

# STEM Resource Kits

## **GCPS STEM Innovation Grant Resource Catalog**

- **Robotics & Programming**
- **3D Modeling**
- **Scientific Inquiry**

***The STEM Resource Kit Catalog is for schools participating in the STEM Innovation Grant program.***

***Each participating school may select one resource kit valued at \$3,000. Please use this catalog to help you make the selection for your school.***

***Orders must be placed by June 26, 2015 online at***  
***<http://goo.gl/forms/PiK8pSGkAq>.***

***Download a copy of this catalog at***  
***<http://steminnovationgrant.weebly.com/>***

***or using the QR code below.***



## Table of Contents

### Product Descriptions

#### Robotics & Programming

MaKey MaKey	3
Bee-Bots	4
Arduino	5
LEGO Mindstorms Education EV3	6
Raspberry Pi	7
VEX EDR	8

#### 3D Modeling

UP Mini 3D Printers	9
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#### Scientific Inquiry

Globisens Mini Wireless Science Lab	10
Globisens LabDisc Physio Wireless Science Lab	10
Globisens LabDisc BioChem Wireless Science Lab	10

### Resource Kits

Elementary School (K – 5)	11
Middle School (6 – 8)	12
High School (9 – 12)	13

Software Tools for Grant Schools	15
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# Robotics & Programming

Page 3



## What's a MaKey MaKey?

MaKey MaKey is **an invention kit for the 21st century**. Turn everyday objects into touchpads and combine them with the internet. It's a **simple Invention Kit for Beginners and Experts** art, engineering, and everything in between. The kit will include everything you see at right: MaKey MaKey, Alligator Clips, USB Cable.

### How Does it Work?

Alligator Clip two objects to the MaKey MaKey board. For example, you and a banana (any material that can conduct a charge will work). When you touch the banana, you make a connection, and MaKey MaKey sends the computer a keyboard message. The computer just thinks MaKey MaKey is a regular keyboard (or mouse). Therefore it works with all programs and webpages, because all programs and webpages take keyboard and mouse input.

### Make + Key = MaKey MaKey!

Target Grade Levels: K—5

Course Possibilities: Science, Math, Music, Art

Focus: Robotics & Programming

Retrieved May 6, 2015. <http://makeymakey.com/>

### Magnetic MaKey MaKey Mazes

by Village of Arts and Humanities, North Philadelphia

Create your own squishy circuit labyrinth and navigate them them using magnets under a table for a time score.

Materials: Thin card table, pencils, paper, Play-Doh, 9V battery, LEDs, 2 Magnets, old telephone wire, Makey Makey Kit, and foil, fruit, wire, or anything that conducts!

Software: Scratch

### "Save the Usable!"

by New Century School, Verona, WI, USA

How a 2nd & 3rd grade class made "conservation inventions."

Materials: 10 MaKey MaKeys (1 for every group of 2 students), 10 PicoBoards (optional), miscellaneous objects—found at home/school, or from second-hand stores

Time: 2 months, done a little at a time :)

Retrieved May 12, 2015. <http://makeymakey.com/guides/maze.php>

# Robotics & Programming

Page 4

## [ Bee Bots ]



This colorful, easy-to-operate, and friendly little robot is a perfect tool for teaching sequencing, estimation, problem-solving, and just having fun!

Directional keys are used to enter up to 40 commands which send Bee-Bot forward, back, left, and right. Pressing the green GO button starts Bee-Bot on its way. Bee-Bot blinks and beeps at the conclusion of each command to allow children to follow Bee-Bot through the program they have entered and then confirms its completion with lights and sound.

Bee-Bot is powered by a built-in rechargeable battery. Recharging is done via a standard USB recharger or USB computer port. A USB recharger cable comes with each Bee-Bot.

Target Grade Levels: K—5

Course Possibilities: Literacy, Science, Math, Social Studies, Art, Music

Focus: Robotics & Programming

Retrieved May 6, 2015. <https://www.bee-bot.us/>



“Bee-Bot brings fun and excitement into the classroom while inspiring learning. Students learn directions, planning, sequencing and work together while having fun. By motivating students, Bee-Bot can be used to introduce and teach a wide range of subjects and enhance student skills in many areas.”

