students to share several reflections and discuss. Choose items that several students chose in order to compare their thinking, and also pick way-out-there items students might have interesting insights about.
6) Bring the point home, saying: Every computing device we use was built intentionally to solve a problem or improve on an earlier invention. Now imagine YOU get to design the next new device or software. Take a minute and write about your invention and what motivates you to create it.
7) After five minutes, ask students to share their ideas in triads; then have each triad share one idea with the class. Congratulate students on creative thinking.
8) Ask students to prepare for the upcoming visit by listing a set of questions they would like to ask the presenter. Our upcoming guest makes her [or his] living in IT and will tell us more about the different kinds of work people do in the field. We’ll want to ask what motivated her [or him] to be in a technical field. Write this on
chart paper or the board: What motivated you to do the work you do? Ask students what other questions they would like the presenter to answer, and add them to the list.

9) In advance of the upcoming program, share the reflections and questions with the presenter. Discuss ways she or he might bridge from this activity to the presentation.

Set-the-Stage Activity Two: Computer Technologies in the World

- **Objective:**
  Access prior knowledge and awareness of living in a digital world.

- **Directions:**

  1) If you have not done so already, introduce the presentation to come. You may say: We have a special guest coming from (institution) to teach us about computer science and information technologies. During the hour we will learn about the world of computing and do some fun activities that will get you thinking about opportunities ahead. To get started, let’s tap into what we already know, or what we THINK we know.

  2) Have students meet in small groups of four or five to brainstorm applications of computer technology in the home. Write this on the board for reference, and say: Computer technologies are everywhere, and there are a lot of them in our homes.

  Brainstorm a list of all the computer technologies at work in modern homes. Challenge teams to work for ten minutes to make an exhaustive list. If they are unsure whether an application involves computing, have them write it anyway. As they work, encourage them to think of every room in the house, from the bathroom to the kitchen to the garage.

  3) After ten minutes, reconvene and ask teams to take turns reading their lists. Record all responses on a running list on poster paper. As in the game Boggle, have each team cross out any item that appears on all teams’ lists. Along the way, teams may challenge whether an application involves computing. Record disputed applications as well, but put a question mark next to them. (Encourage students to pursue their own research to define what a computer is and whether the disputed applications involve computing, and remind them they can learn more from the presenter who will visit.) At the end, the team with the most unique and undisputed items wins the challenge.

  4) Discuss how this exercise would differ if teams thought about a different setting – a grocery store, an animation studio, a car, a medical research lab, and so on. Ask students to brainstorm all the places where digital technologies are likely to be prominent, and write these on another list. Ask interested students to research these settings for all the computer technologies at work in them and report back. (Example, grocery store: bar code scanners, deli weigh scales with label printers, climate control, security cameras and alarm system, inventory control systems, digital design on packaging, employee ‘clock in’ stations, cash registers, back-office computers and printers).

  5) Ask students to prepare for the upcoming visit by listing a set of questions they want to ask the presenter. Collect these and share with the presenter in advance of the upcoming program. Discuss how she or he can follow up, answering questions, discussing disputed items from the game, defining what a computer is versus another electrical device.

  6) Have all work available and visible as a jumping off point when the presenter arrives.
Extension Activities

Extensions include: Programming activities, robotics, and careers exploration. The amount of time each takes depends on the activity, the number of students involved, and the depth you go. You may wish to test the activities in advance, or walk through them with the hosting teacher.

Note: If you cannot complete these additional activities, please share them with the hosting teacher. He or she may wish to use them to extend your program.

Extension Activity One:

Tell A “Robot” How To Make A Cream Cheese & Jelly Sandwich

- Description:
The presenter acts as a robot and follows instructions from students in order to build a cream cheese and jelly sandwich. Since the “robot” is a mechanized computing device that only understands finite and sequential instructions and makes assumptions about nothing, it executes the instructions just as they are given, with funny and illuminating results.

- Objective:
Students understand that computing devices function by acting on precise and sequenced instructions, and these instructions are delivered through computer program languages that devices “understand” and execute.

- Materials needed for activity:
Raised flat surface to work on, loaf of sliced bread, jar of jelly, package of cream cheese, plate, butter knife, spoon.

- Directions:
Introduce the activity. You may wish to say:
We are going to do an activity that helps you understand what is at the heart of computing – programming. All computing devices function by acting on precise and sequenced instructions. These instructions are delivered through computer program languages that devices “understand” and execute.

