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iBot, uBot, We All Build Robots

iBot uBot We all build Robots

Robotics- the Application of Science using Technology

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Goals and Objective

iBot uBot…. We all build Robots
Lego-Mindstorm EV3

Goal:
To introduce my eighth grade students to the world of robotics, using the Lego Mindstorm EV3 kit. Through the processes of creating a robot, students will engage themselves by creating, commanding (programming) their creations.

Objective:
The learner will develop their sense of science processes, investigation and data analysis and interpretation through data programming using technology.

Common Core State Standards:
LACC.68. Standards for literacy in Social Science, Science and Technical Subjects
RST.3.7. Integrate quantitative or technical information expressed in words, in a text with a version of that information expressed visually (e.g.. in a flowchart, model, graph, diagram or table).

Next Generation Science Sunshine Standards (NGSS)

Big Idea 1: The Practice of Science

SC.8.N.1.1 Define a problem from the eighth grade curriculum, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigation of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

SC.8.N.1.2 Differentiate replication (by others) from repetition (multiple trials).

SC.8.N.1.3 Distinguish between an experiment (which must involve the identification and
control of variables) and other forms of scientific investigation and explain that not all scientific knowledge is derived from experimentation.

SC.8.N.1.4 Identify test variables (independent variables) and outcome variables (dependent variables) in an experiment.

SC.8.N.1.5 Describe the methods used in the pursuit of a scientific explanation as seen in different fields of science such as biology, geology, and physics.

SC.8.N.1.7 Explain that scientific knowledge is the result of a great deal of debate and confirmation within the science community.

Big Idea 2 The Characteristics of Scientific

SC.6.N.1.5 Recognize that science involves creativity, not just in designing experiments, but in also creating explanations that fit evidence.

SC.6.N.2.1 Distinguish science from other activities involving thought.

SC.6.N.2.2 Explain that scientific knowledge is durable because it is open to change as new evidence or interpretations are encountered.

SC.7.N.3 Identify that scientific theories are explanations and laws describe relationships, and both are supported by evidence and to identify a benefit of using a model to explain how things work.

Course Outline/ Overview

iBot uBot…. We all build Robots
Lego-Mindstorm EV3

Robots are important technology that greatly increases all productivity. Overall, as we advance in society, there is a need to maintain a high level of performance. Robotic in general are being used in the high-value areas such as medical imaging and within the fields of Space exploration. Robotic can eliminate the problems of social security in countries, where many are competing for qualified employees or from the lack of workers due to old age.

Now why should we teach robotics in school is the question? How will Lego Mindstorm help students increase their achievement levels, as I was reading on the benefits of robotics in the classroom, I read an article by Colin Angle Chairman of the Board, Chief Executive Officer and Co-Founder, iRobot® Corp. He stated, we need robotics because our future depends on our ability to educate our children in the ways the world works. We need them to be curious. We need them to understand how all of this holds together, because the United States isn't going to compete in a global economy by being the best burger flippers in the world. We're going to compete by being the inventors, by being those that challenge the status quo and ask, "Why?"

In order to do that, you need to have an understanding about the mechanics of the universe. There's a magical time when you're a child where your curiosity is piqued. Everything is exciting, and to try to merely keep our educational system from destroying that innate curiosity is something we need to do, and I feel like robots are a bit magical in that regard.

The activities and lessons with LEGO MINDSTORMS EV3 is exciting and engaging for the students and teacher. In the LEGO sessions, the teacher actually becomes the facilitator of the learning environment. Students enjoy working on STEM based projects. With LEGO MINDSTORMS EV3, building and programming there own robot has never been easier. Think of a robot or use on of the 18 offered robots building guides to build it. Use the motors and sensors to add behavior and movement. The software guides the learner to help bring their robot life.

Create: Build your robot using the LEGO elements, motors, and intelligent sensors included in the set.

Command: Program your robot in the intuitive icon-based programming interface. Drag and drop the actions that you want into the programming window and adjust them to suit your robot's behavior.

Go! Once you have built and programmed your robot, it's time to play!

Visit **LEGO.com/mindstorms** to see what's new and what others are doing with their LEGO MINDSTORMS set. When you and other LEGO MINDSTORM.

Lesson 1

Robotics History and Introduction

Objective of the Lesson:
The Students will be able to:

- Identify basic generations of robots.
- Explain differences in types of robots.
- Distinguish the changes in robotic practices and usage.

Background for the teacher

- **~270**BC an ancient Greek engineer named Ctesibus made organs and water clocks with movable figures.
- **1818** - Mary Shelley wrote "Frankenstein" which was about a frightening artificial lifeform created by Dr. Frankenstein.
- **1921** - The term "robot" was first used in a play called "R.U.R." or "Rossum's Universal Robots" by the Czech writer Karel Capek. The plot was simple: man makes robot then robot kills man!
- **1941** - Science fiction writer Isaac Asimov first used the word "robotics" to describe the technology of robots and predicted the rise of a powerful robot industry.
- **1942** - Asimov wrote "Runaround", a story about robots which contained the "Three Laws of Robotics":
    - A robot may not injure a human, or, through inaction, allow a human being to come to harm.
    - A robot must obey the orders it by human beings except where such orders would conflic with the First Law.
    - A robot must protect its own existence as long as such protection does not conflict withe the First or Second Law.
- **1948** - "Cybernetics", an influence on artificial intelligence research was published by Norbert Wiener
- **1956** - George Devol and Joseph Engelberger formed the world's first robot company.
- **1959** - Computer-assisted manufacturingg was demonstrated at the Servomechanisms Lab at MIT.
- **1961** - The first industrial robot was online in a General Motors automobile factory in New Jersey. It was called UNIMATE.
- **1963** - The first artificial robotic arm to be controlled by a computer was designed. The Rancho Arm was designed as a tool for the handicapped and it's six joints gave it the flexibility of a human arm.
- **1965** - DENDRAL was the first expert system or program designed to execute the accumulated knowledge of subject experts.
- **1968** - The octopus-like Tentacle Arm was developed by Marvin Minsky.

