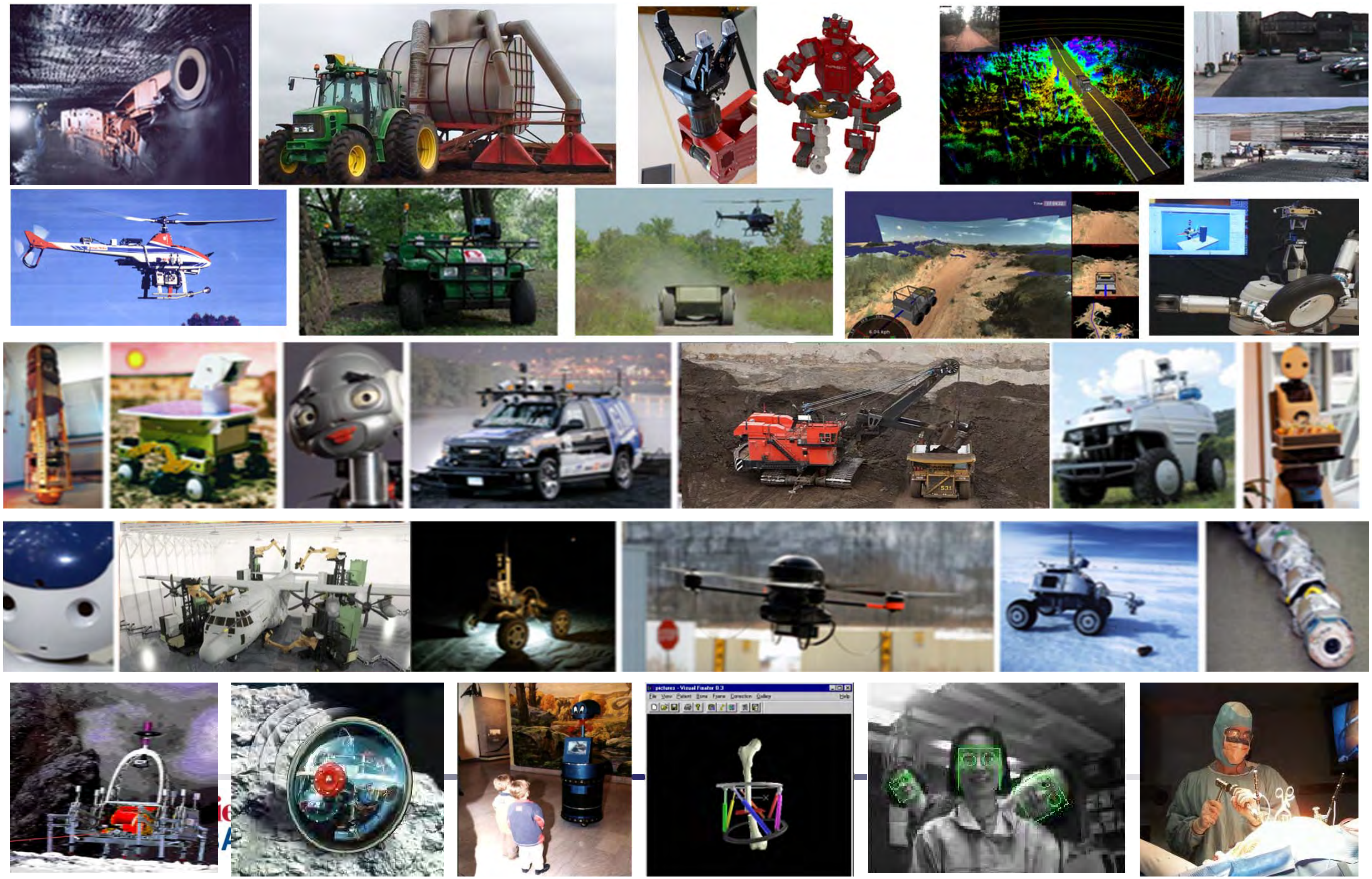
Robotics Research At Carnegie Mellon Robotics Institute



What I Will Cover Today

- Introduction
- Robotics – the Transformative Technology
- Teaching with Robotics –
  - Math – The Robot Algebra Project
  - Engineering – Training the Robotics Competition Community Project
  - Computer Science – Changing Culture in Robotics Classrooms Project
  - Robot Virtual World Math Tools
  - Expedition Atlantis
- Recruit Schools and Teachers for our DRK-12 Research Project
- Show you where to find lots of free resources for your class

Carnegie Mellon

Carnegie Mellon
SCHOOL OF COMPUTER SCIENCE

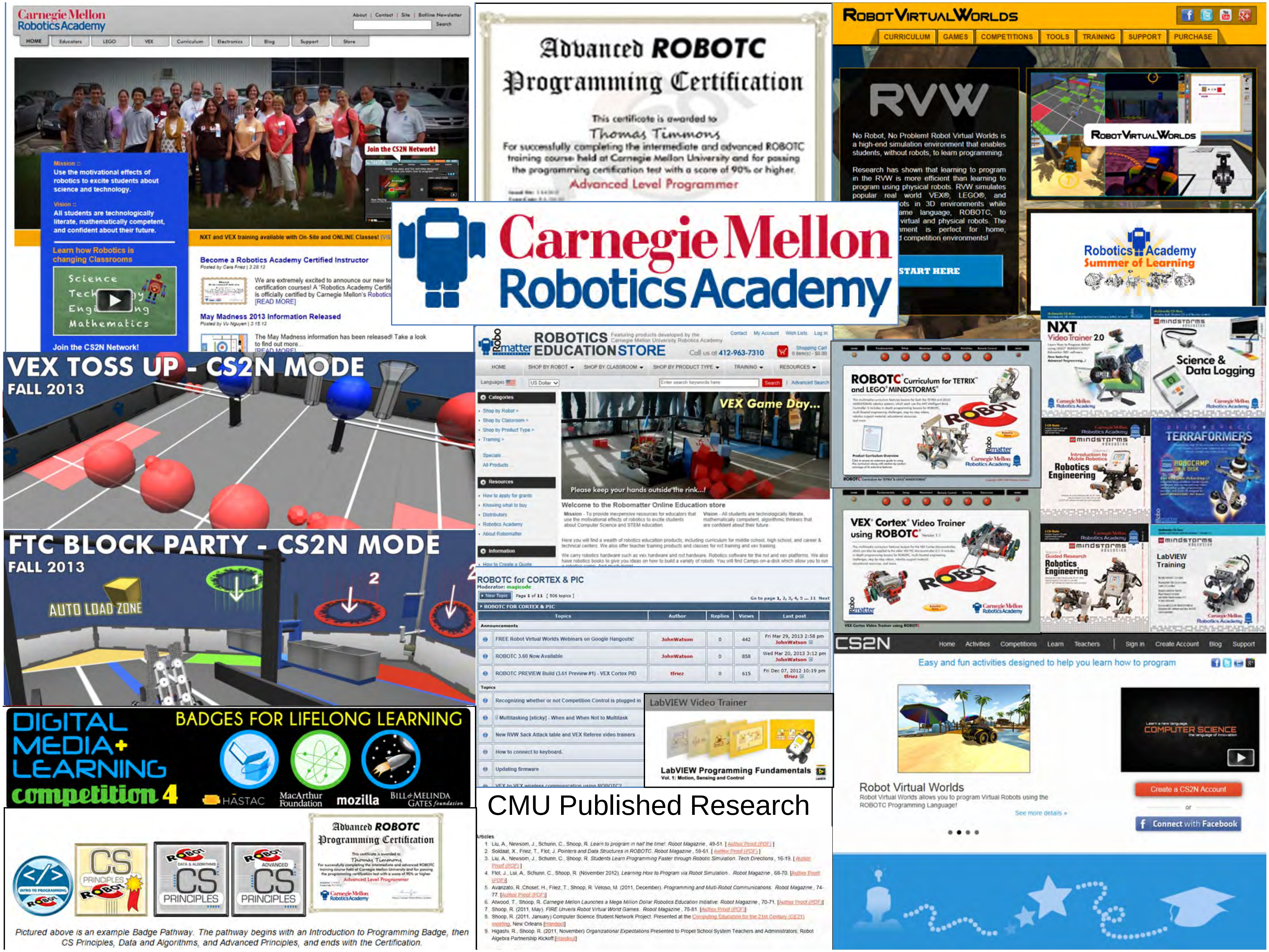
THE ROBOTICS INSTITUTE

Basic robotic research

Applied robotic research

Carnegie Mellon
Robotics Academy

Educational robotic research



Carnegie Mellon Robotics Academy
Mission :: Use the motivational effects of robotics to excite students about science and technology.
Vision :: All students are technologically literate, mathematically competent, and confident about their future.
Learn how Robotics is changing Classrooms
Join the CS2N Network!
Become a Robotics Academy Certified Instructor
May Madness 2013 Information Released
Advanced ROBOTC Programming Certification
This certificate is awarded to
Thomas Timmons
For successfully completing the intermediate and advanced ROBOTC training course held at Carnegie Mellon University and for passing the programming certification test with a score of 90% or higher.
Advanced Level Programmer
Carnegie Mellon Robotics Academy
RobotVirtualWorlds
CURRICULUM
GAMES
COMPETITIONS
TOOLS
TRAINING
SUPPORT
PURCHASE
RVW
No Robot, No Problem! Robot Virtual Worlds is a high-end simulation environment that enables students, without robots, to learn programming.
START HERE
Robotics Academy Summer of Learning
VEX TOSS UP - CS2N MODE
FALL 2013
FTC BLOCK PARTY - CS2N MODE
FALL 2013
AUTO LOAD ZONE
ROBOTICS EDUCATION STORE
VEX Game Day...
Welcome to the Robomatter Online Education store
ROBOTC for CORTEX & PIC
LabVIEW Video Trainer
LabVIEW Programming Fundamentals
ROBOTC Curriculum for TETRIX and LEGO MINDSTORMS
VEX Cortex Video Trainer using ROBOTC
NXT Video Trainer 2.0
Science & Data Logging
Robotics Engineering
TERRAFORMERS
LabVIEW Training
CS2N
Easy and fun activities designed to help you learn how to program
Robot Virtual Worlds
COMPUTER SCIENCE
Create a CS2N Account
Connect with Facebook
DIGITAL MEDIA+ LEARNING competition 4
BADGES FOR LIFELONG LEARNING
HASTAC
MacArthur Foundation
mozilla
BILL&MELINDA GATES foundation
CS PRINCIPLES
CMU Published Research
Pictured above is an example Badge Pathway. The pathway begins with an Introduction to Programming Badge, then CS Principles, Data and Algorithms, and Advanced Principles, and ends with the Certification.

The Robotics Academy is located at NREC

Started in 1999

hosting robotics camps

Carnegie Mellon Robotics Academy

Robotics Academy Team

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Curriculum Specialist, Robots In

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University of Pittsburgh, LRDC Faculty

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Post Doc, University of Pittsburgh

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Research Programmer, Robots I

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Robotics Academy Outreach Coordinator

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Teacher, Beaver School District/Robomatter

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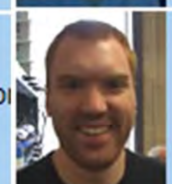
Robin Shoop
Project Manager, CS2N

Dick Swan
Inventor, ROBOTC

Timothy Hunkele
Systems Software Engineer, CS

Krishna Pandravada
Multi-Media Developer, Robot Virtual Wo



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Jesse Flot
Project Manager, Robot Virtual V

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Allison Liu
LRDC Graduate Student

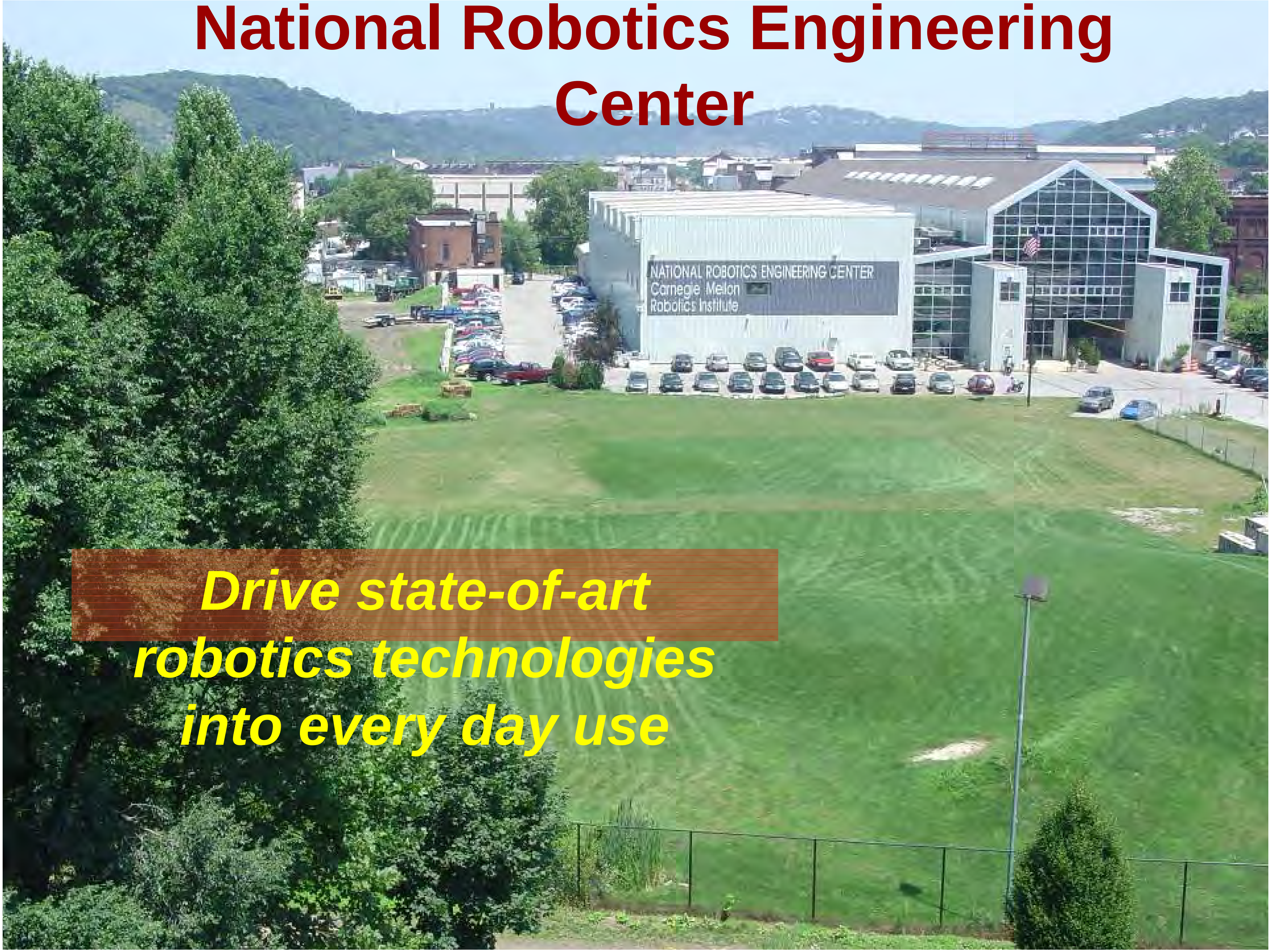
Timothy Friez
Software Engineer, Multi-Robot (
Project