In order to think about how robots or any computing devices are programmed to do the things we want them to do, I'm going to pretend to be a robot – a computer with mechanical functions - that needs to make a cream cheese and jelly sandwich. I'll take my instructions from you, one step at a time. In front of me is a loaf of bread, jar of jelly, a package of cream cheese, plate, butter knife, and a spoon.

In order to encourage balanced participation, you may want to choose students by counting off every third student or moving up and down the rows for each next instruction. Or, you may ask the teacher to call on students for you so you can stay in robot mode. Remember, encourage inclusive participation and don’t let “tech” kids dominate.

As students deliver instructions avoid taking any assumed steps. If you're told by a student to “put the cream cheese on the bread,” pick up the package of cream cheese and place it on the bread. If a student says, “Spread the cream cheese on the bread,” but the cream cheese is still in its packaging or you have not been told to pick up the knife, you can say that you are unable to complete that task at this time (or something similar). Wait for a student to tell you to put the knife into the cream cheese package and get some cream cheese on it before
executing a spreading “command.” When the bread bag is open and you have one slice of bread on the plate, if you are told to do something with the bread, ask which bread. The key is to get students thinking about how to properly sequence the actions needed while providing precise detail for you, the “robot.”

Try not to give any analysis of the students' commands during the activity. Let students use the opportunity to figure out on their own how to issue instructions to the “robot.”

End the activity whenever it seems the point has been made even if you have not constructed a complete sandwich. Conclude the activity and discuss what happened. Call on a variety of students to answer (even those not raising hands). Some sample questions:

What surprised you about what we just did? (Answers will vary)

What things can you assume when giving instructions to a human that you can't when giving them to a computer or “robot”? (Humans have ears and eyes, can interpret voice commands and visual cues. Robots need a computer chip that transmits instructions and sensors that interpret what they are acting upon. Humans make assumptions and fill in gaps. Computers do not.)

What if you could only use a restricted set of commands? Which ones do you think would be the most useful?

When you told me to pick up the bread, I did. Do you think it would be easy for a robot to find the bread? (Could lead to a discussion of how a robot “sees,” with sensors).

How could you have told me to move if I said I didn’t know what bread was?

Discuss robotics as an important science. Ask: Are robots just for fun? Most robots do real work. If a job is boring or dangerous, a robot is probably doing it! When might robots be most useful? (Repetitive tasks like making the same weld on each car moving down an assembly line, dangerous tasks like bomb removal, or working with hazardous chemicals.)

Close the discussion by telling students the robot activity was a programming exercise, and remind them programming is at the heart of all computing. To make a computing device do anything it needs precise instructions, and these are written in computer languages they can learn. The brochure you hand out has resources that they can use to explore computing and robots right away.
Extension Activity Two: Tell a Computer to Draw a Picture

This is a Kinesthetic Learning Activity (KLA), meant to physically engage students in the learning process. KLAs fill an important niche — energizing students, employing underutilized learning styles, and achieving especially challenging learning goals. Discuss this activity with the teacher and plan how students will pair, arrange themselves, and use their materials.

- **Description:**
  A student “programmer” thinks about transmitting information so a fellow student “computer” acts on it, moving his or her pencil to draw a line drawing that only the “programmer” sees. Students may describe using some terms that express scale and position, but they will find it takes precise instructions for the drawing to come close to matching the original picture.

- **Objective:**
  Students understand that computing devices function by acting on precise and sequenced instructions, and these instructions are delivered through computer program languages that devices “understand” and execute.

- **Materials:**
  Enough photocopies of several different line drawings so each pair has one sheet (samples included); 8.5” x 11” sheets of blank paper; pencils or pens, space in the room to have students sit back to back on the floor or at tables or desks with a divider between them (could use a propped up 3-ring binder).

- **Directions:**
  Introduce the activity. You may wish to say:

  In order to think about how you could program a robot or other computing device to draw a picture, we're going to do a drawing activity in pairs. One of you will be the “programmer” giving instructions and the other will be the computing device acting on those instructions and drawing. You should sit such that neither of you will be able to see the other's paper. You can do this by sitting back to back or by propping a 3-ring binder or large book on the table between you. (You may wish to ask the teacher in advance which method is best.)

  Say: I'll start by giving a line drawing to each programmer. [It is important that students sitting near each other have different drawings, otherwise they can listen to descriptions given by describers on other teams.] If you are the programmer, don't tell the “device” what the picture is. Instead, try to tell your partner how to draw the object in simpler terms, describing pieces of the drawing one at a time. The “device” cannot ask any questions, but may ask for a command to be repeated if they can't act on it. After the picture has been described and drawn, wait for my cue and then you can show your pages to one another. This activity should only take five minutes or so.