Retrieved May 12, 2015. <https://www.bee-bot.us/>

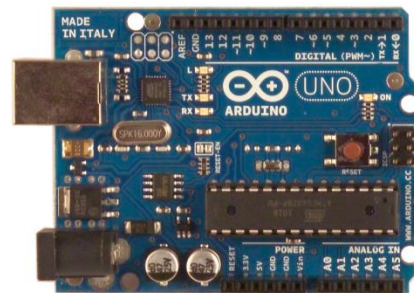
# Robotics & Programming

Page 5

## Arduino

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.

Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can communicate with software running on your computer (e.g. Flash, Processing,.) The boards can be assembled by hand or purchased preassembled; the open-source IDE can be downloaded for free.



Target Grade Levels: 6—12

Course Possibilities: Science, Math, Art, Music, Computer Science

Focus: Robotics & Programming

Retrieved May 7, 2015. <http://www.arduino.cc/en/Main/ArduinoBoardUno>

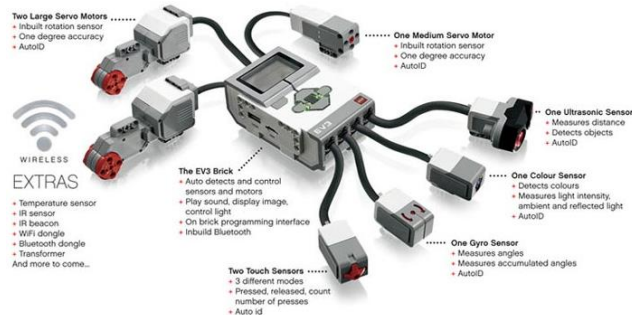
### The Arduino Starter Kit



This kit walks you through the basics of using the Arduino in a hands-on way. You'll learn through building several creative projects. The kit includes a selection of the most common and useful electronic components with a book of 15 projects. Starting the basics of electronics, to more complex projects, the kit will help you control the physical world with sensor and actuators. The projects in the kit are:

- 06 LIGHT THEREMIN create a musical instrument you play by waving your hands
- 07 KEYBOARD INSTRUMENT play music and make some noise with this keyboard
- 08 DIGITAL HOURGLASS a light-up hourglass that can stop you from working too much
- 09 MOTORIZED PINWHEEL a color wheel that will have your head spinning
- 10 ZOETROPE create a mechanical animation you can play forward or reverse
- 11 CRYSTAL BALL a mystical tour to answer all your tough question
- 12 KNOCK LOCK tap out the secret code to open the door
- 13 TOUCHY-FEEL LAMP a lamp that responds to your touch
- 14 TWEAK THE ARDUINO LOGO control your personal computer from your Arduino
- 15 HACKING BUTTONS create a master control for all your devices!

Retrieved May 12, 2015. <http://www.arduino.cc/en/Main/ArduinoStarterKit>



## LEGO Mindstorms Education EV3

This core set is optimized for classroom use and contains all you need to teach using LEGO® MINDSTORMS® Education EV3. It enables students to build, program, and test their solutions based on real-life robotics technology. It contains the EV3 Intelligent Brick, a powerful small computer that makes it possible to control motors and collect sensor feedback. It also enables Bluetooth® and Wi-Fi communication as well as provides programming and data logging. Students are encouraged to brainstorm in order to find creative solutions to problems and then develop them through a process of selecting, building, testing, and evaluating. This is also an excellent way of getting students to talk to each other and cooperate as well as giving them hands-on experience with an array of sensors, motors, and intelligent units. Printed building instructions for the Robot Educator model are included in the set, and instructions for four additional models are included in the software. The set also comes in a sturdy plastic storage bin with a sorting tray for easy classroom use and organization. Software sold separately.