- **1969** - The Stanford Arm was the first electrically powered, computer-controlled robot arm.
- **1970** - Shakey was introduced as the first mobile robot controlled by artificial intellence. It was produced by SRI International.
- **1974** - A robotic arm (the Silver Arm) that performed small-parts assembly using feedback from touch and pressure sensors was designed.
- **1979** - The Standford Cart crossed a chair-filled room without human assistance. The cart had a tv camera mounted on a rail which took pictures from multiple angles and relayed them to a computer. The computer analyzed the distance between the cart and the obstacles

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Vocabulary

- **Android**: an automaton that resembles a human being
- **Anthropomimeti**c: mimicking the human form
- **Artificial intelligence (AI**): computer systems that simulate human intelligence
- **Asimov, Isaac**: first person to use the term "robotics" in "Runaround," a short story published in 1942. He also developed the 3 Rules of Robotics.
- **Automation**: the act of implementing the control of equipment with advanced technology usually replacing human workers with machines.
- **Autonomous**: robots work completely under the control of a computer program. The often use sensors to gather data about their surrounding in order to navigate.
- **Biomimicry**: sustainable innovation inspired by nature.
- **Biometric:** detecting unique physical traits as a means of confirming identity.
- **Co-robots**: robots that work cooperatively with humans.
- **DARPA Defense Advanced Research Projects Agency**: is an agency of the US Dept of Defense responsible for the development of new technology for use by the military
- **da Vinci Surgical System** :This system enhances the surgeon's skills by scaling down and refining hand movements as the surgeon manipulates the instruments through the computer-mediated robotic system.
- **Drone**: an aircraft without a pilot that is operated by remote control.
- **Humanoid**: an automaton that resembles a human being.
- **Industrial robot**: automated machines that work on assembly lines.
- **Intelligent agent**: system that perceives its environment and takes actions that maximize its chances of success.
- **Latency**: a major obstacle in telesurgery-the time delay between the doctors moving his or her hands to the robotic arms responding to those movements.
- Nano-robot: micro robot-a robot the size of a molecule designed to work inside the human body.
- **Remote-controlled**: robots are controlled by humans with a controller such as a joystick or other hand-held device.
- **Robotics**: designing, building, and using robot
- **Superautomation**: advanced, computer-aided automation
- Tele-controlled robots work under the control of humans and /or computer programs

Stratgey

Materials needed for each student: A reading passage of the Robots timeline, from the passage of The RobotShop. Have students read and make notes of timeline facts. Have them create a timeline foldable using information given. Students will need white paper for the timeline creation. Students can work in pairs to create unique and innovative timelines.

Lesson 2

(Excerpts from: Perry Roth-Johnson and Andrew Lee)

Student Will be able to:

- To introduce students to the wide world of robotics
- To familiarize students with basic programming
- Playing with robots!

Background for the Teacher

Robots are everywhere. Most of us do not really think about it but robots are shaping how we live each and every day. Many of the manufacturing processes that were performed by huge assembly lines of people are now replaced by hordes of robots. One of the best examples of this is car assembly lines which are mostly automated. Although robots have an obvious manufacturing utilization, they are having a much larger presence in our daily lives as well. If anyone hates vacuuming, then they have probably heard of the vacuuming robot, Roomba. Of course, as engineers, we do not just use robots for vacuuming. Many engineers in college actually have a hand in building their own robot. Each of these robots is designed with a specific purpose in mind and it is this kind of problem solving that all robots are designed for. In other words, robots are always designed to solve a certain problem. These problems could range from a simple academic problem like designing a robot to climb up a slope or to a much more practical application like designing a robot to do your dirty dishes.

The future of robot innovation is heading in the direction of making humanoid. Which are robots that are making robots that are humanlike. The above picture shows ASIMO, a robot created by Honda that mimics human walking. Although these robots are still relatively "dumb", the field of robot research is progressing rapidly. However, if a robot is designed with artificial intelligence and glowing red eyes then this engineer votes that we should demolish it right away.

Vocabulary

- Robotics
- Sensors
- Programming

Strategy

We have a troublesome robot that wants to wander away all of the time. Since we don't want our robot to get far away from home and get lost, we will "draw" a "box" on the ground with electrical tape to keep the robot inside. We need to write a "box" program for the robot that will "teach" it to stay inside the box instead of wandering away all of the time.

- Survey students' prior knowledge about programming, sensors, and robotics. Explain that programs are like a set of instructions given to a robot to accomplish a specific task. Sensors help the robot become aware of its surroundings so it can carry out these instructions, based on its environment (5-10 min).

- Fill out worksheets to write the "box" program (10 min).
- Enter the "box" program from the worksheet into the robot. Test if the program works (20 min).
- Wrap-up, concluding remarks, quasi post-test, what is being done in research? (5-10 min).

Materials

- LEGO Mindstorm EV3 Robot (~$389), three (or more) per site
- Electrical Tape (one roll, ~$1.00), one (or more) roll(s) per site

Procedures

1. Introduce students to the different sensors on the robot with the pre-loaded "Try Me" programs.
    a. Push the orange ("OK") button to turn the robot on.
    b. Push the left arrow to scroll over to "Try Me" and push the orange button to select it.
    c. Try running each of the Try-programs one at a time, so the students get a feel for how each of the sensors work. Use the orange ("OK") button to

execute programs, and use the grey (“BACK”) button to return to previous menus.