  After drawing is complete ask pairs to raise their hands if their two pictures (the original and the drawing) ended up different from one another. Call on pairs to describe how the drawings differed (e.g., item placement, shape, scale)

  Ask pairs: What terms did you use to describe the task? Ask if other groups used other terms.

  Discuss how computers need to have precise language. For example, it would not be enough to say, “Draw a square.” The size of the square would need to be specified. Computers (think: “compute”) use mathematical terms to express position, shape, size, and relationships.
Select one original and hold up all its renderings so students can compare. Ask: Which picture most closely matches the original? Ask that pair of students what kinds of terms they used. Ask the students if they could think of other ways to describe drawings to a computer. If no one has thought about describing line segments in terms of end points, ask if that might be a good way to describe drawings. Other alternatives to suggest:

- Pen up, pen down, north for ‹distance›, south for ‹distance›, west for ‹distance›, and east for ‹distance›. Ask the students if any of them have drawings that could not have been done (easily) with this method (anyone with a circle or diagonal line should show their drawing).
- Drawing a grid, then moving left to right across each row, saying if a grid square should be colored in or not. (Can lead to a discussion of pixels on a computer screen.)

Ask: Do you think it would have helped you to know what the object was that you were trying to draw? Do you think it would help a computer?

If time allows, switch roles of programmer and computer and repeat the activity with different pictures. At the conclusion, ask students if they did anything differently this second time. Did they change their terms after the discussion about different approaches? How? If so, did they have a better result?

Close the discussion with a suggestion that students try their hand at programming and programmable devices like robots. The brochure and links to the NCWIT Web site offer many opportunities, including activities, camps, devices to buy, competitions, do-it-yourself crafts, and more.

Conclusion (5 minutes): If your hour presentation ends here, take a moment to discuss the brochure and insert. Encourage students to explore IT!

**Extension Activity Three: Programming**

Scratch and Alice are two programming languages suitable for youth. Each Web site below has information for teaching.

**Scratch**

Scratch is a programmable toolkit that enables kids to create their own games, animated stories, and interactive art -- and share their creations with one another over the Internet. Scratch is being developed by the Lifelong Kindergarten research group at the MIT Media Lab, in collaboration with KIDS research group at the UCLA Graduate School of Education & Information Studies. The Scratch Web site supports adult use of Scratch with kids: http://weblogs.media.mit.edu/llk/scratch/educators.html

**Alice**

Middle school to college-age students learn to program interactive 3D graphics with Alice v2.0. Alice is an object-oriented, Java-based computer-programming environment created by Carnegie Mellon University researchers. The Alice Web site and Alice Community Forum support the use of Alice with kids. http://www.alice.org/
**Extension Activity Four: More Robotics**

If you have the means to bring Crickets, Lego Mindstorms, a Roomba vacuum or other robotic devices, consider these steps for an inquiry activity.

1. Simply put the device to work and ask: What do you think this is? What is it responding to? How does it sense the world? How would you describe its “brain”? What makes it go?

2. Explain that a robot is a mechanical computer. It functions through a processor, responds to programming instructions, and interacts with the world with sensors. Robots are fun but they are useful. If a work task is incredibly repetitive or hazardous, a robot is probably performing it.

3. Show students how you change one instruction to make the device function differently. Describe the other things it can do (PicoCrickets can “dance,” twirl, and jump).

4. Have students form small teams to plan a secret function they want the robot to perform. They will get three tries to make it perform as desired. As each group interacts with the computer, the rest of the class watches, and asks questions about what they are trying to make it do, and offers suggestions for changing its behavior.

5. Discuss the ways in which working with the robot is similar to the “programming” activity they did prior.

6. Answer questions about the devices.

7. Remind students their takeaway brochure has information about “virtual” robotics on the Web, and robots they can buy.

**Extension Activity Five: University of Washington Careers Videos**

Show one or more of three videos from University of Washington Computer Science & Engineering so students can see people working and talking about their work in IT. All videos from Why Choose CSE? University of Washington, www.cs.washington.edu/WhyCSE.

- **Power to Change the World** – First-person accounts of computer science and engineering students, alumni, and faculty explaining why they chose computer science as their field. Use the video to introduce computing as an exciting field full of opportunities.

- **Pathways in Computer Science** – Illustrates the diverse professional pathways students can pursue after receiving a degree in computer science or computer engineering. Use the video to explore how a degree in computing prepares students for almost any imaginable future.

- **A Day in the Life** – Six brief profiles of recent computer science and engineering graduates. Meet bright young women engaged in secure, highly collaborative, creative, diverse, challenging, and well-compensated work. These role models will resonate with young people who might not otherwise consider a career in computing.