Ryan Cahoon
Research Programmer, DML Badges/Rol
Worlds

Rajadurai Balasubramanian
Programmer, Robomatter

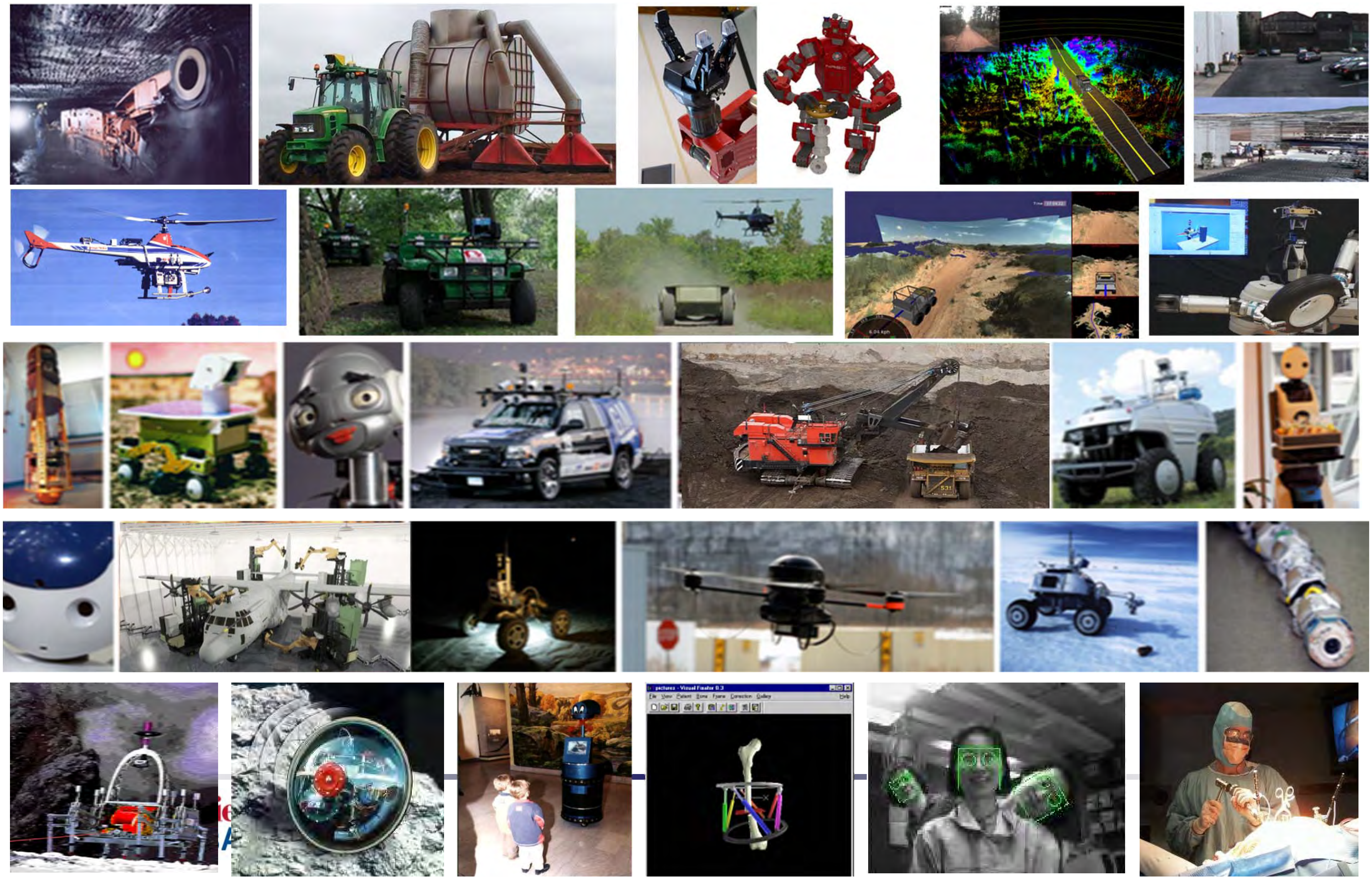
Carnegie Mellon Robotics Academy

National Robotics Engineering Center



Drive state-of-art robotics technologies into every day use

Robots are everywhere, we just don’t call them robots.



NATIONAL ROBOTICS NREC ENGINEERING CENTER

Carnegie Mellon University Robotics Institute

National Robotics Engineering Center

Carnegie Mellon

SEARCH

Home | About | Projects | Capabilities | Process | Markets | Partnering | Education | Media | Contact

Featured Project

Automated agriculture is blossoming at NREC

The Integrated Automation for Sustainable Specialty Crops (IASSC) project tests sensing and automation technologies in the orange groves of Florida. Visit its

MARKETS

NREC serves a wide sector of markets and is moving into more

Mining

Defense

Agriculture

News

Strawberry plant sorter outperforms workers

In a successful field test this fall, the machine classified and sorted harvested plants more consistently and faster than workers could, with a

The DARPA Grand Challenge

2004 DARPA Grand Challenge

The first competition of the DARPA Grand Challenge was held on March 13, 2004 in the Mojave Desert region of the United States, along a 150-mile (240 km) route that follows along the path of Interstate 15.

No car finished the race.

2005 DARPA Grand Challenge

The second competition of the DARPA Grand Challenge began at 6:40am on October 8, 2005.

All but one of the 23 finalists in the 2005 race surpassed the 11.78 km (7.32 mi) distance completed by the best vehicle in the 2004 race.

2007 DARPA Urban Challenge

•Vehicle must be stock or have a documented safety record.

•**Vehicle must obey the California state driving laws.**

•Vehicle must be entirely autonomous, using only the information it detects with its sensors and public signals such as GPS.

•DARPA will provide the route network 24 hours before the race starts.

•Vehicles will complete the route by driving between specified checkpoints.

•DARPA will provide a file detailing the order the checkpoints must be driven to 5 minutes before the race start.

•Vehicles may “stop and stare” for at most 10 seconds.

•**Vehicles must operate in rain and fog, with GPS blocked**.

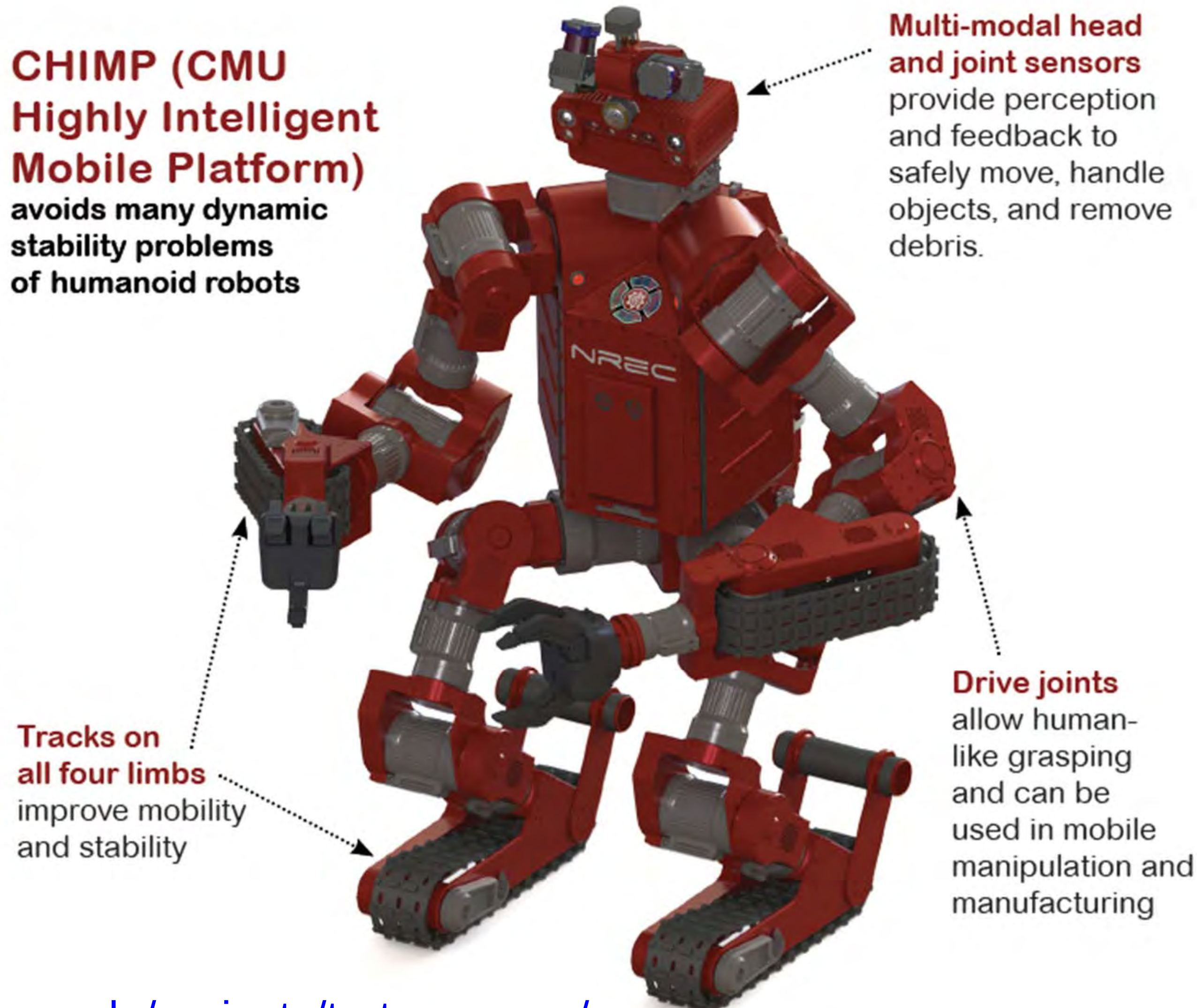
•**Vehicles must avoid collision with vehicles and other objects such as carts, bicycles, traffic barrels, and objects in the environment such as utility poles.**

•Vehicles must be able to operate in parking areas and perform U-turns as required by the situation.

New DARPA Grand Challenge Tasks!

1. Drive a utility vehicle at the site.
2. Travel dismounted across rubble.
3. Remove debris blocking an entryway.
4. Open a door and enter a building.
5. Climb a ladder and traverse a walkway.
6. Use a tool to break through a concrete panel.
7. Locate and close a valve near a leaking pipe.
8. Replace a component such as a cooling pump.

Meet CHIMP



http://www.rec.ri.cmu.edu/projects/tartanrescue/

Robotics and Senior Care

1 in 5 Americans will be over 60 by 2030

Smart Kitchens that gently remind the senior citizen that the water is running in the sink or that the stove is turned on.

Systems that reminds seniors to take their medicine, gives remote access to caregivers to check to see if someone has opened the refrigerator, flushed the toilet, or turned on the stove that day.

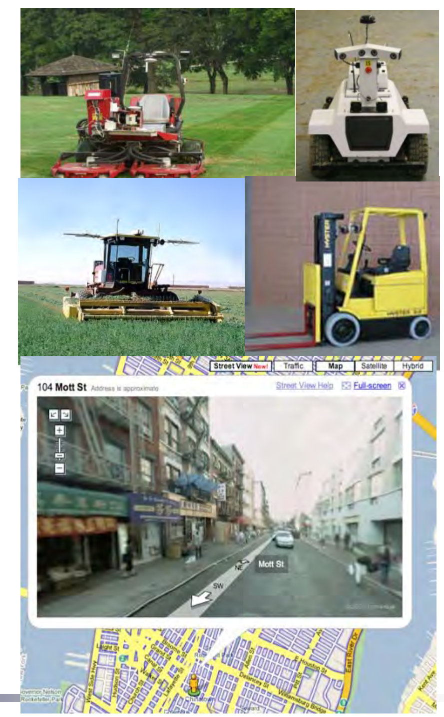
Systems that allows telepresence so that friends and relatives can remotely share a meal together.

Carnegie Mellon Robotics Academy

Service Robotics - Autonomous Driving

Consider the rapid advancement of robotic autonomous driving technology.

"When we blend the data available via Global Positioning Systems (GPS) with current networks and real time feedback from satellites we can predict that driverless cars are only a decade away…" Sebastian Thrunn, Stanford



Future roboticists will couple "Google maps like data" and real time GPS feedback with new sensing technologies ...

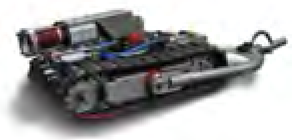
Service Robotics Market

70 Billion per year

Field

Cleaning

Inspection

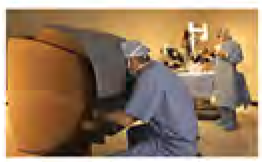


Construction

Assistive

Logistics

Medical



Underwater

Defense

Entertainment

Education

Laboratory

Public Relations

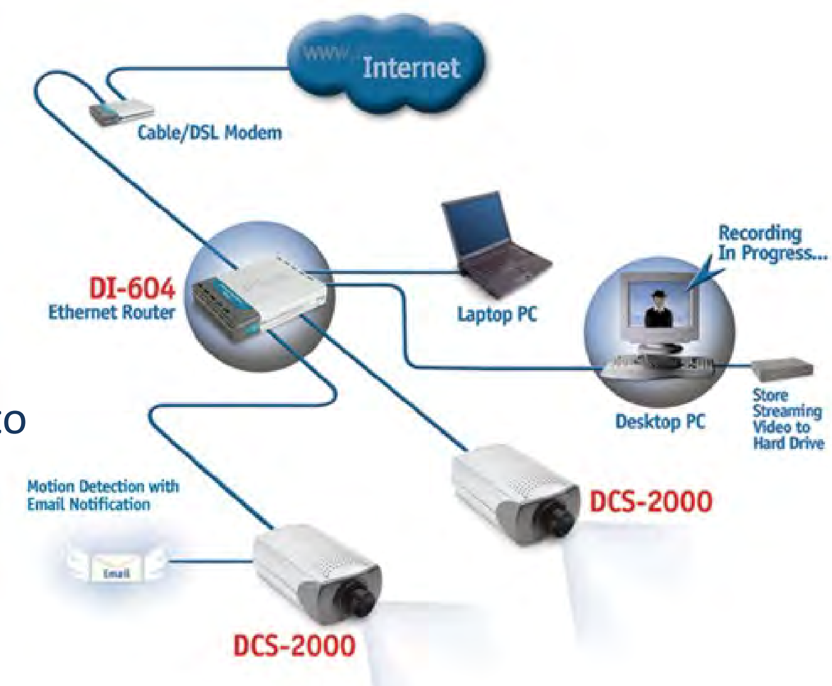
Home Security

Domestic

Web2.0 to Web3.0

Web 3.0 – the internet is connect to sensors, software, and robotic networks globally.


The significance of these connections cannot be overstated; robotic systems that provide remote access and feedback will be everywhere.



Cars, connected to GPS, connected to traffic cameras, connected to Google maps, connected to On-Star or some other provider, connected to real time news…

Robots will have the same effect on the emerging economy as the computer did on the information age!