2. Ask the students to plan out their “box” programs on their worksheets.
3. “Draw” a “box” on the ground with the electrical tape. The dimensions of the box should be at least 2 feet on each side.
4. Enter the “box” program into the robot.
a. Push the grey (“BACK”) button several times to return to the home screen.
b. Push the right arrow to scroll over to “NXT Program” and push the orange button to select it.
c. Push the orange button again to confirm the port settings.
d. Enter the students’ “box” program from their worksheet. Select each command block one at a time with the arrows, and push the orange (“OK”) button to enter each block into the program. The correct order for the “box” program is listed below:
i. Forward (move forward until the next condition is satisfied)
ii. Dark (when the light sensor sees a dark color, move on to the next command)
iii. Back right 2 (backup and turn right for 2 seconds)
iv. Empty (do nothing, move on to the next command)
v. Loop (go back to step 1)
e. Select “Run” to execute the “box” program.

Resources
1. http://mindstorms.lego.com/en-us/default.aspx

How do I use the Introduction to Programming EV3 Curriculum in my class? LESSON 3

Introduction to Programming is designed for student self-pacing in small groups, preferably pairs. Each pair of students should work together at one computer, with one EV3 robot.

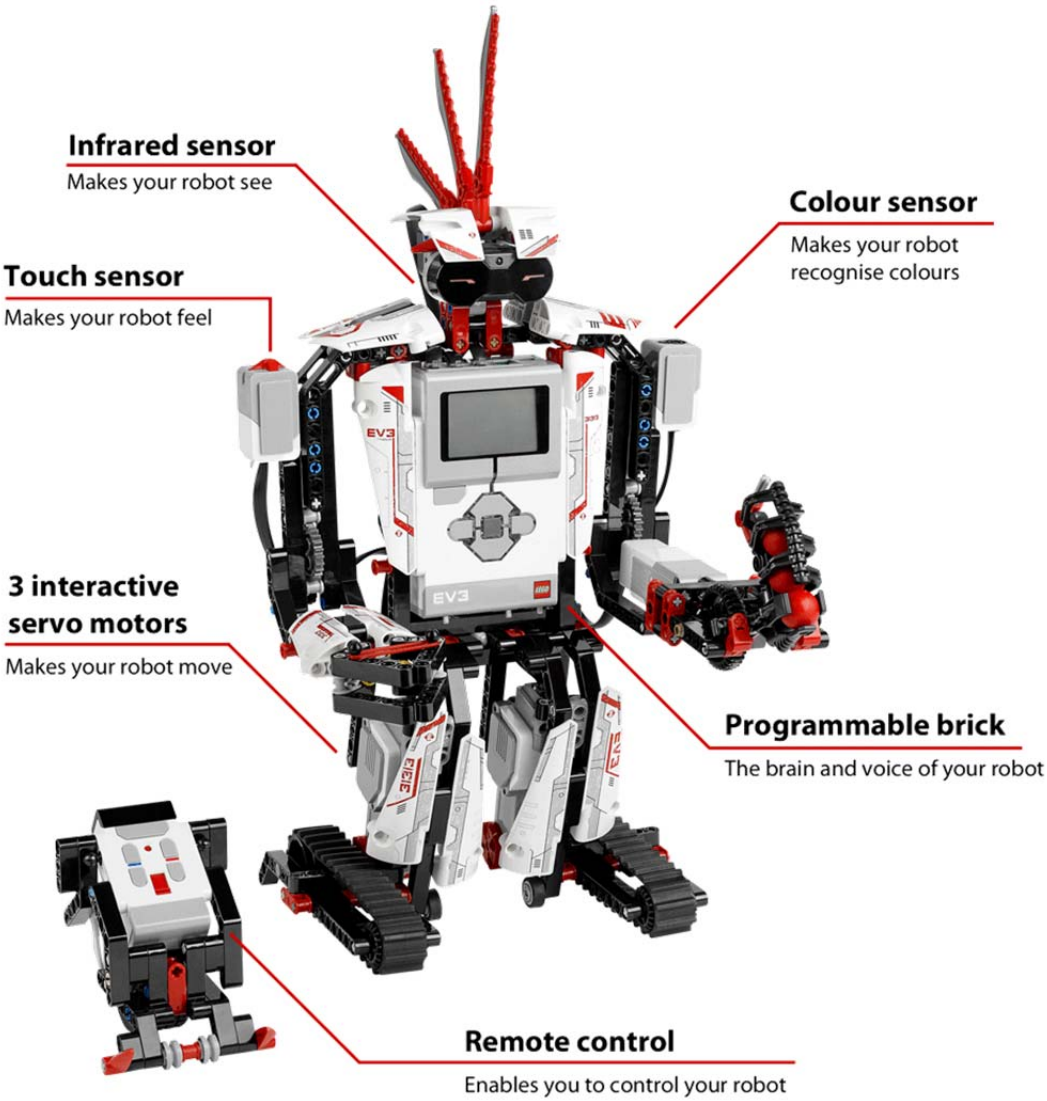
Curriculum tasks are designed to involve some – but not extensive – mechanical consideration, so that hands-on design tasks may remain authentic without becoming logistically difficult.

Solutions will not require parts in excess of those included in the 45544 EV3 Core set, so it is sufficient to leave each team with one kit (although access to additional parts may allow students to construct more creative solutions to problems).