**Following the videos, use these steps:**

1. Have students write a reflection on this prompt: Use your imagination - If you could change the world and use technology to do it, what would you do? What would you invent or improve? Encourage students to be imaginative and have fun, and tell them there are no right or wrong answers.

2. Have students share their reflections and discuss how their ideas might tie back to fields of CS and IT.

3. Encourage students to keep their eyes open, talk to people who do what interests them, and to follow their passion!
NCWIT Outreach-in-a-Box: Discovering IT

Acquiring a LineChaserz Car

Here are some ideas for where to purchase a LineChaserz car for use in the NCWIT Outreach-in-a-Box: Discovering IT main learning activity.

Amazon features several retailers who offer the Line Chaserz cars, which are available in different models and typically cost between $12-$20. To find these retailers, visit http://amzn.to/asoav7.
Dear Presenter:

The Outreach-in-a-Box: Discovering IT program guide supplies you with everything you need to prepare and present a fifty-minute or extended program about computing for middle-school students. Most program elements are completed for you, but you will need time to acquire materials (a robotic car, provided by NCWIT) and to customize features of the program to include:

• Your history, specialty and passions
• Information about your institution/organization/workplace
• Opportunities for youth in your community (optional)

Please take time to become familiar with the program, discuss it with your host educator, and customize the presentation.

Contents of the Program Guide

A. Using Advance Materials
B. Preparation Steps
C. Tips for Relating to Your Audience
D. Activity Plan
E. Extensions and Wrap-up

A. Using Advance Materials

Below are resources and steps that will help you prepare for your presentation. Once you have set up your school visit, review items b) and c) with your host. Each of these advance materials is a separate document on the Web site.

1. Acquiring a LineChaserz Car  NCWIT purchased robotic cars for presenters to use during their Outreach-in-a-Box session. The instructions for acquiring the car are in this document. Please plan ahead; it will take several days for the car to arrive and you will want time to practice using it for the class activity.

2. Sample letter  This letter announces the IT-in-a-Box opportunity, describes the purpose and contents of the program, and describes logistics such as material needs, preferred setting, and time frame. Customize this letter and send it to school personnel (administrator, teacher, or school counselor), or if you prefer, call the school directly to discuss the opportunity with this letter as your guide.

3. Set-the-Stage Activities  Your program will have a greater impact if students are prepared. Your host educator has a choice of two Set-the-Stage activities he or she can use in advance which will reveal prior understanding and beliefs about IT, and get students thinking about the learning ahead. Share these activities with the hosting educator and learn whether he or she will be using one or both of them. Prior to your presentation, review the Set-the-Stage experience with the teacher and discuss how the students’ experience can serve as the “stepping off” point for your visit.
B) Preparation Steps

1. Order your LineChaserz car now. See the Acquiring LineChaserz Car page.

2. In advance of your presentation, if possible, meet with the hosting educator.
   - Discuss program goals and seek advice about managing activities so they are inclusive (getting to the less technical kids).
   - Ask your host to arrange for a computer (or bring your laptop), projector, and screen for the slide presentation. Discuss the room arrangement – Students at desks for presentation, in chairs in semi-circle for activity.
   - Share Set-the-Stage class activities he or she can use to prepare students for the program ahead. (This is a separate document.)
   - Discuss the brochure. Together, customize it by adding an insert with local opportunities such as high school courses, clubs, and events.
   - Prior to your presentation, talk with the hosting educator again to discuss Set-the-Stage activities he or she may have conducted with the class. Discuss ways to respond to these during your presentation.

3. Read the lesson plan and prepare for the presentation and activities as advised.

4. Materials necessary for each activity are described in the activity.
   a. Prepare the slide presentation.
      - The slide set is on a light background. Customize the set by adding your institution's slide background or choose another light background.
      - Review the slides and read the slide notes (see “normal” view in PowerPoint) for prompts and more information.
      - Several slides start with the word TEMPLATE. These are yours to customize, following the prompts on each slide and adding slides as you wish. Please leave the last “credits” slide.
      - Review the entire slide presentation. You will return to the slides during the robot car activity to show details of the car otherwise too hard to see.
   b. Prepare and copy the brochure, one for each student. The hosting teacher may be able to help you with this.
C) Tips for relating to your audience

The intent of Outreach-in-a-Box is to cast IT in an appealing light and inform young people about myriad opportunities in computing. Like it or not, as a guest in the school your very presence puts you in the position of “role model”. And, like it or not, as an IT professional you wear the mantle of young people’s previous perceptions about people who work in the field. We encourage you, through your appearance, demeanor, and language, to put forth the most appealing and professional presence you can. This means:

**Appearance:** Appear approachable but professional. Wear “casual Friday” apparel – not so dressy you seem alien, yet not “weekend sloppy” either.