Transportation

- Electronic flight control systems (autopilot, fly-by-wire)
- Route planning (which planes/trucks, which routes)
- Inventory tracking (barcode scanners, RFID, satellites, web interface)
- Airport traffic control

Business & Finance

- High-speed stock trading (algorithms, online trading system)
- Business model and market simulations
- Accounting Software
- E-commerce/Credit Card Processing
- Internet Storefronts
- Router/Network Devices
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Health Care Equipment

- Heart Monitors
- CT Scanners
- Patient Monitoring
- Medicine

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- Security scanners (airports, sports arenas)
- Red light cameras
- Credit card fraud/theft detection
- Facial recognition and identification
- Border sensor networks

Green Homes/Buildings

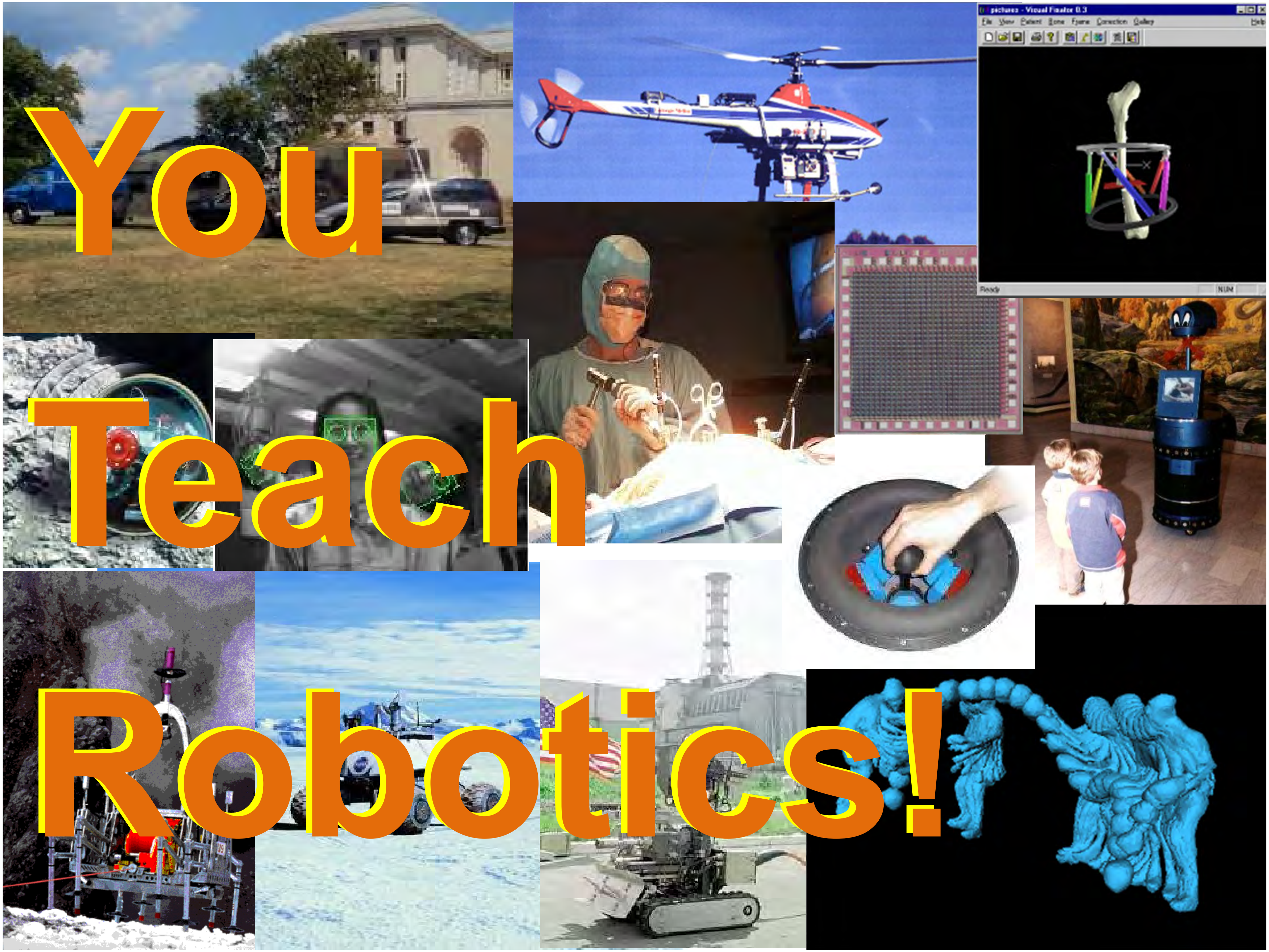
- "Quality of Life" Smart Homes
  - Remote access to senior citizen homes
  - Smart kitchens and bathrooms
  - Medicine dispensers and monitors
- Thermostats HVAC
- Solar/Wind/Geothermal Systems

Embedded Systems

- Cars
- Cell Phones
- Modern Appliances (microwaves, refrigerators, stoves, dryers, washers)
- Industry/Factory automation
- Robots
- CNC machinery

Entertainment Media

- Video games
- Special effects (algorithmic filters)
  3D crowd imagery (movies with lots of digital "extras")
- Motion capture


You
Teach
Robotics!

Robotics - is a content organizer that allows you to teach many disciplines

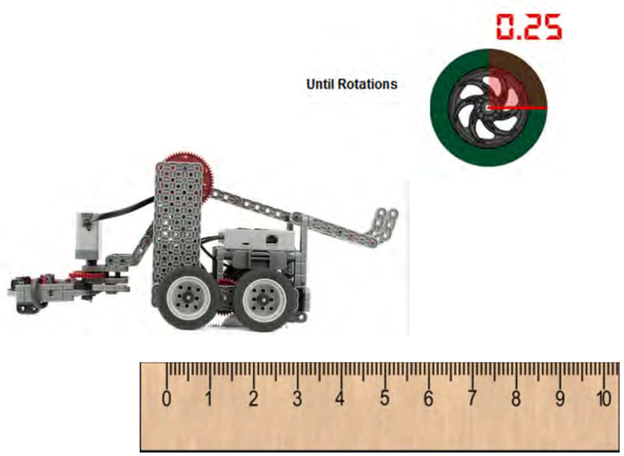
Classroom robotics is about 15 years old. *Most robotics teachers are not trying to create future roboticists, they using robotics as a content organizer* to teach: engineering, math, CS, technological literacy…

Lesson Learned – In order to be effective as a robotics teacher you have to foreground and measure the concept that you are trying to teach.

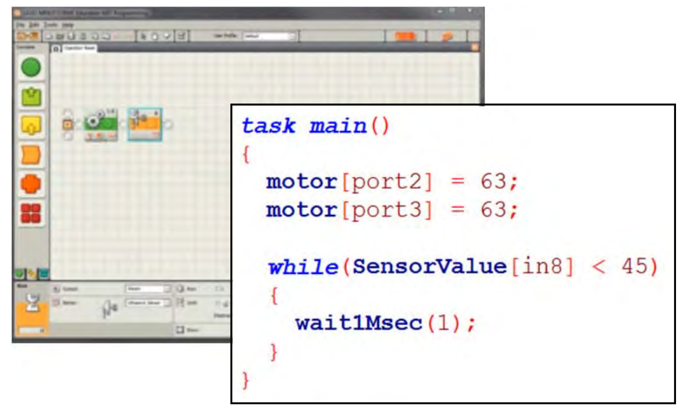
- Math
- Engineering Process
  - 21st Century Skill Sets
    - Cooperation/Collaboration
    - Teamwork
    - Problem Solving
    - Resource Allocation
    - Time Management
  - Electronics
  - Scientific Methods
  - Technological Literacy
  - Communications, English, and Language Arts
  - Persistence
- Computer Science

Robot Algebra Lesson Learned

A teacher needs to decide what to foreground in a robotic lesson, you can't teach everything



Math



Programming

Separate the Math from the Programming

Find Papers on teaching math with robotics at: www.cs2n.org/teachers/research

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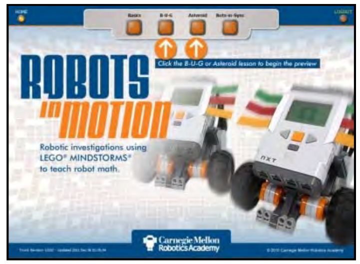
Teaching Math In Robotics Classrooms

Robots In Motion
Model Eliciting Activities

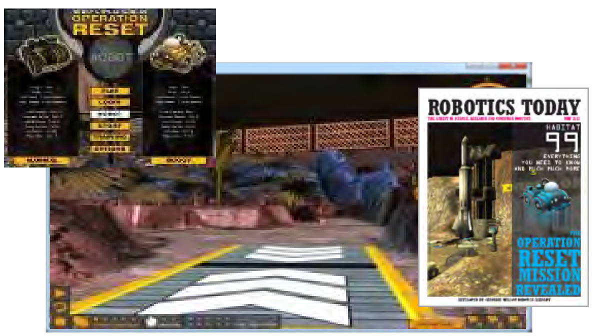


Cognitive Tutor Enabled
Robots In Motion

Abstraction Bridge
Word Problems

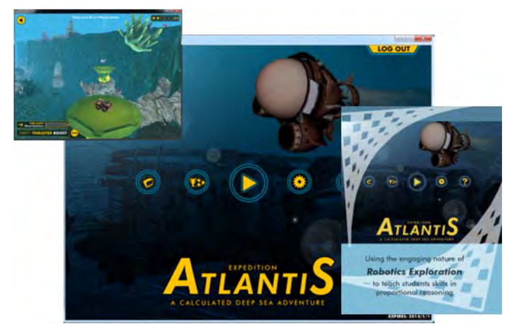
Math Enabled Robot
Virtual Worlds

Integrating Robot Math Into Gameplay



Operation Reset
Programming Game

Unlockable Badged
Achievements



Expedition Atlantis

Carnegie Mellon
Robotics Academy

Model Eliciting Activities

Cliff notes Version

Principles for MEA Design
Reality Principle - Will students make sense of the situation based on extensions of their own personal knowledge experience?
Model Construction - Does the task create the need for a mental model to be constructed (or modified, extended, or refined)?
Model Documentation - Will the response require students to explicitly reveal how they are thinking about the situation (define their goals, possible solutions, and work paths)?
Self Evaluation - Does the statement of the problem strongly suggest the criteria that enables students to judge for themselves when the responses are good enough?
Model Generalization - Is the model not only powerful for the specific situation and client at hand but also shareable with others and reusable in other situations?
Simple Prototype - Is the problem as simple as possible for the given instructional goals?

The problem is placed in a context that makes sense to kids

Kids have to come up with a mental model of the math

They need to describe the math

They have to evaluate either their solution or another kids solution

Their knowledge is generalized

Designed in a way that makes it easy for students to get started?

The Robot Synchronized Dancing Unit

Write programs to teach these
4 robots to dance in synchrony

Combines:

Robots
Music
Dancing
& Creativity

Teaches:

Proportional Distance
Proportional Turning
Proportional Speed

Measuring Distance, Angles, Rate, Scale, Conversion of Units

Carnegie Mellon Robotics Academy

MEA - Robot Synchronized Dancing

Students have to Create a Mathematical Toolkit

Create a "how to" toolkit that the *Bots-N-Sync* captain can use to modify submitted dance routine programs so that all of the dancers do the routines in sync with each other. New dance routines are submitted often and new dancers will be joining the team regularly. So, a good toolkit would work for the current dance routine, but an ideal toolkit would be easy to use or adapt for new routines and new robots. An ideal toolkit would also include explanations of why the solution works, so the captain can easily understand how it works and how it can be adapted later for other similar situations. Your toolkit can utilize words, numbers, graphs, pictures, and/or any other form that effectively conveys your ideas and meets the needs of your client, the *Bots-N-Sync* captain.

The Better Deal

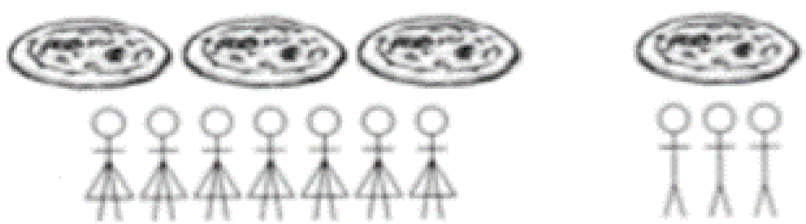
Abstraction Bridge Example

The Better Deal

Name_______________________________________

Directions: Show all work, describe how you got the answer using mathematics and words, and circle your final answer.

The Problem: Who gets more pizza, a girl or a boy? *Explain your answer using math and words.*



Make connections between robot math and other math

Integrate Abstraction Bridge questions into student activities

St. Patrick’s Day

Name____

Directions: Show all work, describe how you got the answer using mathematics and words, and circle your final answer.

The Problem: Will was responsible for marking the route for the St. Patrick’s Day Parade downtown. He was asked to put green tape in a circle around each telephone pole on the route. There are 150 telephone poles on the rout and each telephone pole is 35 centimeters wide. How many rolls of tape does Will need to finish the job if each role is 50 meters long? *Explain your answer using math and words.*

Better Deal 2

Abstraction Bridge Example

The Better Deal 2

Name____

Directions: Show all work, describe how you got the answer using mathematics and words, and circle your final answer.

The Problem: Two girls got into the theater on State Street for $3.00. Five boys got into the theater on Main Street for $6.00. Which group, the girls or the boys, got the better deal? *Explain your answer using math and words.*

How are Abstraction Bridges Used?

Integrate Abstraction Bridge questions into student activities

To Foreground the Math

- Used as a warm-up activity – as kids are filing into class the problem is on the board, they learn that as soon as the problem is finished they start the work.
- Single problem homework assignments
- They serve as formative assessment tools

Three Scaffolded MEAs

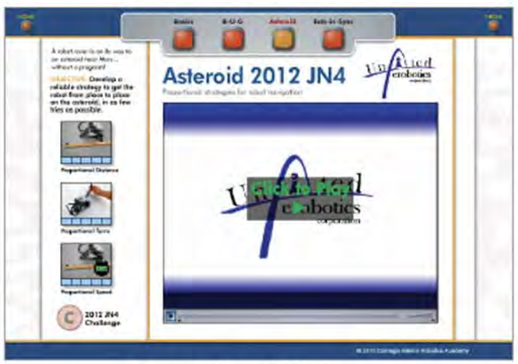
Measurement

iKnowMATION Toy Company

Students are given the job of developing testing procedures designed to ensure that each iKnowMATION toy robot:

- Travels the correct distance
- Turns the correct angle
- Travels the correct speed

← **Measurement**



Proportional Distance

United Areobotics Corporation

Students are given the mission of programming a remote robot that has different physical sizes than the robot that they typically work with. They only have one chance to program the robot and it must:

- Travel exact distances
- Turn precise angles
- Travel correct speeds

← **Proportional Distance**

Direct and Inverse Proportional Relationships

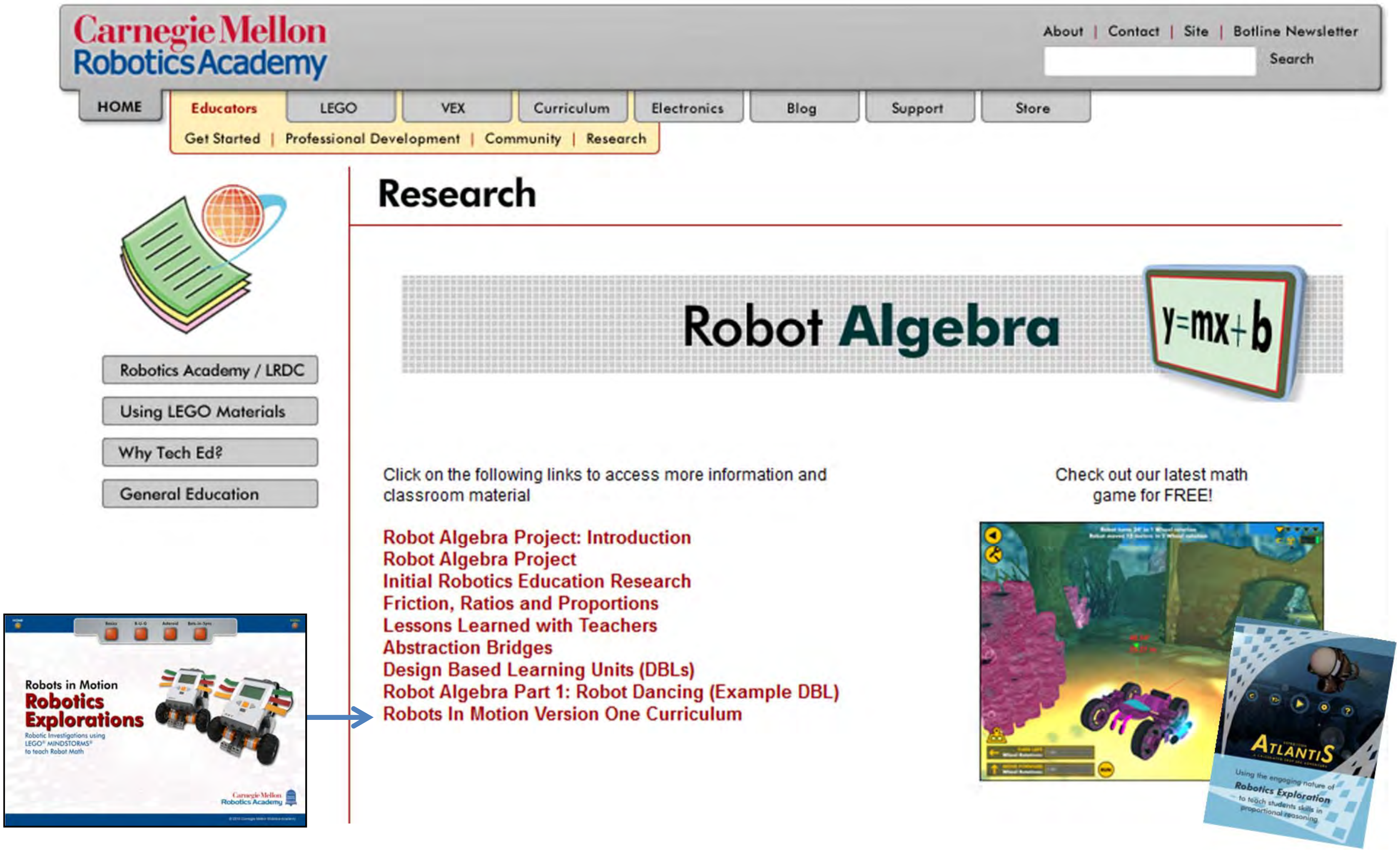
Bots-n-Sync Dance Company

Bots-n-Sync needs help. They have lots of different size robots that they need to teach to dance in synchrony. Students are tasked to develop a set of formulas that allow the programmers to teach the dancing robots to:

- Go the same distances
- Turn the same angles
- Dance the same speeds

← **Direct and Inverse Proportional Relationships**

Printable PDFs are at the RA website



http://www.education.rec.ri.cmu.edu/content/educators/research/robot_algebra/index.htm

Atlantis – Free a the Robotics Academy Website

Carnegie Mellon Robotics Academy

http://www.education.rec.ri.cmu.edu/content/educators/research/robot_algebra/index.htm

Engineering Education/Robotics Competitions

There are over 30,000 US Robotics Teams involved with the following competitions:

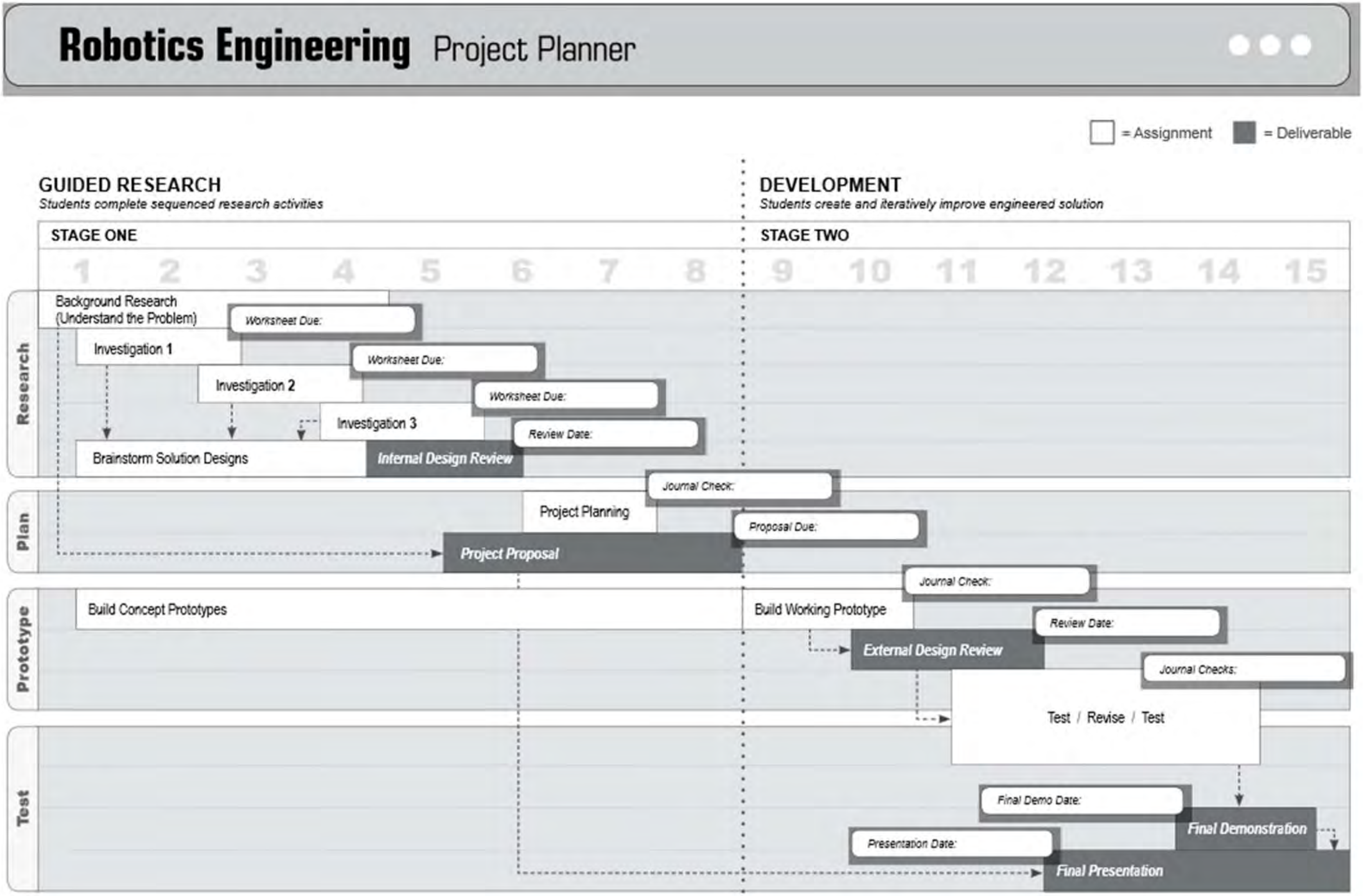
- BattleBots
- BEST
- BotBall
- FIRST FRC, FTC, FLL
- REC Foundation VEX, VEXIQ
- Trinity Fire Fighting
- TSA

The Competition Format Teaches:

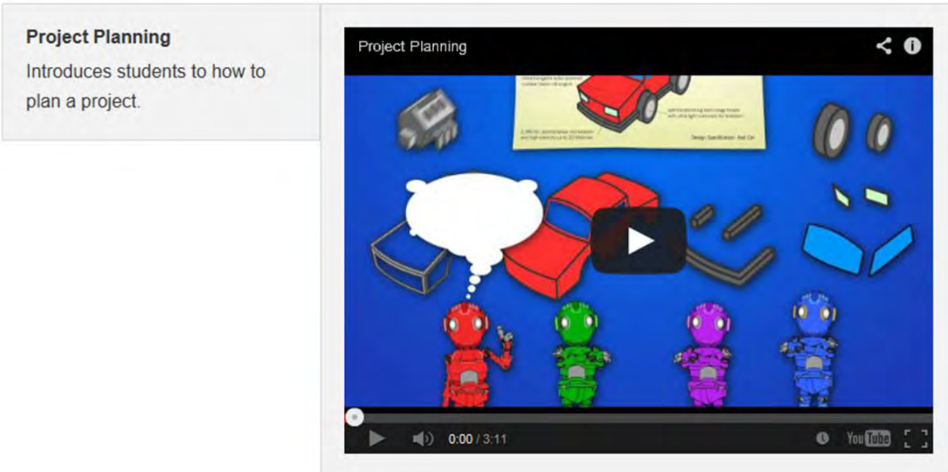
- Engineering Process
- 21st Century Skill Sets
  - Cooperation/Collaboration
  - Teamwork
  - Problem Solving
  - Resource Allocation
  - Time Management
- Electronics
- Scientific Methods
- Technological Literacy
- Communications, English, and Language Arts
- Persistence

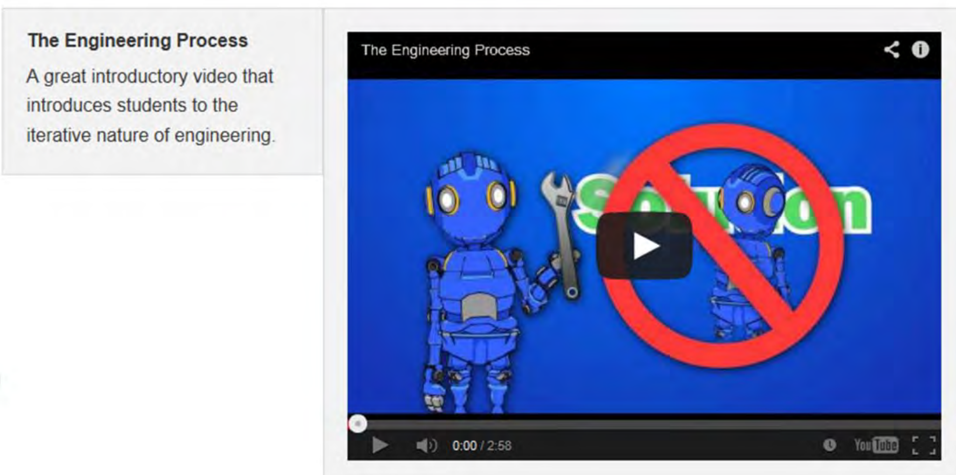
Carnegie Mellon Robotics Academy

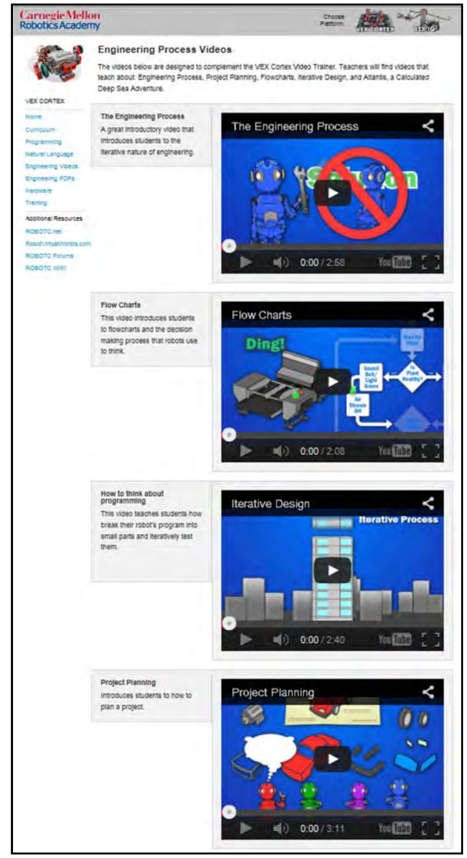
Engineering Education/Robotics Competitions



Engineering Education/Robotics Competitions

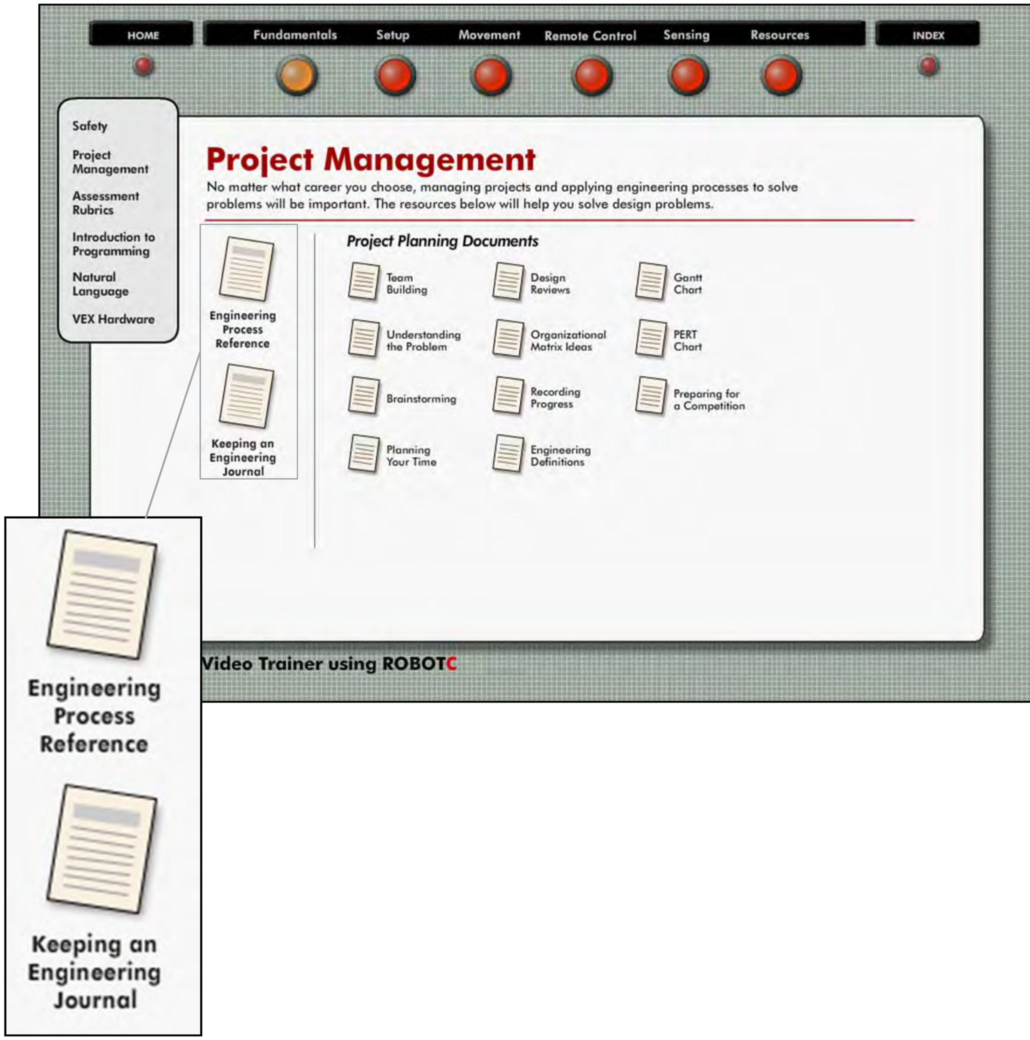






These videos and others are free at www.vexteacher.com

Engineering Education/Robotics Competitions



The full ROBOTC for LEGO and VEX Curriculums are available for free at www.robotc.net

Is Computer Science Important to Tech Ed?