A typical plan for an Introduction to Programming chapter is:

1. View the introductory video as a class, or in individual groups, then review the challenge task for the unit
   - In a group, identify and note key capabilities the robot must develop, and problems that must be solved in individual engineering journals or class logs (e.g. on sticky paper posted on the walls)
2. Groups proceed through the video trainer materials at their own pace, following the video instruction directly, and constructing solutions to the Try It! and Mini-Challenge steps as they go
3. Each group constructs its own solution to the Unit Challenge
   - Groups may be asked to document their solutions in journals or logs, and especially to explain how they overcame the key problems identified at the start of the unit
4. Assign the Reflective Question for the chapter
   - Students answer the Reflection Question for the chapter individually, as an in-class or homework assignment
   - Reflection Questions for each chapter can be found in the Reproducibles section of this Teacher's Guide

Program Components



Background for the Teacher

What are the Big Ideas taught in the Introduction to Programming EV3 Curriculum?

Robotics can be something you teach with, as well as something you teach about. Introduction to Programming uses robots, and covers robotics content, but ultimately seeks to give students experience and access to a much broader set of skills and perspectives called Computational Thinking.

Objectives in the series of lessons

The Student will be able to:

- Big Idea #1: Programming is Precise

  If you want a robot to do something, you need to communicate that idea with mathematical and logical precision, or it won't quite be what you intended.
- Big Idea #2: Sensors, Programs, and Actions

  Data from sensors gives a robot information about its environment. A program uses that data to make decisions, and the robot Acts on those decisions. Data underlies the core of the entire process.
- Big Idea #3: Make Sense of Systems

  To understand the way something works, construct a mental "model" of it in your head that captures the important features and rules of the system. This helps you make sense of it, and also gives you a tool to "play out" (similar) new scenarios in your head to predict what would happen.
- Big Idea #4: Break Down Problems and Build Up Solutions

  To solve a difficult problem, try breaking it down into smaller problems. Then, solve the smaller problems, building up toward a solution to the big problem.
- Big Idea #5: Computational Thinking Applies Everywhere

  These skills – mathematical and logical clarity, using data, systems thinking with mental models, and problem solving – are not just for robotics. They are key to solving many problems in the world.

Components of the EV3

Large Motor- Lets you program precise and powerful robotic actions.

Medium Motor-Maintain precision while trading some power for compact size and faster response**.**

EV3 Brick- Serves as the control center and power station for the robot.

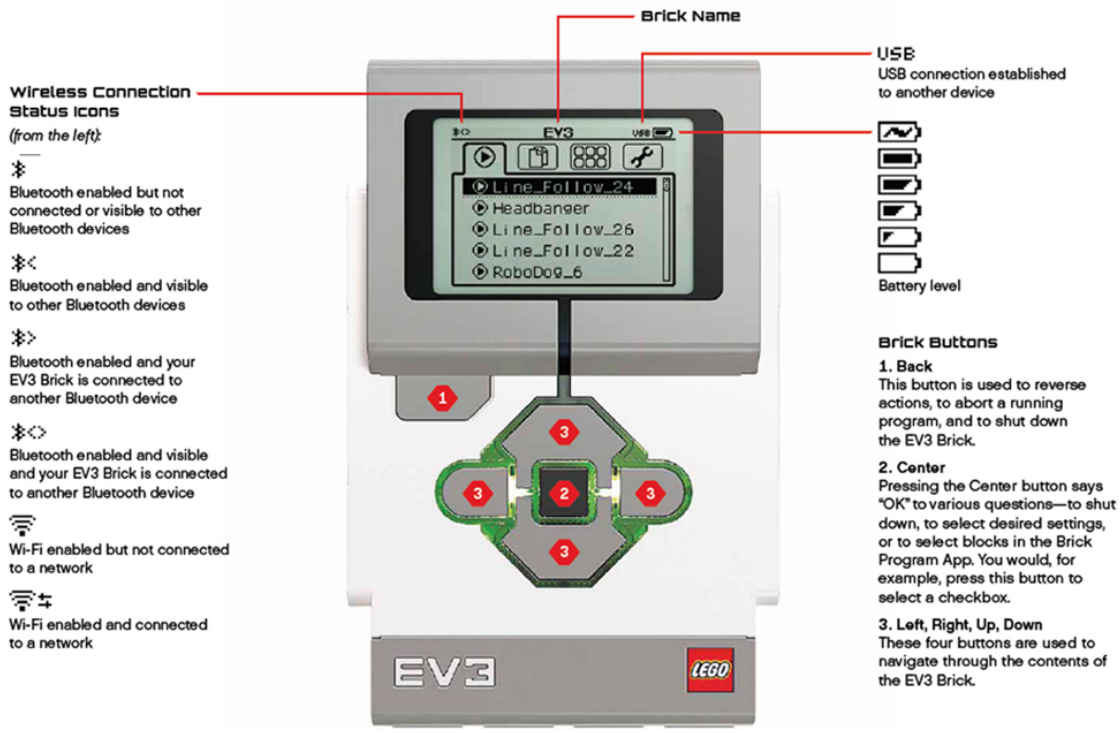
Remote Infrared Beacon- remote controls your robot from a distance.

- **Touch Sensor**- Recognizes three conditions: touched Bumped and release**.**
- **Color Sensor**- Recognizes seven different colors and measures light intensity.
- **Infrared Sensor**- Detects objects and can track and find the Remote Infrared Beacon.

EV3 Brick

The **Display** shows you what is going on inside the EV3 Brick and enables you to use the Brick Interface. It also allows you to add text and numerical or graphic responses into your programming or experiments. For example, you might want to program the Display to show a happy face (or a sad face) for a comparison response or to display a number that is the result of a mathematical calculation (learn more about using the **Display Block** in the EV3 Software Help). The **Brick Buttons** allow you to navigate inside the EV3 Brick Interface. They can also be

used as programmable activators. For example, you might program a robot to raise its arms if the Up button is pressed or to lower them if the Down button is pressed (for more information, see **Using the Brick Buttons** in the EV3 Software Help).