**Demeanor:** Being well prepared will help you appear polished and credible. Strike a professional but friendly demeanor. Kids like adults who obviously like them. Chat with students before you begin your presentation and show interest in what is going on in the school. Give students an opportunity to see you as a person first and as a computing professional second.

**Language:** Don’t oversimplify the presentation in an effort to make it work. Use the vocabulary of the discipline, but define key terms and write important words on the chalkboard. Avoid acronyms and unnecessary jargon.

**Check for understanding, Individual differences:** The intent of this program is to encourage all students – and especially girls and other underrepresented populations – to get excited about computing. Here are tips for being inclusive of everyone:

- When you ask a question, the more technically inclined students may have their hands raised before your words are out of your mouth. Give the class time to think before you call on anyone. Ask open-ended questions that have many right answers so everyone can participate with confidence.

- If activities involve sharing technology, make sure all kids have turns to use devices. Assertive students may tend to dominate, so ask the hosting teacher for advice on class management and strategic grouping to assure equal access and equal opportunity to learn.

- Demonstrate that everyone can be “good at” technology. If an activity requires a volunteer, choose students who do NOT raise their hands and let them bask in the light of their successes.
D) Activity Plan

This lesson plan has four parts: 1) Introduction 2) Presentation 3) Activity 4) Extensions and Wrap-up

1. Introduction – 5 minutes

Briefly introduce yourself, your work, and your organization. (More of this comes in the slideshow presentation, so be brief.) Ask students if they know others who work where you do, or anyone who works in computer science or IT.

In advance of your arrival, did the hosting educator engage students in preparation activities? (see Set the Stage Activities) If so, ask students to describe what the class did. Review pictures on the wall or lists they made, and relate their activity to what you will do during the period. Tell them by the time the session ends they will have learned more about computing and be inspired to consider computing opportunities as they move beyond middle school.

2. Slide Presentation – 7 to 10 minutes

Description: This presentation starts with slides that help you tell your story and that of your institution. The next few slides connect students’ experiences and interests to the range of computing topics. The last slide sets up and illustrates the activity you will do with the class.

Objective: Students become familiar with computing and relate their knowledge and interests to opportunities ahead.

Materials needed: Slide presentation: (file name: Outreach-in-a-Box_Presentation.ppt), a computer, projector, and screen. A remote device for advancing slides is helpful so you can move around the room.

Room set: Students are seated at desks.

Directions: Deliver the slide presentation, following the suggestions in the notes associated with each slide. (You may wish to print the presentation with the notes showing to use as a guide as you deliver the presentation.)

3. Robot Car Activity – 35 minutes

Description: This inquiry activity will get students thinking about how computers work. Discuss the activity with the hosting teacher. He or she will have ideas for overall management of the activity.

Objective: Students learn that a robotic car is a mechanical computing device that employs sensors. Students recognize how sensors are used in a variety of applications in their everyday world.

- Materials needed:
  - LineChaserz car (at least one)
  - Blank white paper
  - 8.5” x 11” scratch paper for planning
  - 2’x3’ butcher paper or chart pack paper, one for each pair (half the number of students in class)
  - Black markers – thicker chisel point similar to that in the kit - one for each pair (half the number of students in class).

- Room set: Situate students in chairs in a semi-circle around open floor space so they can see the car in action.
- **Directions:**

  a) **Show.** Demonstrate how the car follows a black line on a 2’x3’ piece of paper. Keep the line fairly simple and run the car several times. Ask students how they think it operates. Don’t go into great explanation here. Just encourage many possibilities and then say, “Let’s find out.”

  b) **Involve Students.** Follow these steps:

    i) Invite student pairs to draw their own line with a thick-tipped black pen on a 2’ x 3’ sheet of paper. (You may want students to pencil sketch their idea on small paper before drawing their path on the large sheet.)

    ii) Collect the large sheets and randomly select eight sheets, keeping them face down.

    iii) Pull a sheet, find the pair who drew it, and let this pair run the trial. Before each pair runs the car on their sheet, ask the class to predict how the car will respond to the design.

    iv) After trying all eight, ask and discuss: What seems to give the car trouble? Success? Which drawings worked? Which ones didn’t?