Transportation

- Electronic flight control systems (autopilot, fly-by-wire)
- Route planning (which planes/trucks, which routes)
- Inventory tracking (barcode scanners, RFID, satellites, web interface)
- Airport traffic control

Business & Finance

- High-speed stock trading (algorithms, online trading system)
- Business model and market simulations
- Accounting Software
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- Video Monitors/Onscreen Displays

Health Care Equipment

- Heart Monitors
- CT Scanners
- Patient Monitoring
- Medicine

Security

- Security scanners (airports, sports arenas)
- Red light cameras
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- Facial recognition and identification
- Border sensor networks

Green Homes/Buildings

- "Quality of Life" Smart Homes
  - Remote access to senior citizen homes
  - Smart kitchens and bathrooms
  - Medicine dispensers and monitors
- Thermostats HVAC
- Solar/Wind/Geothermal Systems

Embedded Systems

- Cars
- Cell Phones
- Modern Appliances (microwaves, refrigerators, stoves, dryers, washers)
- Industry/Factory automation
- Robots
- CNC machinery

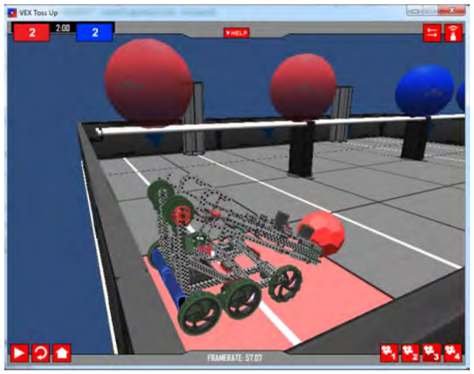
Entertainment Media

- Video games
- Special effects (algorithmic filters)
  3D crowd imagery (movies with lots of digital "extras")
- Motion capture

All Emerging Technologies will be Programmed

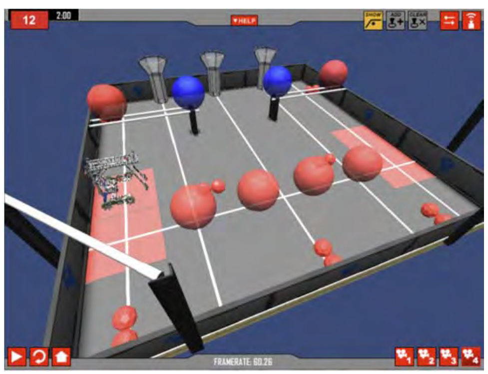
Teaching Computer Science via Robotics

Toss Up



Block Party

The Actual Game Simulation



A Modified Game that can be Challenged using Autonomous only mode

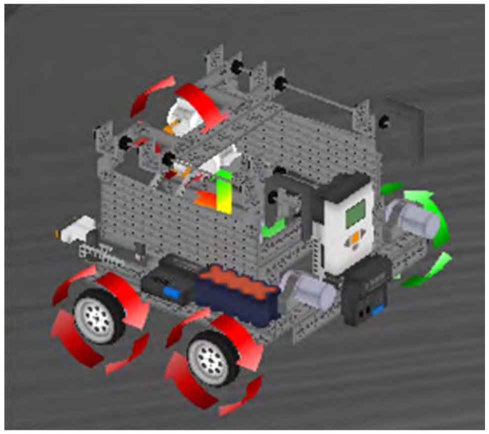
Supporting Teaching Programming in Classrooms

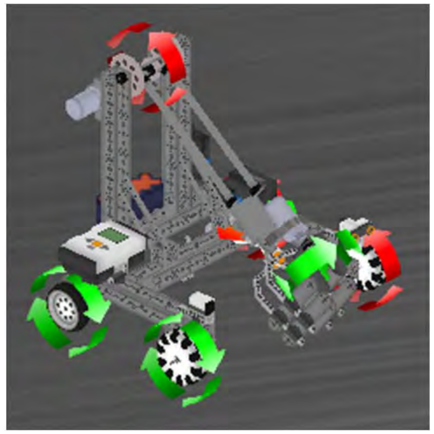
For the past two seasons we've made two versions of the game. At the top is the actual *FTC Game Simulation* that uses allows both autonomous and driver control.

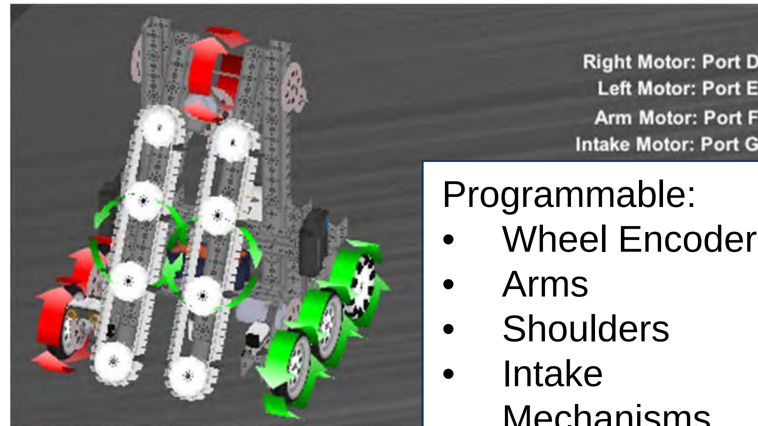
At the bottom is a specially designed game that we've developed specifically to teach robot programming. *This game uses all of the elements of the FTC game, but includes additional features that allows the game to be challenged in an autonomous only mode.*

Multiple Programmable Robot Types

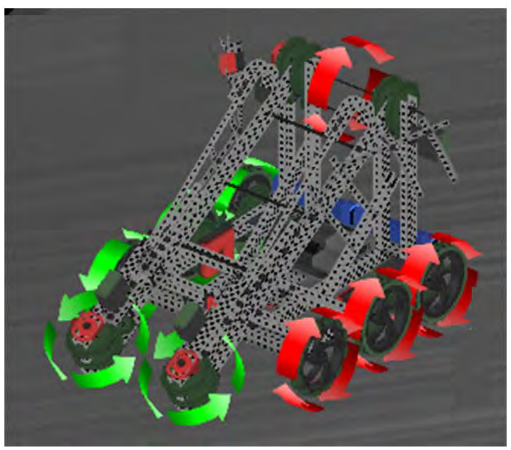
FTC Robots

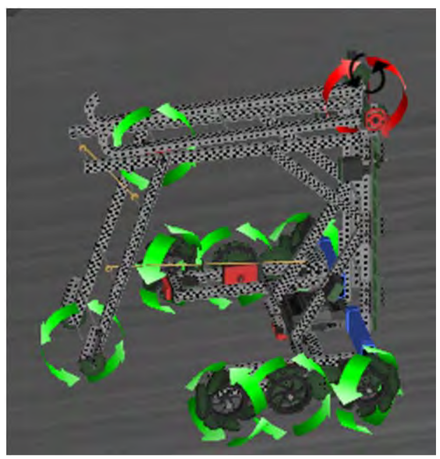


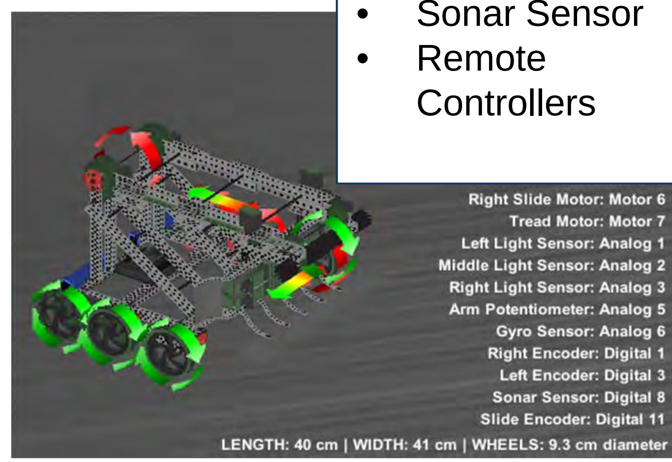




VEX Robots







Programmable:

- Wheel Encoders
- Arms
- Shoulders
- Intake Mechanisms
- Gyro Sensor
- Light Sensor
- Sonar Sensor
- Remote Controllers

Carnegie Mellon Robotics Academy

Computer Science Education Act – This Could Include Tech Ed

9/13/2013 – Referred to Subcommittee on Education

Carnegie Mellon Robotics Academy

Future CS K-12STEM Offerings

CollegeBoard
inspiring minds™

The College Board

Computer Science: Principles

Computational Thinking Practices

Big Ideas, Key Concepts, and Supporting Concepts

Computer Science: Principles is a pilot course under development. It is not an official Advanced Placement course currently being offered by the College Board.

This document is based upon work supported by the National Science Foundation, grant CNS-0938336. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

The National Science Foundation Provides $5.2 Million Grant to Create New Advanced Placement® Computer Science Course and Exam

Innovative College-Level AP® Course Created To Increase Interest In Computing Degrees And Careers, Particularly Among Female And Minority Students�

CollegeBoard

New Course and Exam — AP® Computer Science: Principles to Launch in Academic Year 2016–17

- Overview
- Development
- Higher Education Acceptance
- Curriculum and Assessment

The College Board plans to launch a new course, AP Computer Science Principles (CSP), in fall 2016, with the first AP CSP Exam scheduled to be administered in May 2017.

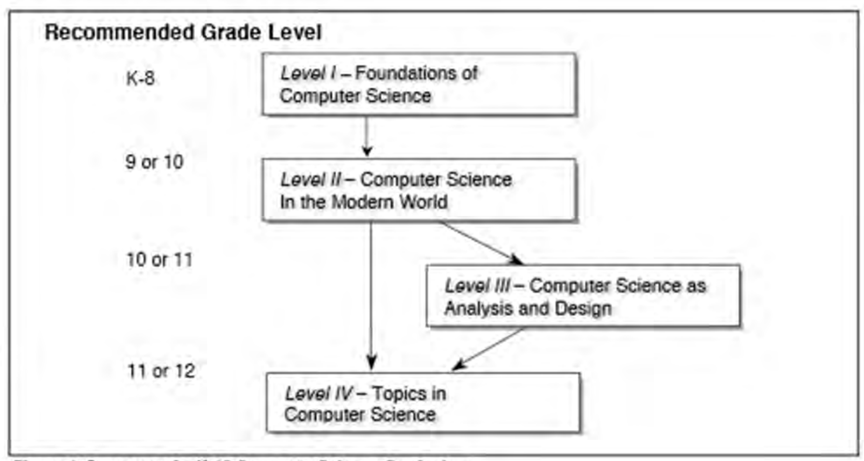


Figure 1. Structure of a K-12 Computer Science Curriculum

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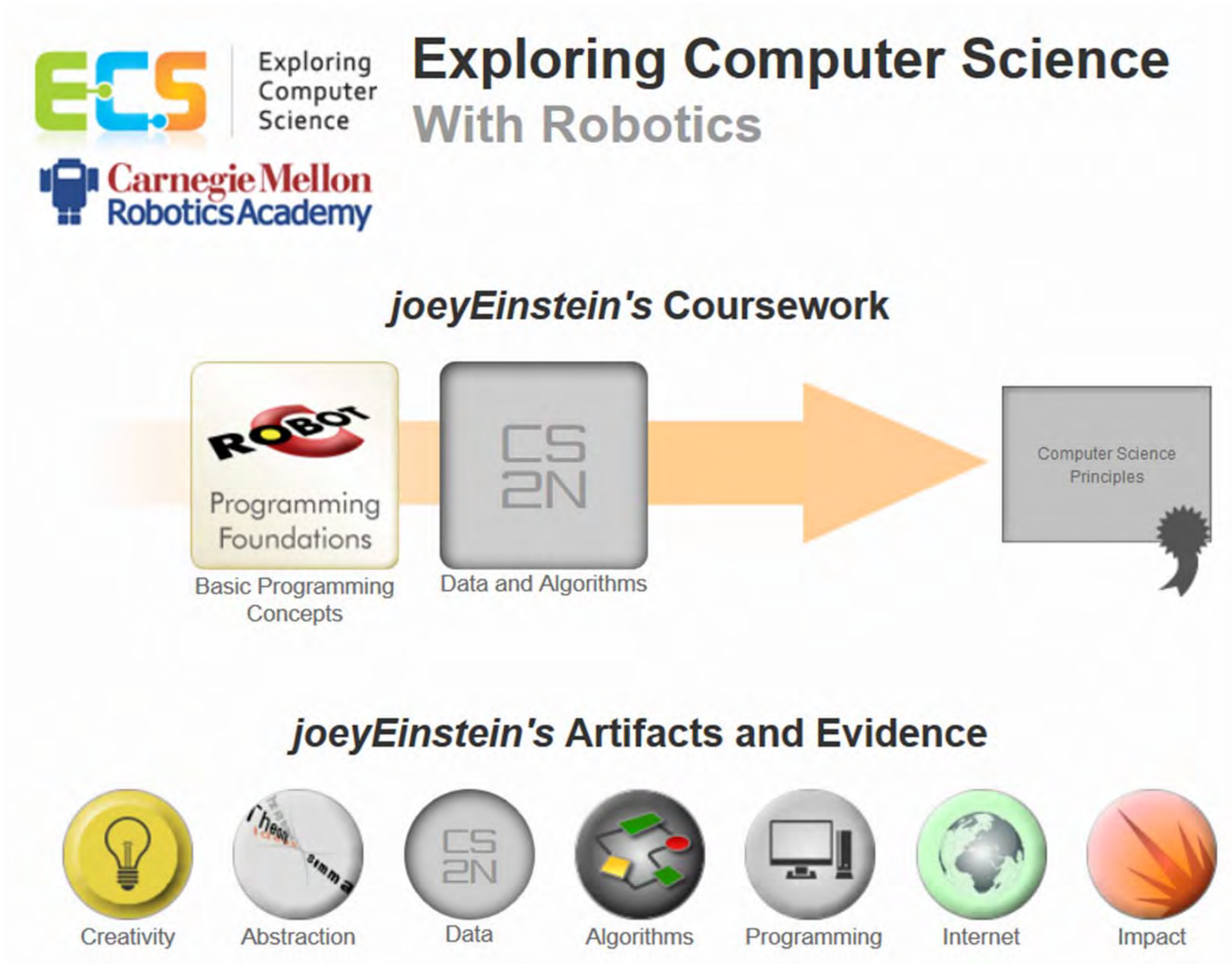
This Could Be Us



Recruiting Partner Schools

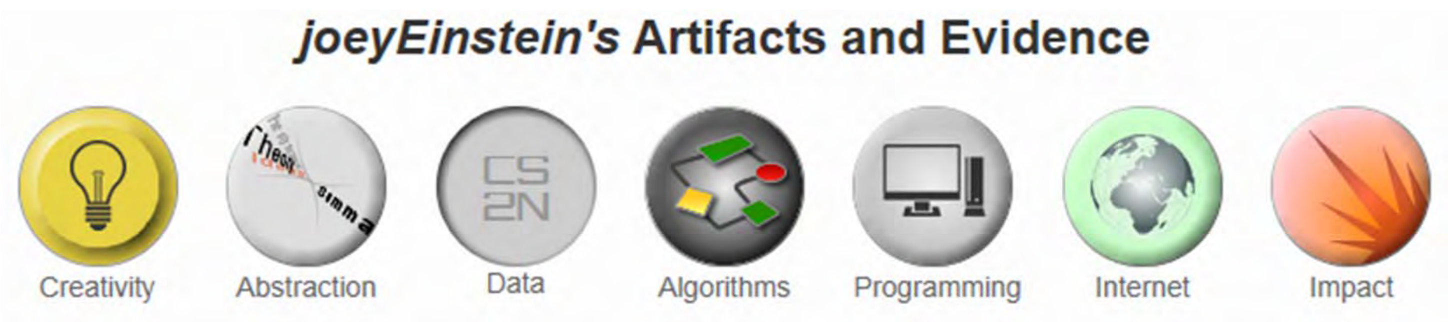
To prepare over 1,000 Highly Competent robotics instructors able to *teach students how to use robotics as an organizer to teach students engineering process and to introduce students to the CS Principles Computational Thinking* Practices identified as important for all students to understand (Astrachan, et al., 2009-2013); and to do so through their existing robotics classes.