EV3 Brick

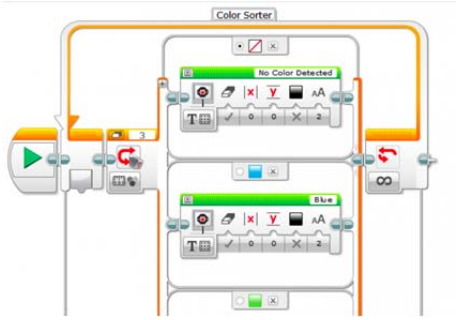
The **Brick Status Light** that surrounds the Brick Buttons tells you the current status of the EV3 Brick. It can be green, orange, or red, and can pulse. Brick Status Light codes are the following:

+ Red = Startup, Updating, Shutdown
+ Red pulsing = Busy
+ Orange = Alert, Ready
+ Orange pulsing = Alert, Running
+ Green = Ready
+ Green pulsing = Running program

You can also program the Brick Status Light to show different colors and to pulse when different conditions are met (learn more about using the **Brick Status Light Block** in the EV3 Software Help).

Input Ports- ports 1, 2, 3, 4 are used to connect sensors to the EV3 Brick.

Output Ports- ports A, B,C,D used to connect motors to EV3 Brick.

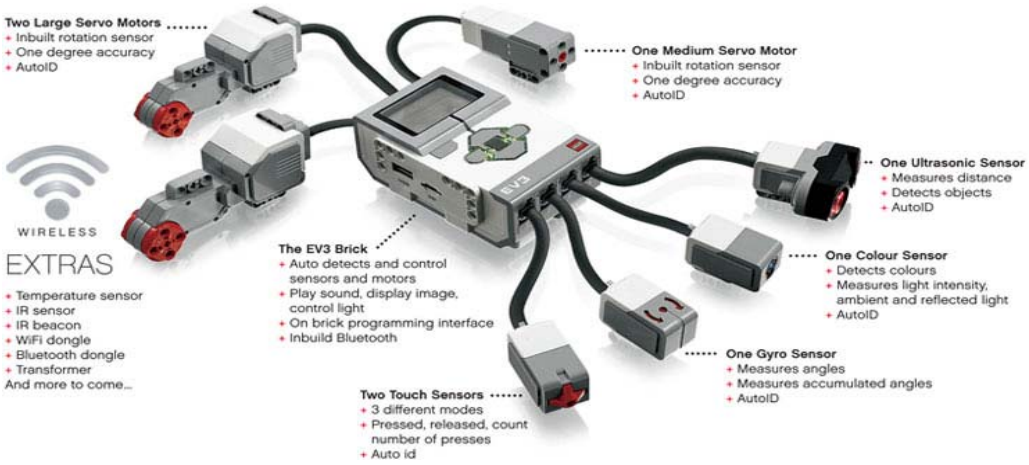


Speaker -All sounds from the EV3 Brick come through this speaker—including any sound effects used in programming your robots. When the quality of the sound is important to you, try to leave the speaker uncovered while designing your robot.

USB Host Port- **Can** be used to add a USB Wi-Fi dongle for connecting a wireless Connection.

Putting it all together

The Large Motor is a powerful "smart" motor. It has a built-in Rotation Sensor with 1-degree resolution for precise control. The Large Motor is optimized to be the driving base on your robots. By using the Move Steering or Move Tank programming block in the EV3 Software, the Large Motors will coordinate the action simultaneously.



Medium Motor

The Medium Motor also includes a built-in Rotation Sensor (with 1-degree resolution), but it is smaller and lighter than the Large Motor. That means it is able to respond more quickly than the Large Motor.

The Medium Motor can be programmed to turn on or off, control its power level, or to run for a specified amount of time or rotations.

Sensors

The Color Sensor is a digital sensor that can detect the color or intensity of light that enters the small window on the face of the sensor. This sensor can be used in three different modes: Color Mode, Reflected Light Intensity Mode, and Ambient Light Intensity Mode.

In **Color Mode**, the Color Sensor recognizes seven colors—black, blue, green, yellow, red, white, and brown—plus No Color. This ability to differentiate between colors means your robot might be programmed to sort colored balls or blocks, speak the names of colors as they are detected, or stop action when it sees red.

In **Reflected Light Intensity Mode**, the Color Sensor measures the intensity of light reflected back from a red light–emitting lamp. The sensor uses a scale of 0 (very dark) to 100 (very light). This means your robot might be programmed to move around on a white surface until a black line is detected, or to interpret a color-coded identification card.

In **Ambient Light Intensity Mode**, the Color Sensor measures the strength of light that enters the window from its environment, such as sunlight or the beam of a flashlight. The sensor uses a scale of 0 (very dark) to 100 (very light). This means your robot might be programmed to set off an alarm when the sun rises in the morning, or stop action if the lights go out. The sample rate of the Color Sensor is 1 kHz/sec. For the best accuracy, when in Color Mode or Reflected Light Intensity Mode, the sensor must be held at a right angle, close to—but not touching—the surface it is examining.

Sensors and Motors

In order to function, motors and sensors must be connected to the EV3 Brick.

Using the flat black Connector Cables, link sensors to the EV3 Brick using Input Ports 1, 2, 3, and 4. If you create programs while the EV3 Brick is not connected to your computer, the software will assign sensors to default ports. Those default port assignments are:

+ Port 1: Touch Sensor
+ Port 2: No sensor
+ Port 3: Color Sensor
+ Port 4: Infrared Sensor

If the EV3 Brick is connected to your computer while you program, the software will automatically identify which port is being used for each sensor or motor. Using the flat black Connector Cables, link motors to the EV3 Brick using Output Ports A, B, C, and D. As with the sensors, if the EV3 Brick is not connected when you are writing a program, each motor will be assigned to a default port.