  c) **Inquire.** Ask students how they think the car might be working. You can pass the car around for students to look at, if you’d like. Tell them not to take it apart, but guess “what’s under the hood?” Ask them to describe what they see on the car.

  d) **Discuss what’s going on.** Show the slides with photos of car details. Talk about how the car follows the line.

    i) On the bottom of the car are two red LEDs (light emitting diodes) and two pairs of IR (infrared) emitter/detector pairs. Explain: When the car is turned on, the red LEDs are illuminated and cast light under the car, changing the color on the paper. Notice the LEDs are on the outside of the IR pairs.

    ii) The IR emitter sends out a beam of infrared light (which you can’t see), which detects the reflected light sent out by the LEDs. The color of the reflected light tells the sensor if it’s over a black line or not. (More detailed description: When the LED casts a beam on black (the line) it is absorbed and shows nothing for the IR pair to sense. When it casts a beam on white (plain paper) it is reflected, and it is this reflected light that the IR pairs sense. So LED beam over black is like “off”, LED beam over white is like “on”.)

    iii) Ask: Why are there two pairs? (Get students to think about this.) What would happen with only one set? Could we still follow a line? Would it work as well? Why or why not?

    iv) Pop the cover off the chassis and expose the circuitry. (Run any additional trials with the cover off.) Explain that this is circuitry like in any computing device. It responds to electric signal based on programmed computer code. Give more detail if students show interest.

    v) Write pseudocode for line-following on the board or show the slide with this “code” on it. Explain that the circuitry “reads” the code and relays instructions to the car. Read the code aloud.

      
        if left-ir sees black, steer to left, otherwise steer to right

        if right-ir sees black, steer to right, otherwise steer to left

        


Ask: What's happening in this code? What happens when neither line sees black? (Car should go straight – verify this with your car.) The students can also experiment with the car held in the air, using paper to block one or the other pairs of sensors.

Ask: Why not the following? Are we really using both sides to follow the line with the code below?

Ask: What happens if a line forks? Does the car tend to take one branch rather than the other? Test.

Ask: What does this tell us about the car's programming?

Discuss precision in instrumentation, that a toy car doesn't require the fine-tuned precision of a surgical instrument for instance.

e) Discuss Sensors. Explain that the IR pairs are sensors that read information about the environment; the car acts on the information from these sensors to change its behavior, based upon the program (above).

Explain that not all sensors are light sensors. There are motion sensors, tilt sensors, touch sensors, and more. All sensors give feedback to circuits that instruct a machine to do work, like steering the robot car. Ask: Where else do you see sensors? Have the students brainstorm, and write examples on the board. Here are ideas:

- Faucets in bathrooms that turn on automatically (use a distance sensor)
- Automatic doors at stores (might use a distance sensor or a motion sensor)
- Alarm systems (might have motion sensors, contact sensors on windows and doors, or audio sensors)
- Toys (Furby and Sony Wii have a tilt sensor and touch sensor; Mindstorms has sensors in the kit)
- Roomba vacuum cleaner (touch sensors in bump skirt, IR emitter/detector pairs to prevent going off stairs)
- Television (IR detector to read signal from IR emitter in remote control)
- Thermostat (temperature detector to turn on heat or air conditioning)
- Rain gauge in a sprinkler system (contact sensor)
- Cars (speed readings, thermometer for engine heat, sensing problems with engine)
- Automatic lights that come on when it gets dark (if not on timer, otherwise controlled by a light sensor)
- Bar code scanner at stores (light sensor)

f) Ask: Why do we use sensors so much? This gets at the heart of robotics – computers + mechanics produce automated work. A machine is, by definition, a labor-saving device; the computer sensors make machines even more independent and labor-saving. Encourage kids to brainstorm: How might more sensors be put to work in the world? If time allows, encourage student pairs to draw diagrams of their ideas to share now or continue with later.

If time allows and students show interest in coding, explore: How could this car run differently? One example: A car could be programmed to stay between two parallel lines instead of following a single line. The “programming” would look like:

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if left-ir sees black, steer to right, otherwise steer to left
if right-ir sees black, steer to left, otherwise steer to right
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Ask: How might it respond to different colored lines?
E. Extensions and Wrap-up

If time allows or if you can meet with students a second time, consider using the Extension Activities (see: Set-the-Stage and Extension Activities).

Otherwise, at the end of your session, be sure to pass out the brochures. Encourage kids to give them a look now. Ask: What looks good to you? What might you try this week? This summer? Later? Which one will you show your parents or a friend? What more do you want to know about or do?

Before you leave, challenge students to find places in the designed world where there are NOT computing devices. (They are likely to notice them everywhere after today.) Encourage students to explore their interests. If your organization makes visitors welcome, invite them to come by.