Recruiting Partner Schools

Using Robotics to Teach Big Ideas of CS

The CS computational artifact for:

- **Creativity** could be: a robot, a webpage, a logo for their team;
- **Abstraction**: pseudocode, variables, or a map;
- **Data**: the human genome, statistics on global warming, or collecting feedback from sensors via data logging;
- **Algorithms**: a flowchart, an algebraic expression, or an algorithm they developed to calculate a threshold value.
- **Programming**: robots that complete a variety of tasks
- **Internet and Impact**: Robotics competitions also involve team organization, fundraising, marketing, and team promotion, providing additional opportunities for students to create computational artifacts.



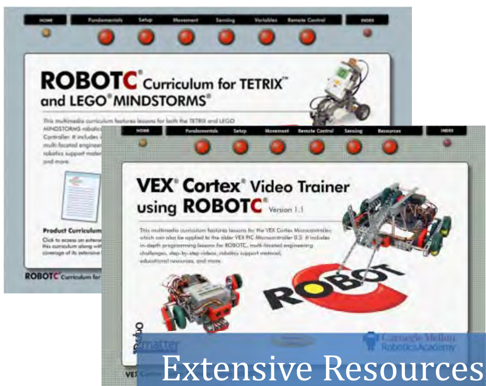
What’s in it for you?

- A Certification that could lead to Job Security
- Free training
- Free software
- An opportunity to be part of a research project

Certifying Teachers, Coaches, Mentors, and Students

Online Training Tools

Online LMS



Extensive Resources

Competition Specific Tools

Automated Assessment Tools

RVW Curriculum Companion

CS2N Groups

CS2N Learns

RVW CS2N Login

The Certification

Computer Science and Robotics Certification

- Algorithmic Thinking
- Syntax, Statements, and Structures
- Robot Mathematics
- Control and Feedback of Motors and Sensors
- Boolean Algebra/Conditional Statements
- Variables/Functions/Parameters
- Pedagogy
- Programming User Interfaces
  - Buttons
  - Joystick
- Troubleshooting/Debugging Code
- Arrays
- Case Statements
- Multi-Tasking
- Multi-Robot Communications
- Pointers
- Recursion

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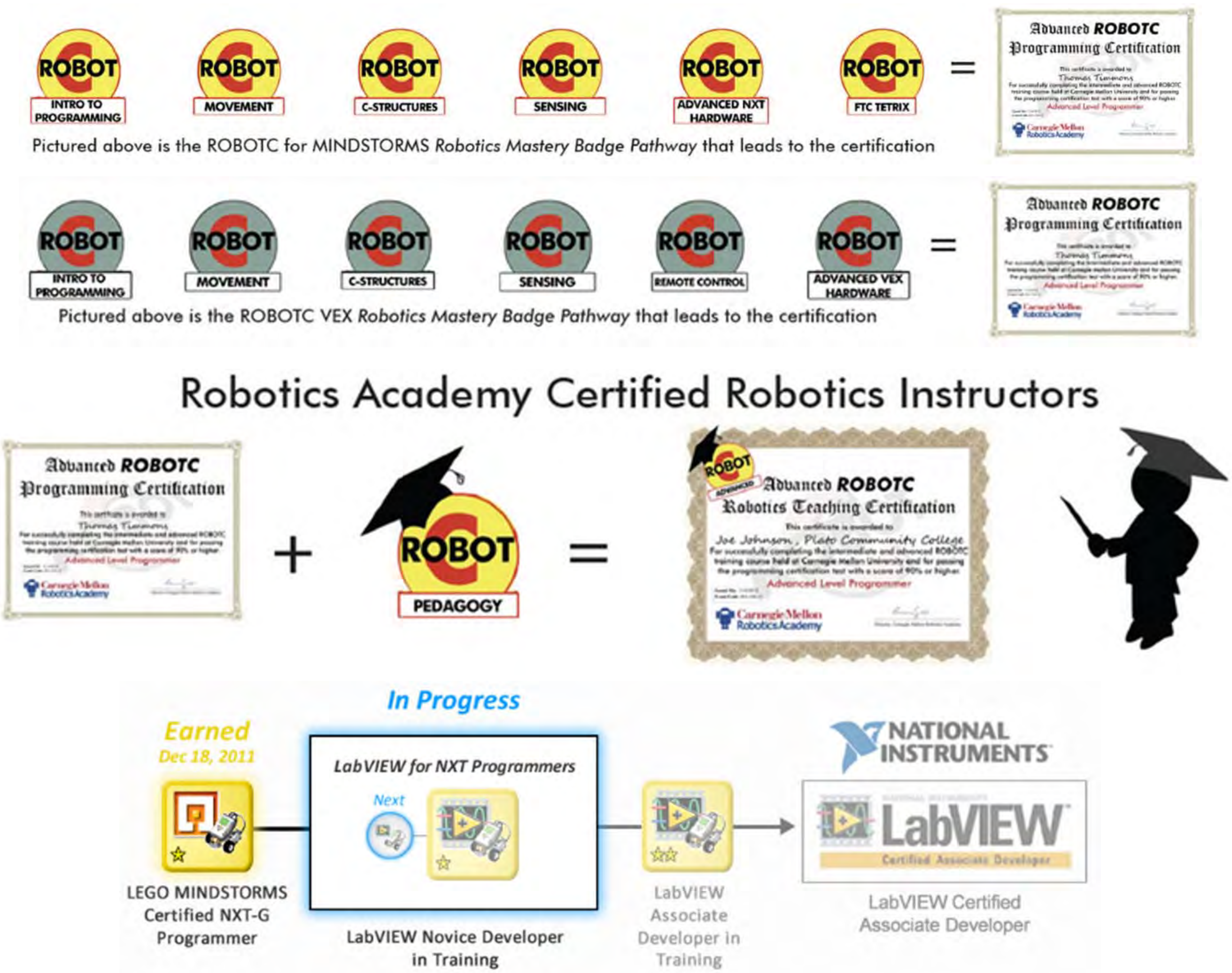
Badge Pathways to Certifications



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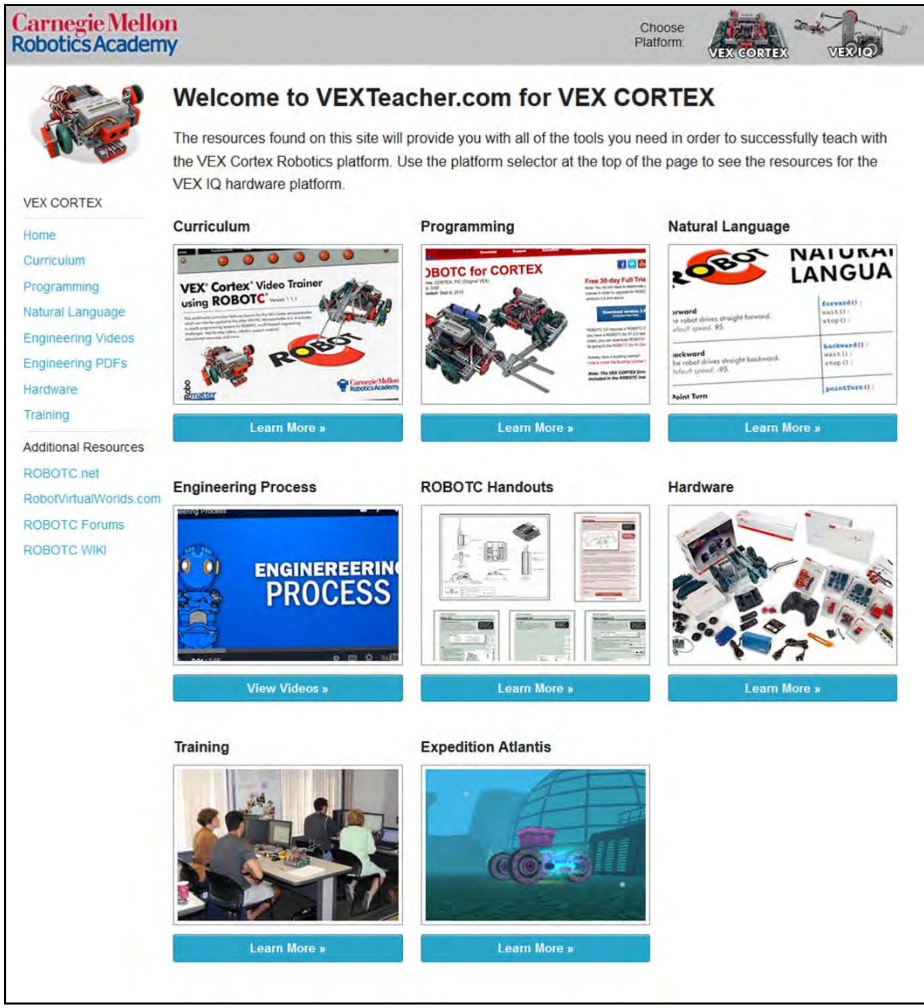
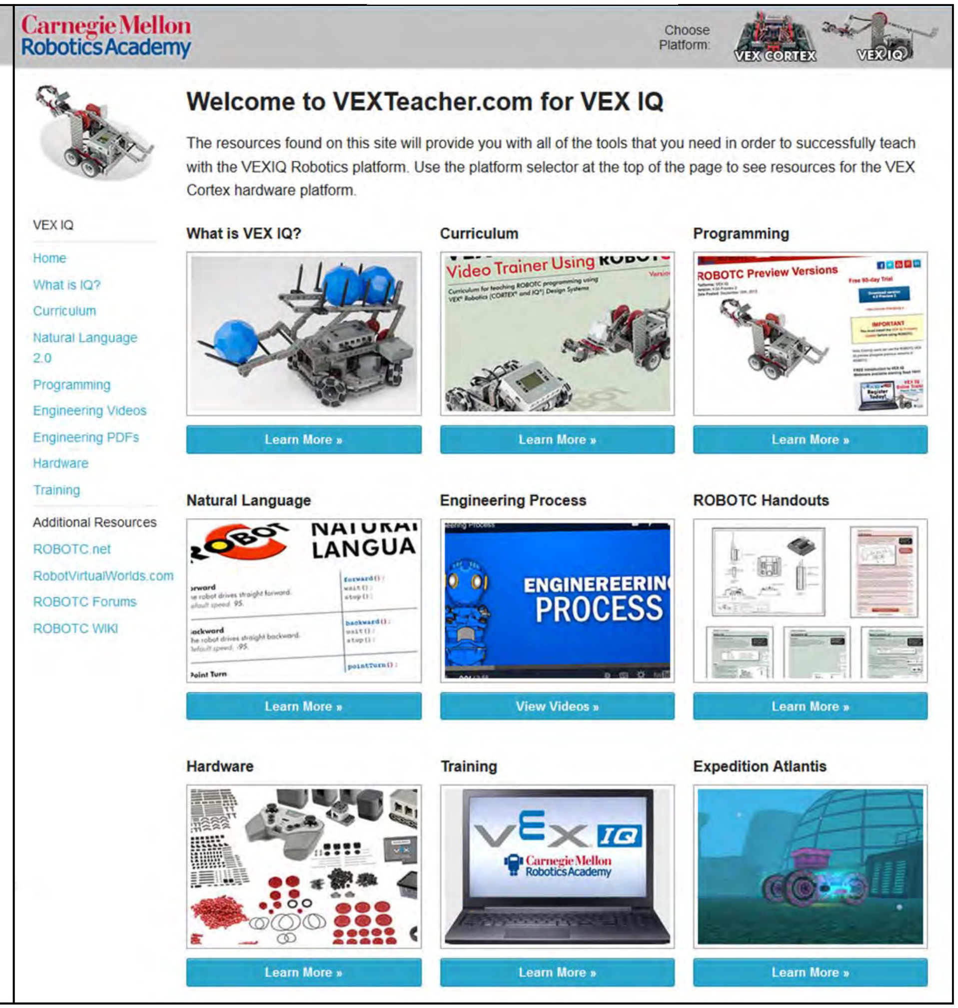
Free VEX Resources