Default port assignments are:

+ Port A: Medium Motor
+ Port B and C: Two Large Motors
+ Port D: Large Motor

If the EV3 Brick is connected to the computer when you are programming, the software will automatically assign the correct port in your programs.

Connecting the EV3 Brick to Your Computer

Connect the EV3 Brick to your computer by USB Cable or wirelessly using either Bluetooth or Wi-Fi.

USB Cable
Using the USB Cable, plug the Mini-USB end into the EV3 Brick's PC Port (located next to Port D). Plug the USB end into your computer.

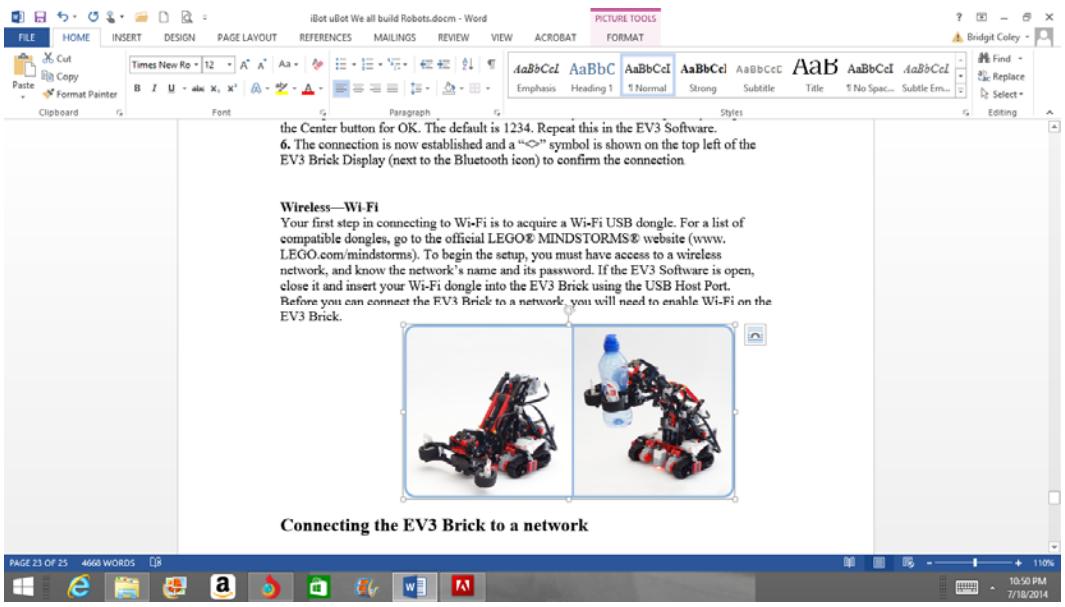
Wireless—Bluetooth
If your computer is not Bluetooth enabled, you will need a Bluetooth USB dongle for your computer.

Making a Bluetooth Connection to the Computer
Before you can make a Bluetooth connection between the EV3 Brick and the computer running the EV3 Software, you will need to enable Bluetooth on the EV3 Brick. Once you have enabled Bluetooth on the EV3 Brick, it can now be connected to the computer and EV3 Software.

1. First, confirm that the EV3 Brick is turned on.
2. Open a new or existing program in the EV3 Software
3. Go to the Hardware Page at the lower right of the screen— expand the window if collapsed.
4. Click on the Available Bricks tab. If your EV3 Brick is not already listed, click the refresh button to locate the EV3 Brick and check the Bluetooth box that will appear.
5. Accept the connection on your EV3 Brick manually, then enter the passkey and press the Center button for OK. The default is 1234. Repeat this in the EV3 Software.
6. The connection is now established and a "<>" symbol is shown on the top left of the EV3 Brick Display (next to the Bluetooth icon) to confirm the connection.