If you can retrieve it later, leave the car with the class so they can perform more investigations.
Information Technology: Inventing the Future
“I do not fear computers. I fear the lack of them.”

- Isaac Asimov (1920 - 1992)
Dr. Michele Seibert
www.vacareerview.org

Counselor
Research Faculty
Virginia Career VIEW
WEBsite to learn about careers for grades K-8
EMILY FIELDER

Art Teacher
Research Faculty
Ph.D. Student
What is information technology?

Information technology (IT) is using computers and computer science to...

Where do you see information technologies in use every day?

- Communicate
- Solve problems
- Design and imagine
- Share, store, retrieve or manipulate information
IT is... Computer Science

Do you like to:
Solve problems?
Help people?
Find ways to do things faster, better, and more easily?

These computer scientists mine genetic information in order to understand disease, develop medicines, and find cures.
IT is... Computer Engineering

Do you want to:
Build a better iPod?
Invent new toys?
Create robots that can do the work for you?
IT is... Computer Graphics and Imaging

Are you:
Very visual?
Someone with a big imagination?
Fascinated by maps, models, or animation?
Are you someone who:

- Understands relationships?
- Likes to do things efficiently?
- Can put yourself in other people’s shoes?
- (Would like to sell lots of stuff?)
Paths to Careers: How Do People Get Started?

Follow a traditional path...

Take math, physics, computer science classes; intern with a company’s technology department

Participate in your school’s computer club; enter a science fair; attend a technology summer camp

Steve Chen (above) is one of the founders and Chief Technology Officer of YouTube. He attended the Illinois Math and Science Academy and majored in Computer Science at the University of Illinois at Urbana-Champaign.
Paths to Careers: How Do People Get Started?

Follow your own path...

Introducing Leah Buechley

Before College: Interested in design and textiles, liked math.

In College: Studied fine arts, then computer science.

Now: Computer scientist at University of Colorado, Boulder. Researches new techniques for integrating computation, electronics and textiles.
You might work at the Googleplex in California!
Collaborative Work

Meeting of an engineering team at the Googleplex in California
Computing Activity - Robots!

LineChaserz Robotic Car
Computing Activity - Robots!

Watch the car in action. Think: What’s going on?

LineChaserz Robotic Car
The robotic car is programmed to respond to sensory information.
The robotic car uses two pairs of light-emitting diodes (LED) and Infrared emitter-detectors to sense the driving surface.
response to the environment depends on how it’s programmed

The LineChaserz programming code:

if left-ir sees black, steer to left, otherwise steer to right
if right-ir sees black, steer to right, otherwise steer to left
Learn More!

information on …
• camps, clubs & competitions
• online programs & classes
• virtual Web experiences
• buying programmable devices

...as well as a Takeaway Tech brochure is available at the NCWIT website: www.ncwit.org/outreach.
Excited about computer science and information technology? Here’s a list of cool resources — virtual experiences on the web, robotics kits, camps and clubs, and career exploration sites — you can use anytime. You can find it and a bigger list of activities, clubs, camps, kits, career ideas and more at (URL TBD).

**Fun with Programming and Robotics**

- **Interactive Robotics** - Museum of Science, Boston
  Get busy online and build your own virtual robot. Requires Shockwave

- **LEGO® Mindstorms™**
  Design and program real robots that do what you want them to do. Create a light-sensitive intruder alarm, or a robotic rover that can follow a trail, move around obstacles, and even duck into dark corners.
  http://mindstorms.lego.com/eng/products/ris/index.asp

- **PicoCrickets**
  Plug lights, motors, and sensors into a Cricket, then write computer programs to tell it how to spin, light up, and play music. Create musical sculptures, interactive jewelry, dancing creatures, and other artistic inventions with Crickets.
  http://www.picocricket.com/index.html
  http://www.handyboard.com/cricket/

**Computer Science Activities, Clubs, Camps and Workshops**

If all the technical camps offered each year were listed in this brochure it would be the size of a phone book. Visit (URL TBD) for a list of programs around the country. Or check with the nearest university or ask a school computer science teacher for ideas.