Target Grade Levels: 4 - 12

Course Possibilities: Science, Math, Career & Technical Education, Engineering, Computer Science

Focus: Robotics & Programming

Retrieved May 7, 2015. <https://shop.education.lego.com>



Key Learning Values:

- Design and build programmable robots using motors, sensors, gears, wheels and axles, and other technical components
- Understand and interpret two-dimensional drawings to create three-dimensional models
- Build, test, troubleshoot, and revise designs to improve robot performance
- Gain practical, hands-on experience using mathematical concepts such as estimating and measuring distance, time, and speed
- Communicate effectively using scientific and technical language

Retrieved May 12, 2015. <https://shop.education.lego.com/legoed/en-US/catalog/product.jsp?productId=5003400&isSimpleSearch=false&ProductName=EV3-Core-Set-&ProductLine=LEGO-MINDSTORMS-Education-EV3>

# Robotics & Programming

Page 7



## What's a Raspberry Pi?

The Raspberry Pi is a low cost, **credit-card sized computer** that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.

What's more, the Raspberry Pi has the ability to interact with the outside world, and has been in a wide array of digital maker projects, from music machines and parent detectors to weather stations and tweeting birdhouses with infra-red cameras. We want to see the Raspberry Pi being used by kids all over the world to learn to program and understand how computers work.

Target Grade Levels: 9—12

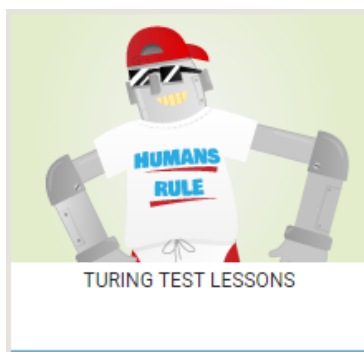
Course Possibilities: Science, Math, Career and Technical Education (Computer Networking, Interactive Media, Computing, STEM)

Focus: Robotics & Programming

Retrieved May 7, 2015. <https://www.raspberrypi.org/help/what-is-a-raspberry-pi/>



Teach students how to use loops and conditions to sort students into houses, Harry Potter style!



An introduction to text programming using Python on the Raspberry Pi to create a chatting robot.



Teach the basics of building for the web with Google Coder.

Retrieved May 12, 2015. <https://www.raspberrypi.org/resources/teach/>





## VEX EDR Programming Control Kit

Build a programmable starter robot!

The Programming Control Starter Kit includes everything needed to build a fully capable robot using the included programmable Cortex Microcontroller and various sensor types. Programming software (sold separately) is required for autonomous programming, integration of sensors and more.

With more and more schools adopting VEX Robotics as a platform to enrich and enhance science, technology, engineering, and mathematics (STEM) courses, there is a need for an integrated program which allows teachers to seamlessly add VEX into their classrooms. As such we have worked with various partners to create an array of VEX curriculum offerings, each tailored to the specific needs of teachers wishing incorporate VEX into their classes.

Target Grade Levels: 9—12

Course Possibilities: Science, Math, Career and Technical Education (Computing, Engineering, Architecture, STEM)

Focus: Robotics & Programming

Retrieved May 7, 2015. <http://www.vexrobotics.com/>

### Problem Statement for Sweet Apple Orchards

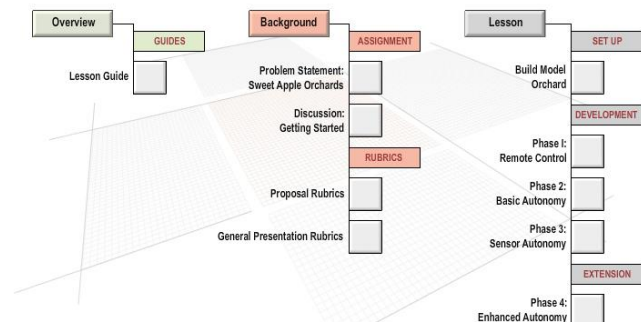
#### Scenario

Your company (give yourselves a name!) develops automation technology to improve production efficiency for client companies. Sweet Apple Orchards Agricultural Suppliers, Inc. is interested in whether automation technology can improve the effectiveness of its pesticide sprayer vehicle fleet.