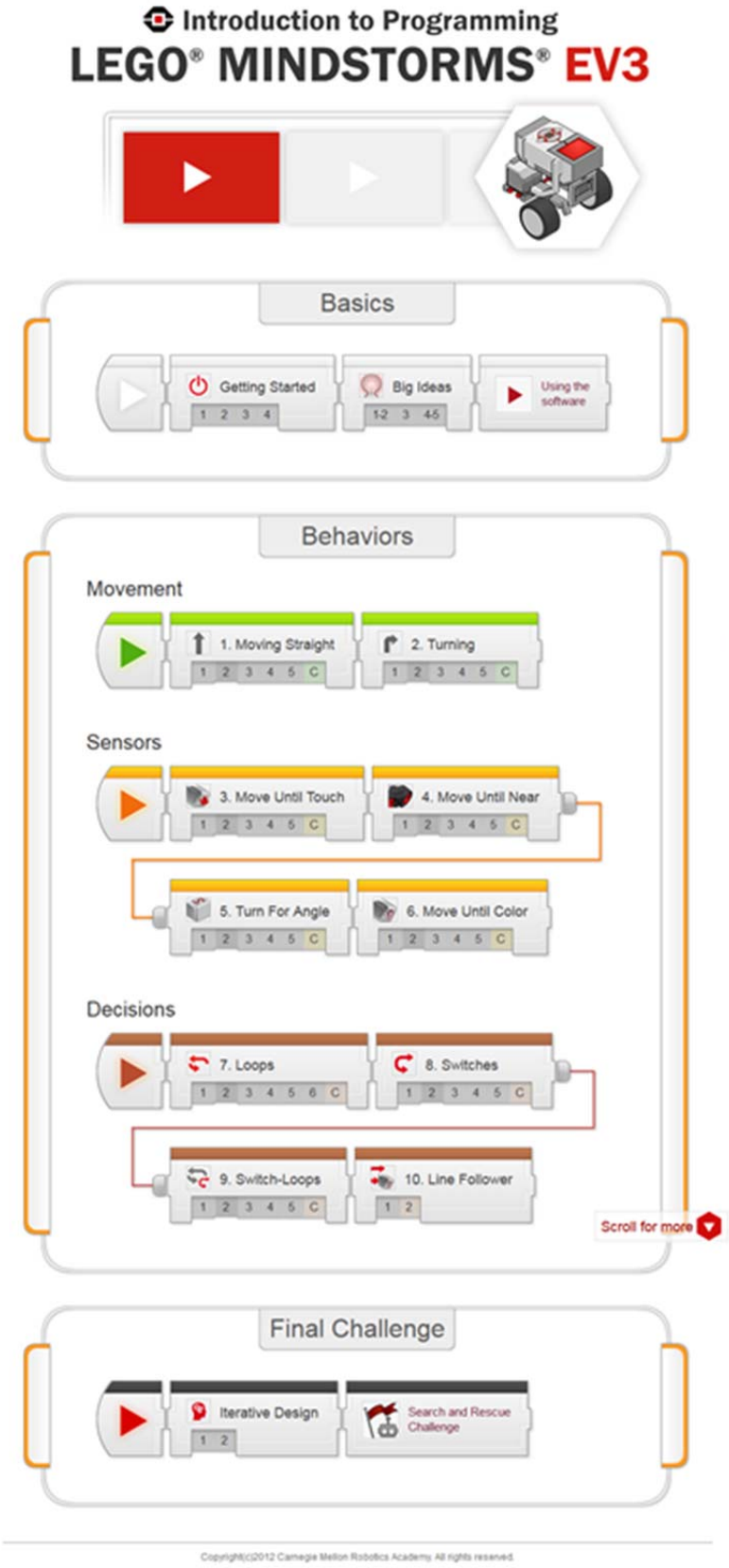
Wireless—Wi-Fi

Your first step in connecting to Wi-Fi is to acquire a Wi-Fi USB dongle. For a list of compatible dongles, go to the official LEGO® MINDSTORMS® website (www. LEGO.com/mindstorms). To begin the setup, you must have access to a wireless network, and know the network's name and its password. If the EV3 Software is open, close it and insert your Wi-Fi dongle into the EV3 Brick using the USB Host Port. Before you can connect the EV3 Brick to a network, you will need to enable Wi-Fi on the EV3 Brick.



Connecting the EV3 Brick to a network

After selecting Wi-Fi on the Settings screen, use the Up and Down buttons to select Connections and press the Center button for OK. The EV3 Brick will now search for and list available Wi-Fi networks. Using the Up and Down buttons for navigation, find your network on the list. If the EV3 Brick is not already connected to your network (indicated by a check mark), select your network using the Center button. In the Network dialog box that appears, select Connect and press OK with the Center button. You will now be asked to enter the encryption type and the network password using the Left, Right, Up, and Down buttons to navigate (upper and lower cases do matter here). Once you have entered the correct password, press the check mark for OK. You will now be connected to the network. If the EV3 Brick does not find your network in its search, the network may be hidden. To connect to a hidden network, select “Add hidden.” You will then be asked to enter the name, encryption type, and password for the hidden network you wish to add (upper and lower cases do matter here). Once done, the EV3 Brick will be connected to the hidden network and the network will be included in the network list.



Basics Unit

Getting Started: Set up the robot and learn about its basic operation and maintenance
Big Ideas: Five big ideas that will be important throughout the course
Using the Software: General usage patterns in the EV3 Programming Software

Behaviors Unit

Movement: Use sequential commands to make the robot move and turn
Sensors: Use Sensors to stop the robot in different situations
Decisions: Use Loops and Switches to control the program with smarter decisions

Final Challenge Unit

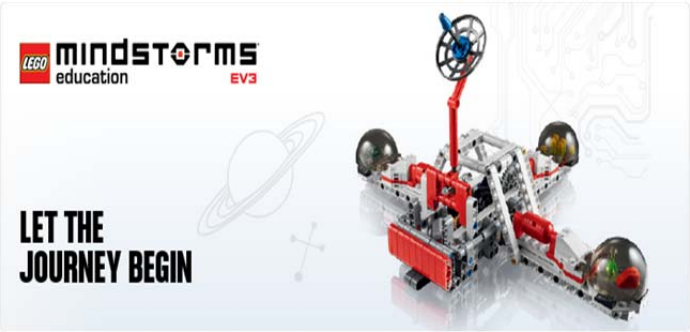
Combine the techniques of earlier units to tackle a more complex challenge.

Building Apps- S.T.E.M.

Students can build EV3RSTORM, TRACK3R, GRIPP3R, SPIK3R and R3PTAR using our Free-to-download building instructions viewed in a 3D environment; using intuitive touch gestures you can zoom, pan and orbit around the model's instructions as you build to get a closer view.

They can complete the building missions step by step, or watch the animated assembly at your own speed; or even check to see what part of the model being building by the click of the sub part viewer. And for the advanced builder; you can tap on each element for a pop-up to appear with the element reference and color.

EV3 Space- S.T.E.M.



Blast into instant success with science, technology, engineering, and maths with LEGO® MINDSTORMS® Education EV3 and the new EV3 Space Challenge Activity Pack! Designed as an engaging and easy way to introduce students to robotics, students will work with a very current and real-world theme – travelling to and living on Mars!
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LEGO MINDSTORMS Education EV3 is available in a variety of different classroom solutions. From individual hardware and software licenses to solutions for every class size, there's an EV3 for every school and budget.