www.vexteacher.com

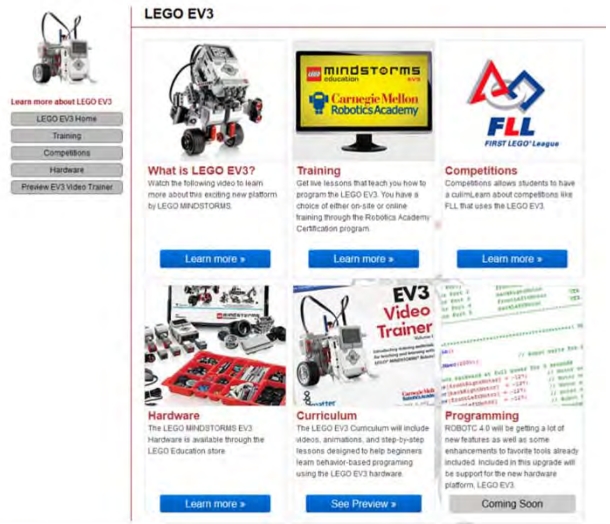




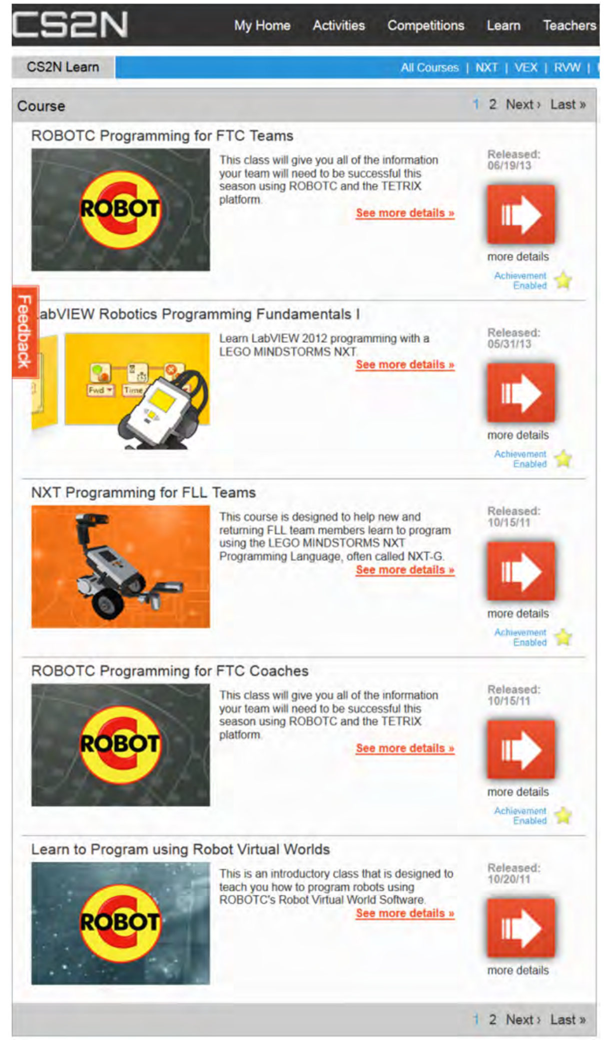
Free LEGO Resources

www.robotc.net

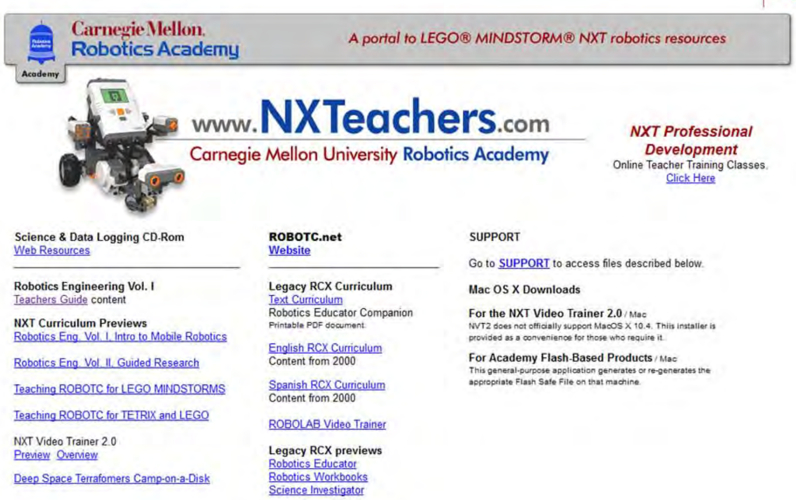
www.education.rec.ri.cmu.edu



www.cs2n.org

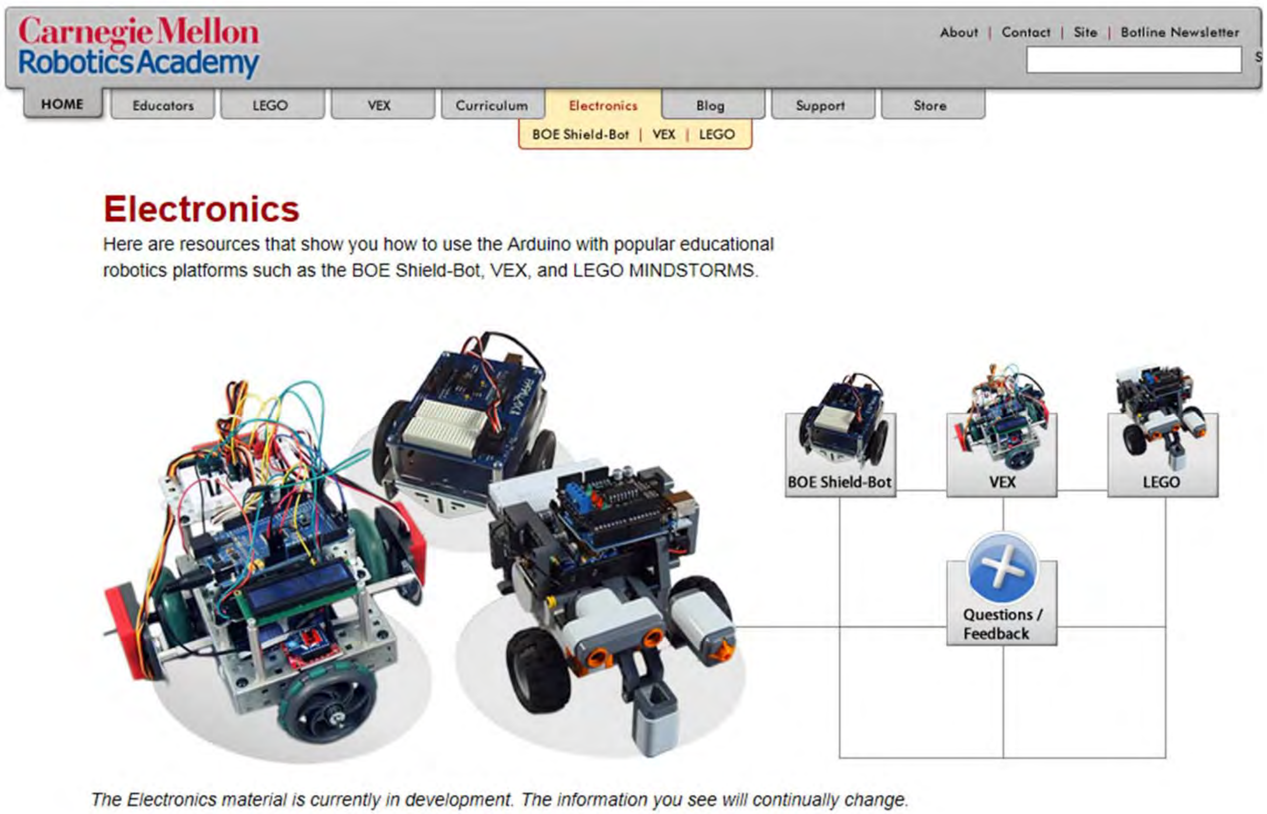


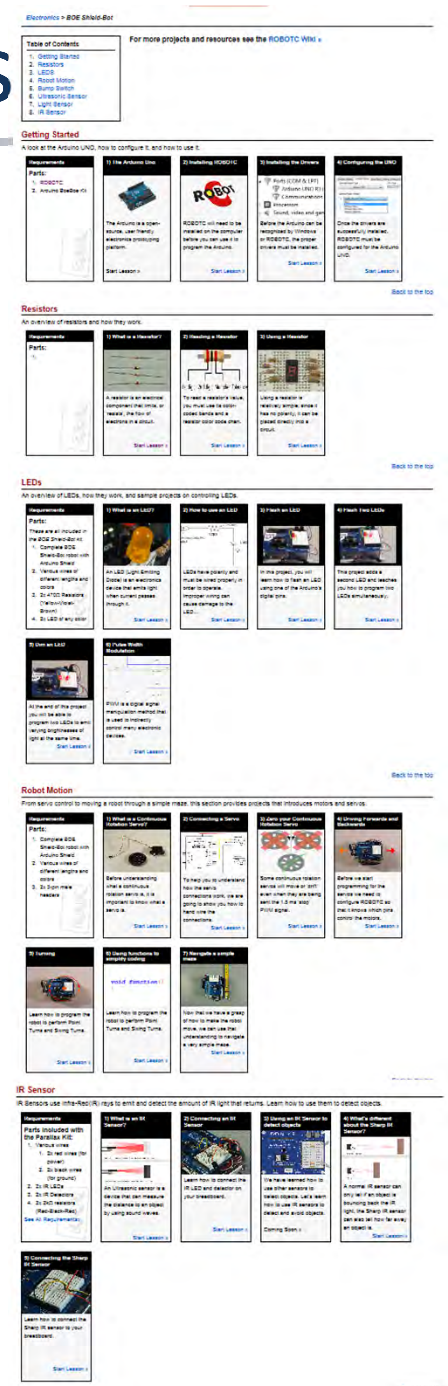
www.nxteachers.com

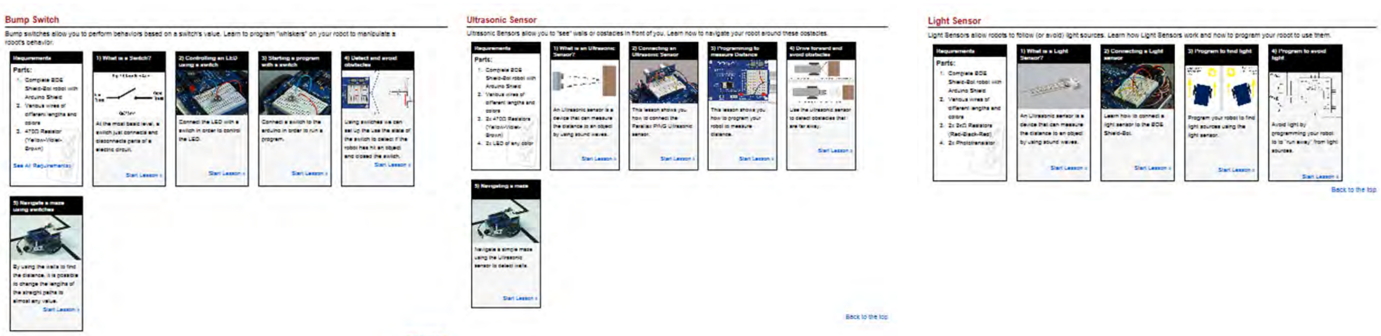


Carnegie Mellon Robotics Academy

Free Arduino Resources







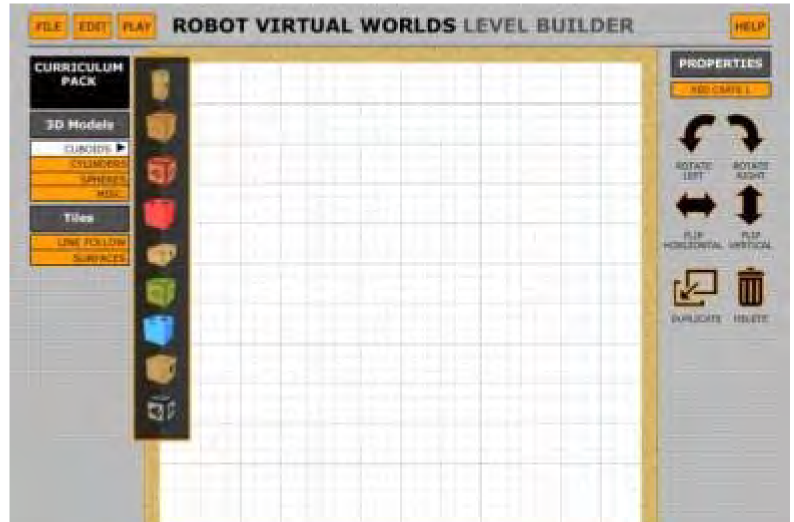
Additional Virtual Tools

RVW Level Builder/Robot Transformer

The Level Builder enables teachers and students to make their own challenges using models that already exist.

Pictured below is an example of the NEW Robot Transformer Technology. Students can swap out robot parts and use them in the game.

Picture above from the New Expedition Atlantis Game



The Level Builder Allows Students and Teachers to Create Programming Challenges

Examples of User-Created Worlds

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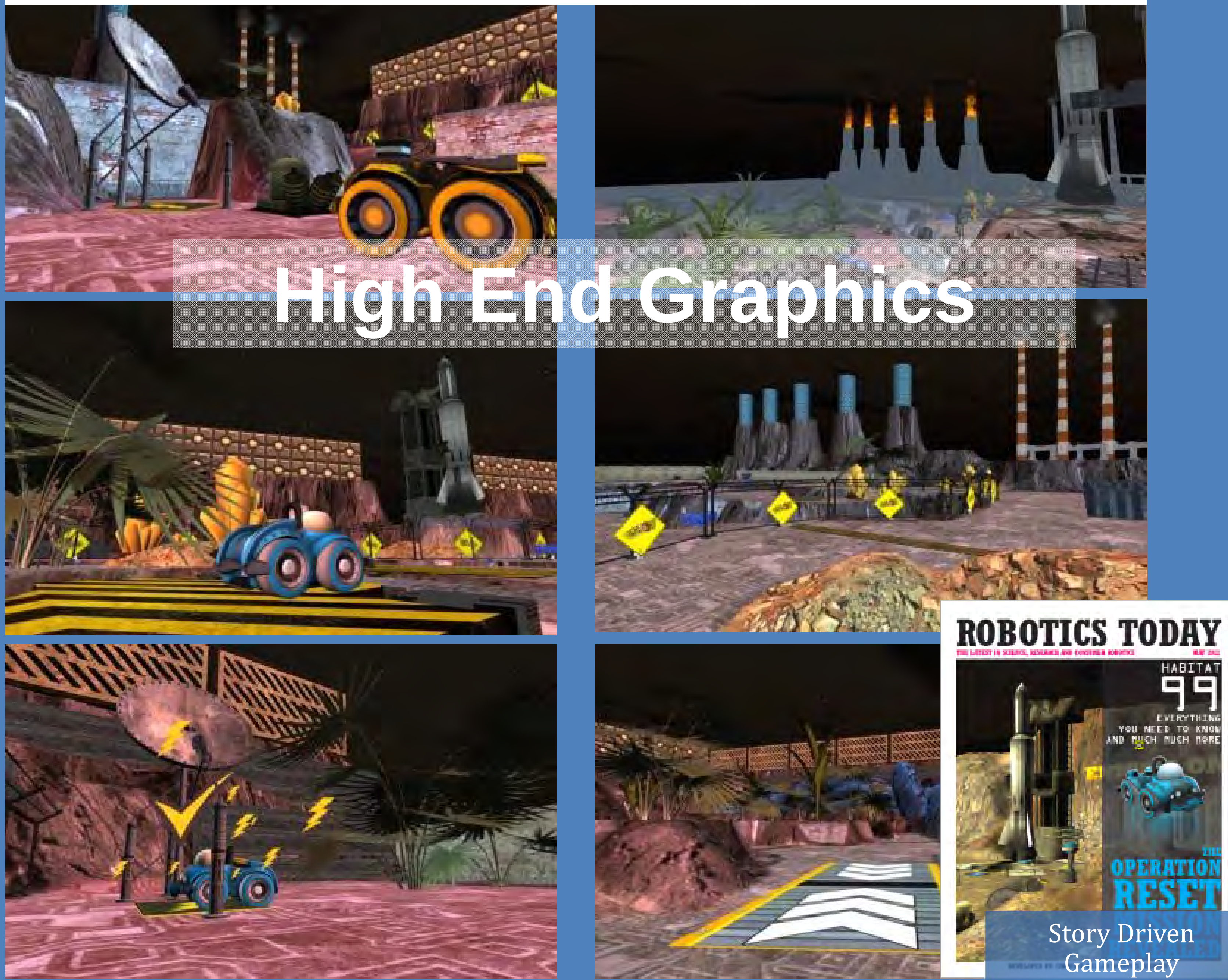
Robot Virtual Programming Games that work with NXT-G, LabVIEW, and ROBOTC

Robot Virtual Programming Games that now work with NXT-G, LabVIEW, and ROBOTC



High End Graphics

Story Driven Gameplay

Additional Virtual Tools

RVW Model Importer

The Model Importer allows students to draw parts using a modeling software (i.e. PTC, Autodesk, Solidworks, or Google Sketchup) and save the part as an FBX file type and import that part into their custom Robot Virtual World.