- **Creative Media and Computing**
  Embroider your skateboard, light up your clothing, felt an iPod cocoon, stitch a robot, and more! Craft is the first project-based magazine dedicated to the world of out-there and edgy crafts. Get do-it-yourself advice from the ‘zine or on the Craft Web site.
  http://craftzine.com/magazine/

- **Leah Buechley’s LED shirt**
  Use silver-coated thread and a microprocessor to create your own version of Leah’s light-up tank top, and learn computing basics at the same time. Free pdf from Craft magazine.
  http://craftzine.com/images/craft/01/electrictanktop.pdf

- **Make**
  Make magazine celebrates your right to tweak, hack, and bend any technology to your own will. Get do-it-yourself advice from the ‘zine or on the Make Web site.
  http://www.makezine.com/

- **Sally Ride Science Toy Challenge**
  Inventing toys is a great way to learn about science, engineering, and the design process. Accept astronaut Sally Ride’s Toy Challenge you and your friends might just win a weekend VIP tour of NASA’s Kennedy Space Center in Florida!
  http://www.toychallenge.com
Switch
Switch is a do-it-yourself Web show that combines design, fashion and technology. Watch designers at work and check out lots of projects in the Learning Library.
http://iheartswwitch.com

Future Scientists and Engineers of America (FSEA)
Want to start your own tech club? This national nonprofit organization supports after school technology clubs.
http://www.fsea.org

Girls Go Tech
Girl Scouts of the USA offers camps and programs where girls can explore their interests in science, math and technology.
http://www.girlsgoteh.com/

Sally Ride Science Club
This science club for girls in grades 4 - 8 reflects astronaut Sally Ride's effort to interest young girls in science, math, and technology. The club features mentors, online chat, newsletters, and science festivals.
http://imaginarylinesinc.com

Career Exploration
Career Ideas for Kids Who Like Computers (book)
Take a quiz and learn if your future lies in the high-tech world of computers. Career Ideas for Kids Who Like Computers gives you the scoop on exciting careers including Artificial Intelligence, Computer Game Design, Computer Programming, Hardware Engineering, Multimedia, and more.
http://www.careerideaskids.com/computer.htm

GetTech
Planning for your future will involve technology. As you plan your career, be aware of all the choices and options. Explore what GetTech has to offer you.
http://www.gettech.org/default2.asp

What Do You Like? Exploring Career Exploring Career Information
Scout out careers in every field – including technical ones.
http://www.bls.gov/k12/

The Fun Works
Match your interests to fun and interesting careers in math, science, and technology. Explore different careers or take a quiz to see which is best for you.
http://thefunworks.org/
Outreach-in-a-Box: Discovering IT

Sample Letter to Schools

[Please modify or remove any text in brackets.]
[This announces the Outreach-in-a-Box opportunity, describes the purpose and contents of the program, and time frame. Customize this letter and send it to school personnel (administrators, teachers, or school counselors), or if you prefer, call the school directly to discuss the same information.]

Dear [Principal or School Counselor – insert names]:

My name is [NAME] from [INSTITUTION]. I am a computing professional who works and lives locally, and I wish to encourage youth in our area to consider career opportunities in computing. I would like to come to your school and present a program during one or more sessions of science or math.

Technical jobs in the U.S. are predicted to be among the fastest-growing over the next decade, yet participation in these fields is dwindling. Young women and minority students continue to be underrepresented in technical fields. Together we can help turn the tide by inspiring youth to pursue opportunities in computing. Middle school is just the right time to engage kids, before they reach the conclusion of “that’s not for me”.

The interactive program I hope to present at your school would strengthen your science and math curriculum and help students see how what they learn today prepares them for exciting career options later in life. They will also learn that computing spans many fields, such as medicine, music, design, manufacturing, conservation, and business. I will describe my career path, share what I enjoy about my work, and introduce students to opportunities in our community and beyond.

The presentation and activities I use were developed by the National Center for Women & Information Technology (NCWIT: http://www.ncwit.org), an organization dedicated to increasing participation in technical fields, especially by women and other underrepresented populations. The program kit, Outreach-in-a-Box: Discovering IT, is designed to meet a variety of standards in math and science, and to change perceptions and knowledge about computing.
The one-hour program includes a slide presentation that connects students’ interests to career opportunities, a fun “programming” activity that teaches computing fundamentals, and a chance to examine how robots interpret sensory input. Time-permitting, we can complete one or two extension activities as well. After the program I will share program materials with each host teacher so he or she can deliver the lesson or share it with colleagues.

To view the program materials, please visit NCWIT at: www.ncwit.org/outreach.

Please introduce this opportunity to your staff and give them the NCWIT Web address for more information. When you establish interest please appoint one staff member (host teacher or counselor) to be my main contact. Please let your staff know I welcome any adults who are available to attend the program. They will benefit from learning about computing and may wish to deliver the program themselves. My personal information follows.

Thank you for your consideration.

Regards,
[Name]
[Organization]
[email address]
[phone number]