Find out more about the EV3 Space Challenge Activity Pack.
http://education.lego.com/en-us/preschool-and-school/secondary/mindstorms-education-ev3/space/introduction

Assessments

Formative assessments can be used in a number of ways to assess students' knowledge and understanding. I will give a few examples of thing I have done with the lessons.

- 3X summarization: To check for understanding ask the students to write three different summaries. One in 10-15 words, two in 30-50 words and the last one in 50-100 words. The different lengths requires attention to detail. Compare/contrast with peers and look at the demonstration model.
- Quizzes: Give a quiz and either you or have them check the answers. Use information from quizzes to guide pace of the lesson,
- Extension Projects: Ideal for the timeline article, diorama, poster, foldable, collage, abc book to demonstrate ideas from the concepts.
- Goggle Forms: Comments/suggestions/questions about the lesson… Give a minimum number to create.
- Apps such as Teacher Pal: If your classroom is a BYOD you can have students ask and answer questions, so that info isn't repeated.
- Text the Answer: Again a BYOD class, can text answers to a site such as Wifitti (http://goo.gl/wrxOC).
- Google Docs: Have students do there writing or notes in google docs while working on the unit. You can make comments and feedback directly, eliminating papers.

Summative assessments, will include the final Robot project and the technical lab report written by each group.

References

Timeline article about the history of robots: Retrieved from:
http://www.robotshop.com/media/files/PDF/timeline.pdf

http://www.robotics-academy.org/blog/tag/mindstorms/

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http://science.dadeschools.net/middleSchool/default.html

Rubrics for Work Skills

Lab Report Requirements

All lab reports must include all of the following parts

Title- written on the top of the page.

Purpose - what are we looking for or why are doing this?

Hypothesis - proposed answer to a question or tentative solution to a problem.

Materials - just list the items used/needed.

Procedure - step-by-step listing of what was/is done. Must be written in your own words, unless otherwise stated.

Data / Observations - usually a table. Be sure to label all tables.

Calculations - give an example of each calculation done. If 3 different types of calculations were done, then give 3 samples (one of each).

Analysis of Results - usually graphs. If the graphs are attached at the back of the report, then write next to Analysis of Results -see attached.

Questions - write the questions (unless stated otherwise). One set of answers per lab report please.

Sources of Error - Don't skip!!! Every lab procedure has sources of error listed.

Conclusion - The most important part of the lab report. If it is missing, one letter grade will be deducted from the final grade.

Must include all 7 points!!!

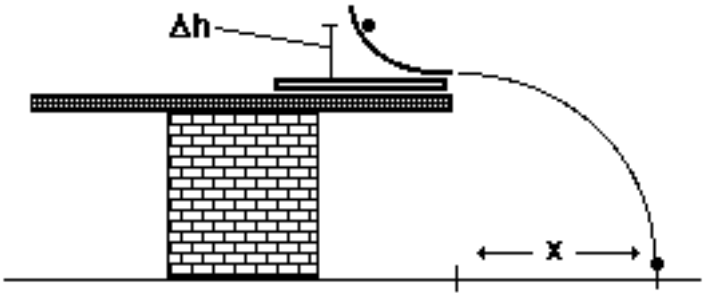
1. State what was investigated.
2. Describe whether or not the hypothesis was supported by the results.
3. Include sample results.
4. Compare the results with other investigations.
5. Provide possible explanations for your results.
6. Recommend additional studies. {What would you do differently?}
7. Discuss possible applications. {How does it apply to real life?}

http://science.dadeschools.net/middleSchool/writingInScience.html

Writing the Science Lab Report

Labs form the basis for our understanding of key concepts in science. The following are basic guidelines for successful writing and production of a quality lab report:

1. Always keep notes and data collected during a lab on loose-leaf paper.
2. Write laboratory reports on loose-leaf paper or word-processed (12 pt, Times New Roman, double space, and on one side only).
3. Write an appropriate title for the report in the center of the first page (cover page) of the report.
4. Write your name, the name(s) of all members of your laboratory team, and the date the investigation was performed under the title.
5. Complete each of the following sections:

Purpose (Hypothesis)	Statement of the problem to be investigated. Describe the reason for performing experiment and what are the expected outcomes. This should provide the overall direction for the laboratory investigation and must be re-addressed in the conclusion.
Apparatus	List and draw all laboratory apparatus used in the investigation. Drawing must be a detailed diagram illustrating the configuration of the apparatus. The variables to be measured should be clearly pictured. See sample below: 
Procedure	List all the procedures necessary to recreate your experiment/activity. Identify and name all experimental variables and briefly describe how the independent variables are controlled. Anyone not present during the lab must be able to understand and recreate the experiment by following your procedures.
Data	Create a table of all the data collected. Data consists only of those values measured directly from the experimental apparatus. No values obtained by way of mathematical manipulations or interpretations of any kind may be included in this section of the report. Data should consist of as many trials as judgment would indicate necessary. The units for physical measurements (kg, m, s, etc.) in a data table should be specified in column heading only.
Evaluation Of Data	Include all graphs, analysis of graphs, and calculations performed in the analysis of data. State each formula, and if necessary, identify the symbols used in the formula. If repetitive calculations are to be performed, substitute only one set of data into each formula and then construct a **table of values** for all additional calculated values. Be certain that your final calculated values are expressed to the correct number of significant figures.
Conclusion	Write the purpose and the results of the experiment: **a)** verify the outcome of the experiment; **b)** state the relationship between the variables identified in the ***Purpose***; **c)** use clear and concise sentences; **d)** (when appropriate), state the meaning of the slope, area under the curve, and discuss the significance of the **y**-intercept, and write the mathematical expression derived from graphical analysis with the appropriate units; **e)** describe any new terms that arise as a result of your evaluation of data; and **f)** provide a plausible explanation when your results differ from what is expected.

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