#### Task

Present a cost-benefit analysis for an automated ground-based vehicle for pesticide application. The ground-based vehicles would be designed to navigate between rows of trees in an orchard and spray pesticides. A single operator, working from a remote location, could oversee the operation of the vehicle, or even multiple vehicles. Your analysis must weigh the pros of this approach with the cons, and make them clear to the client. Be sure to consider environmental, financial, and social factors in your analysis.

### Orchard Project Learning Activities



Retrieved May 12, 2015.

[http://www.education.rec.ri.cmu.edu/products/vex\\_online/curriculum/path\\_planning/orchard/docs/presentation\\_assignment.pdf](http://www.education.rec.ri.cmu.edu/products/vex_online/curriculum/path_planning/orchard/docs/presentation_assignment.pdf)

# 3D Modeling

Page 9

## UP! Mini 3D Printer



Teach children how to think, imagine, create, craft and print in 3D. Make designs come to life while you energize and inspire children's creativity, while preparing them for the jobs of the future.

The UP Mini's form-factor fits neatly into any work environment but it's capabilities are anything but minute. Build anything that can fit within a 120 mm x 120 mm x 120 mm volume or print your model in sections then assemble into a towering masterpiece. The sky is the limit with the UP Mini.

Target Grade Levels: 6—12

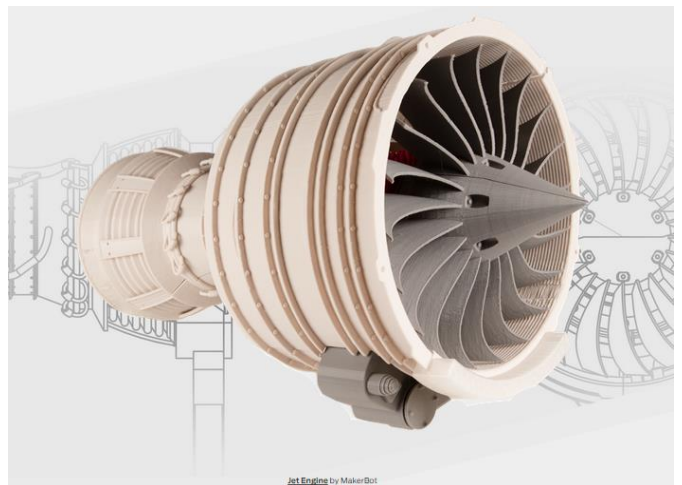
Course Possibilities: Anatomy & Physiology, Career & Technical Education (Architecture, Engineering, Graphics and Design, STEM)

Focus: 3D Modeling

Retrieved May 27, 2015. <http://www.up3dusa.com/#!/mini-features/cf3m>



Architecture and Design



Prototyping and Engineering

Retrieved May 12, 2015. <http://www.makerbot.com/uses/for-educators>



## Globisens Mini Wireless Science Lab

### GENERAL SCIENCE

- Built-in and accessible sensors for K-12 science including external temperature, ambient temperature, humidity, voltage, current, air pressure, heart rate, GPS, pH (electrode sold separately).
- Wireless communication – for convenient and clean data logging
- Single button operation
- Compact clip for easy and secure tablet or belt attachment
- Advanced GlobiLab analysis application for Android, iOS, PC, Mac
- Rich curriculum suite for Biology, Chemistry, Physics and Environmental Science
- Long battery life with over 150 hours between charges

Target Grade Levels: K – 12

Course Possibilities: Biology, Chemistry, Physical Science, Physics, General Science, Math

Focus: Scientific Inquiry

Retrieved May 14, 2015. <http://www.globisens.net/products/mini>

### LABDISC PHYSIO (9 – 12)

#### Built-in sensors include

Accelerometer, Air Pressure, Ambient Temperature, Current, Distance (Motion), External Temperature, Light, Microphone, Universal Input, Voltage



#### Typical activities include:

Lenz and Boyle's Laws, resistor networks, light source efficiency, light vs. distance, sound beat and wave superposition, Newton's Second Law and free fall acceleration.

### LABDISC BIOCHEM (9 – 12)

#### Built-in sensors include:

Air Pressure, Ambient Temperature, Barometric Pressure, Colorimeter, Conductivity, Dissolved Oxygen, External Temperature, GPS, Heart Rate, Light, pH, Relative Humidity, Thermocouple, Turbidity and Universal Input.



#### Typical activities include:

Skin temperature, pulse rates before and after activity, sweat production and photosynthesis, solid, liquid and gas phase changes and pH titration.

# Elementary School STEM Resource Kits

Page 11

## Elementary School (K – 5) Kits

### **KIT A: ES Robotics & Programming Kit**

#### **MaKey MaKey**

8 HID Boards, Alligator Clip Packs, Mini-USB Cables and Jumper Wire Packs

#### **Bee-Bot Double Class Bundle**

8 Bee-Bots , 4 Card Mats and Command Cards

#### **LEGO Mindstorms Education EV3**

4 EV3 Core Sets (\*\*Software license is being provided by the Math and Science program offices.)

### **KIT AA: ES Robotics Kit**

#### **LEGO Mindstorms Education EV3**

8 EV3 Core Sets (\*\*Software license is being provided by the Math and Science program offices.)

### **KIT B: ES General Science Inquiry Kit**

#### **Globisens Mini Science Wireless Lab**

8 compact wireless data loggers with seven built in sensors to optimally meet Earth, Life and Physical Science curriculum needs.

### **KIT C: ES Workshop Kit**

#### **MaKey MaKey**

4 HID Boards, Alligator Clip Packs, Mini-USB Cables and Jumper Wire Packs

#### **LEGO Mindstorms Education EV3**

4 EV3 Core Sets (\*\*Software license is being provided by the Math and Science program offices.)

#### **Globisens Mini Science Wireless Lab**

4 compact wireless data loggers with seven built in sensors to optimally meet Biology, Chemistry and Physics curriculum needs.

# Middle School STEM Resource Kits

Page 12

## Middle School (6 – 8) Kits

### **KIT D: MS Robotics & Programming Kit**

#### **Arduino Starter Kits**

8 Kits each of which includes a project book and over 200 electronic parts/components.

#### **LEGO Mindstorms Education EV3**

6 EV3 Core Sets (\*\*Software license is being provided by the Math and Science program offices.)

### **KIT E: MS Robotics Kit**

#### **LEGO Mindstorms Education EV3**

8 EV3 Core Sets (\*\*Software license is being provided by the Math and Science program offices.)

### **KIT F: MS General Science Inquiry Kit**

#### **Globisens Mini Science Wireless Lab**

8 compact wireless data loggers with seven built in sensors to optimally meet Earth, Life and Physical Science curriculum needs.

### **KIT G: MS 3D Modeling Kit**

#### **UP! Mini 3D Printer Kit**

2 UP Mini 3D Printers, 6 Perfboards, 2 Toolkits, 2 spools of 0.7kg ABS filament  
BONUS – 8 additional 1.54 pound spools of UP! ABS plastic filament

### **KIT H: MS Workshop Kit**

#### **Arduino Starter Kits**

4 Kits each of which includes a project book and over 200 electronic parts/components.

#### **LEGO Mindstorms Education EV3**

4 EV3 Core Sets (\*\*Software license is being provided by the Math and Science program offices.)

#### **UP! Mini 3D Printer**

1 UP Mini 3D Printer, 3 Perfboards, 1 Toolkit, 1 spool of 0.7kg ABS filament  
BONUS – 8 additional 1.54 pound spools of UP! ABS plastic filament

# High School STEM Resource Kits

Page 13

## High School (9 – 12) Kits

### **KIT I: HS Robotics & Programming Kit 1**

#### **Arduino Starter Kits**

8 Kits each of which includes a project book and over 200 electronic parts/components.

#### **LEGO Mindstorms Education EV3**

6 EV3 Core Sets (\*\*Software license is being provided by the Math and Science program offices.)

### **KIT J: HS Robotics & Programming Kit 2**

#### **Raspberry Pi Complete Starter Kits**

8 Starter Kits each of which includes everything needed to build your XBMC media player.

#### **VEX EDR Programming Control Starter Kit**

Build a fully capable, autonomous only robot.

4 Starter Kits including a programming hardware kit and a 6-seat team license.

### **KIT K: HS Robotics Kit**

#### **LEGO Mindstorms Education EV3**

8 EV3 Core Sets (\*\*Software license is being provided by the Math and Science program offices.)

### **KIT L: HS General Science Inquiry Kit**

#### **Globisens Mini Science Wireless Lab**

8 compact wireless data loggers with seven built in sensors to optimally meet general science curriculum needs.

# High School STEM Resource Kits

Page 14

## High School (9 – 12) Kits

### **KIT M: HS Biology/Chemistry Inquiry Kit**

#### **Globisens Labdisc BioChem Wireless Lab**

5 compact wireless data loggers with fifteen built in sensors to optimally meet Biology and Chemistry curriculum needs.

### **KIT N: HS Physics/Physical Science Inquiry Kit**

#### **Globisens Labdisc Physio Wireless Lab**

5 compact wireless data loggers with nine built in sensors to optimally meet Physics curriculum needs.

### **KIT O: HS 3D Modeling Kit**

#### **UP! Mini 3D Printer Kit**

2 UP Mini 3D Printers, 6 Perfboards, 2 Toolkits, 2 spools of 0.7kg ABS filament  
BONUS – 8 additional 1.54 pound spools of UP! ABS plastic filament

### **KIT P: HS Workshop Kit**

#### **Arduino Starter Kits**

4 Kits each of which includes a project book and over 200 electronic parts/components.

#### **LEGO Mindstorms Education EV3**

4 EV3 Core Sets (\*\*Software license is being provided by the Math and Science program offices.)

#### **UP! Mini 3D Printer**

1 UP Mini 3D Printer, 3 Perfboards, 1 Toolkit, 1 spool of 0.7kg ABS filament  
BONUS – 8 additional 1.54 pound spools of UP! ABS plastic filament

# Software Tools Provided to Grant Schools

Page 15

## Defined STEM

### What is Defined STEM?

Teachers are asked to have lessons that are engaging and relevant, cross-curricular, focus on 21st century skills, differentiate learning, incorporate non-fiction reading and writing and provide an authentic assessment of their students understanding. We see this as the core fundamental of what STEM education is all about and Defined STEM strives to bring this type of learning to each teacher and student in a school. Defined STEM is a web-based application designed to promote effective and relevant connections between 21st century learning skills and how those skills are used across all subjects and curriculum.

### How do we do this?

Defined STEM combines a number of different content types that accentuate the educational strategies of STEM education. Real-World Videos set the stage for each lesson by showing the practical application of educational concepts within a company/industry. Performance Tasks built around the specific job/industry ask the students to apply the knowledge learned in real world unpredictable situations. Literacy Tasks ask students to read, synthesize and write informative and/or position papers around the real world career based topic.

## LEGO Mindstorms Education EV3 Software

This powerful, easy to learn, easy to use software for programming and data logging is based on National Instruments LabVIEW™. This is the industry-leading graphical system design software used by scientists and engineers worldwide. It is optimized for classroom use and follows the very latest developments in intuitive software design and gives is really student-friendly.

Programming with the EV3 Software is done by dragging and dropping icons into a line in order to form commands. The language's graphical interface lets students build simple programs, and then easily and intuitively build on their skills until they are developing complex algorithms.

The software's data logging feature is a powerful science tool for carrying out experiments. It is easy to collect, view, analyze and manipulate data from sensors and see the data in interactive graphs. Its unique feature, known as graph programming, makes experiments come alive as students can set threshold values for sensors, such as making a sound when a certain temperature is detected by the sensor.

The in-built content editor enables teachers to customize the curriculum and create their own lessons. It enables students to capture their work directly inside the content creating their own digital workbook, making classroom management and assessment easier.