Videos that show how this works can be found at: www.robotvirtualworlds.com

Create Your Own Parts and Import them into the world

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Research Driven

Students Learn Programming Faster Through Robotic Simulation

By Allison Liu, Jeff Newsom, Chris Schunn, and Robin Shoop

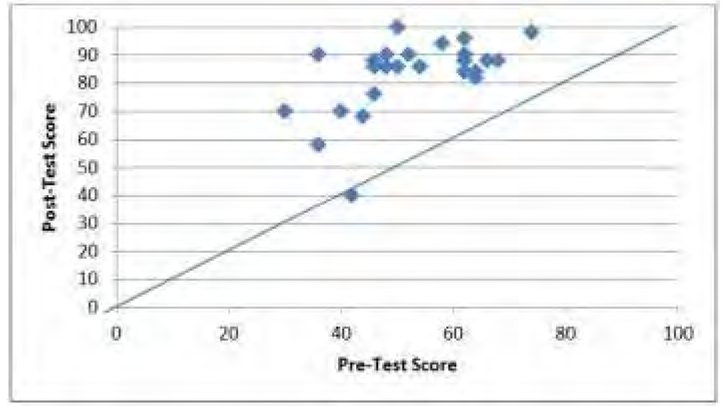
The Brains of the System

A LEGO Mining Bot

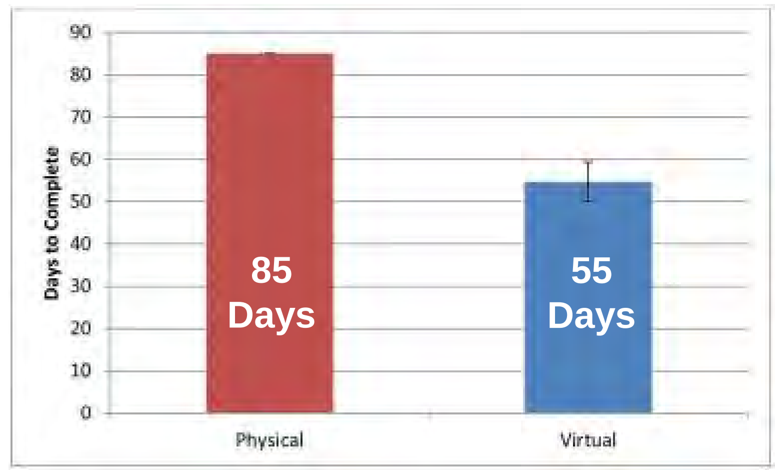
Scene from the Operation Reset programming game

16 techdirections • MARCH 2010

Condition	Pre-Test Average	Post-Test Average	Average Time Taken
Physical	50.2 (*SD*=11.2)	82 (*SD*=10.6)	85.0 (*SD*=0.0)
Virtual	55.9 (*SD*=11.5)	84.5 (*SD*=14.6)	54.7 (*SD*=18.2)



Pretest score vs posttest score. Points above the line improved on the posttest compared with the pretest.



Days taken to complete the course separated by condition.

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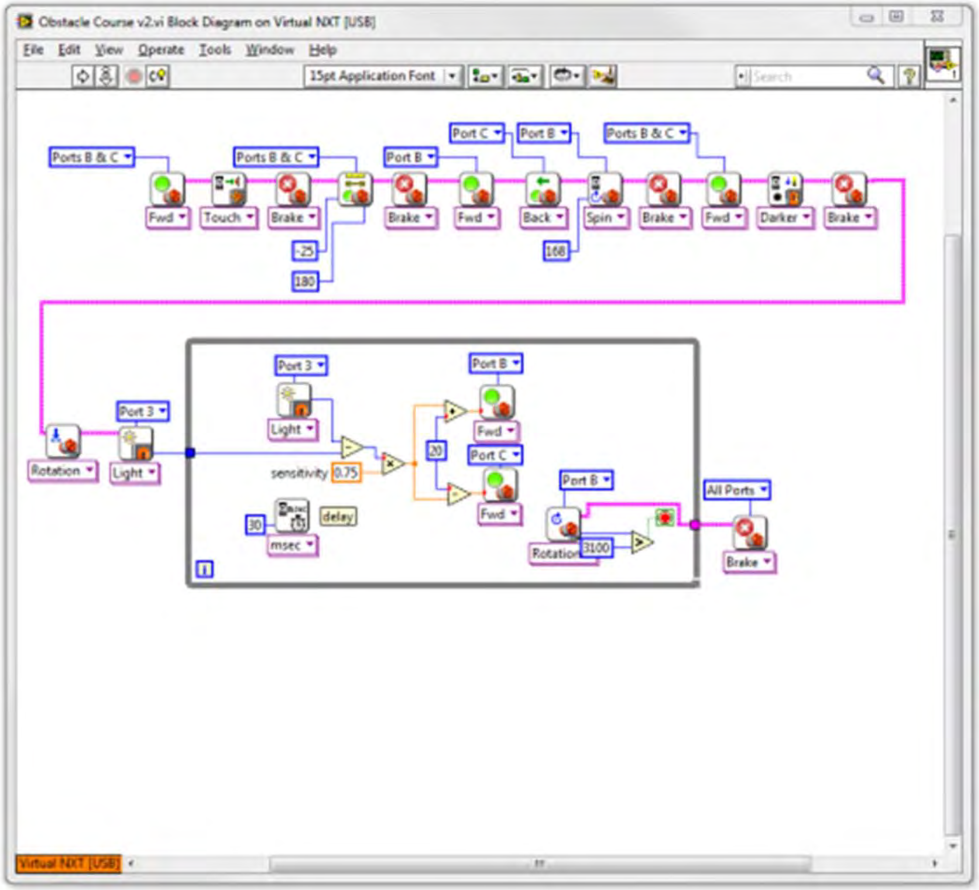
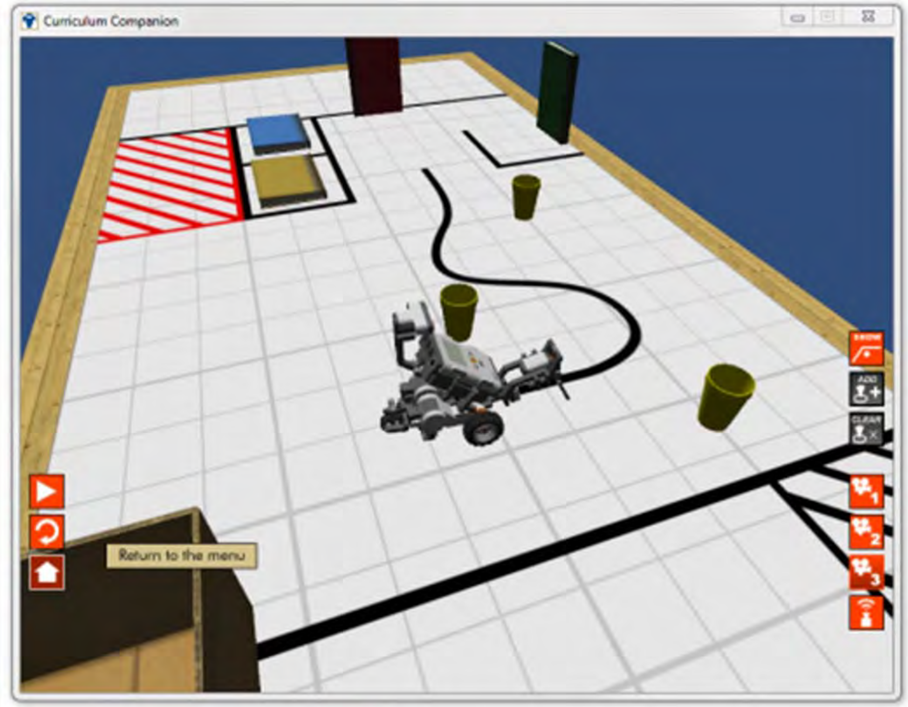
RVW LabVIEW Tools January 2014





Robomatter has been working with National Instruments and now has LabVIEW working with RVWs!

LabVIEW RVW Retail Pricing

Annual Single Seat - $49
Annual Team License - $149
Annual Classroom License - $299

Perpetual Single Seat - $79
Annual Team License - $299
Annual Classroom License - $599

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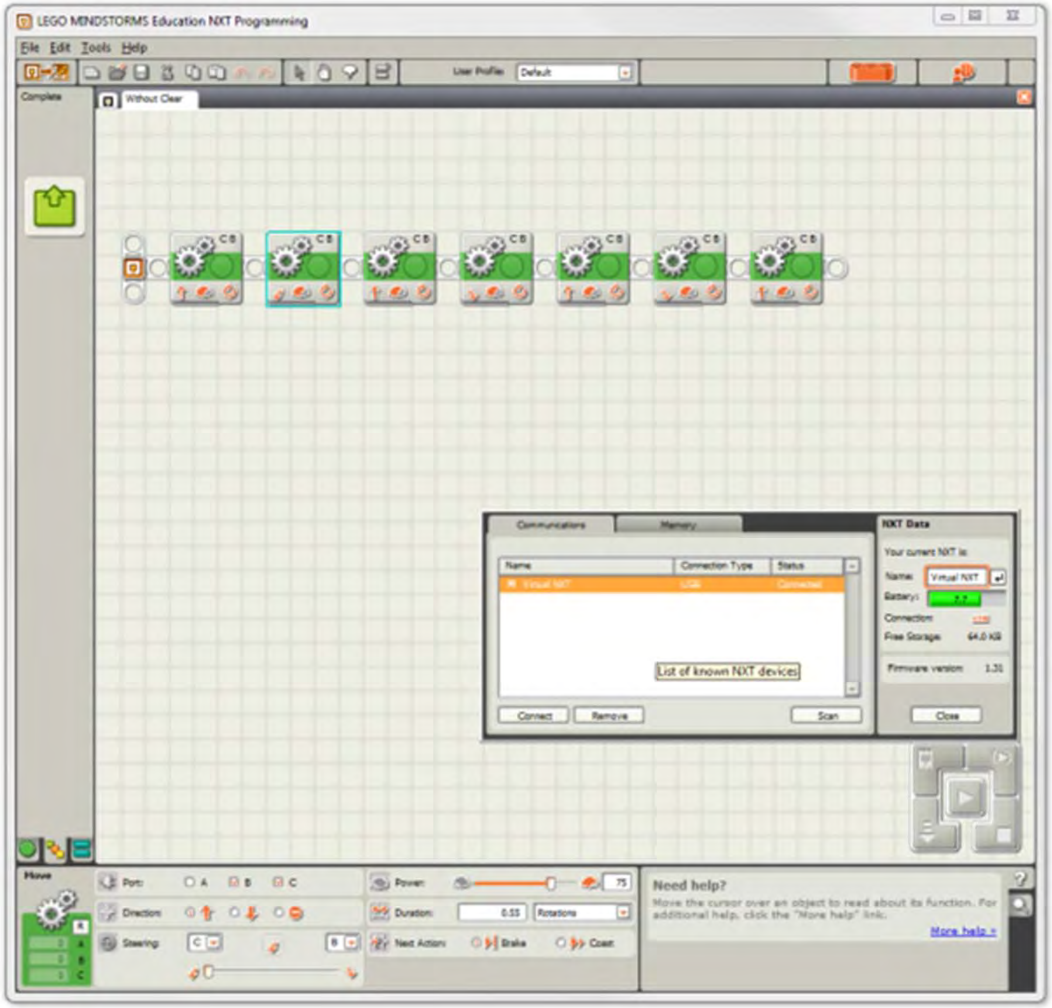
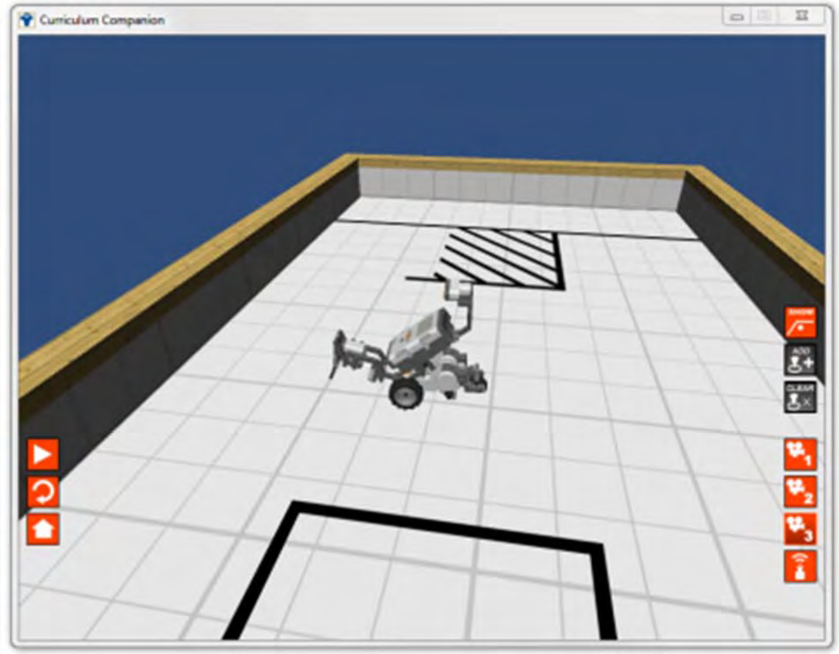
RVW NXT Software January 2014





NXT-G RVW Retail Pricing

Annual Single Seat - $49
Annual Team License - $149
Annual Classroom License - $299

Perpetual Single Seat - $79
Annual Team License - $299
Annual Classroom License - $599

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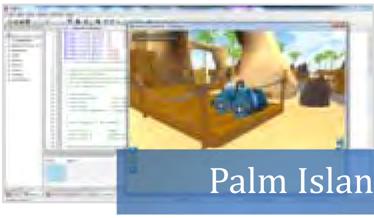
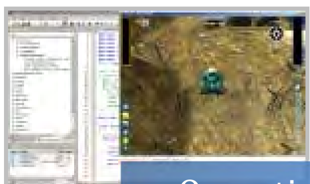
Tools to Teach Programming Using Virtual Robots

Current Game-Like Worlds


Palm Island

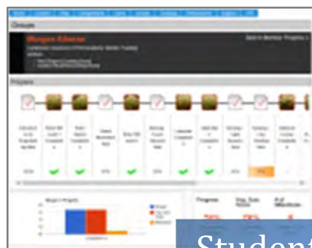

Ruins of Atlantis


Operation Reset

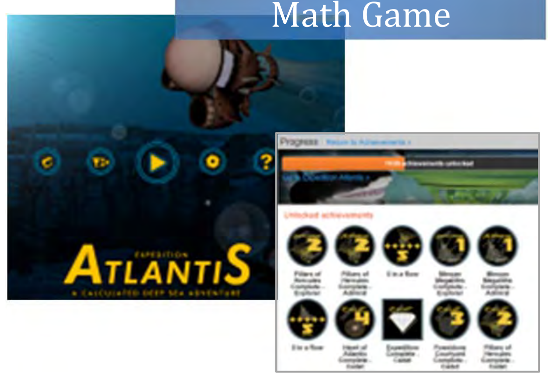

FTC Virtual **Programming Only** Competitions

Automated Assessment Tools

RVW Curriculum Companion


Student Earn Badges

Expedition Atlantis Math Game



Certifying Teachers

Computer Science and Robotics Certification

- Algorithmic Thinking
- Syntax, Statements, and Structures
- Robot Mathematics
- Control and Feedback of Motors and Sensors
- Boolean Algebra/Conditional Statements
- Variables/Functions/Parameters
- Pedagogy
- Programming User Interfaces
  - Buttons
  - Joystick
- Troubleshooting/Debugging Code
- Arrays
- Case Statements
- Multi-Tasking
- Multi-Robot Communications
- Pointers
- Recursion

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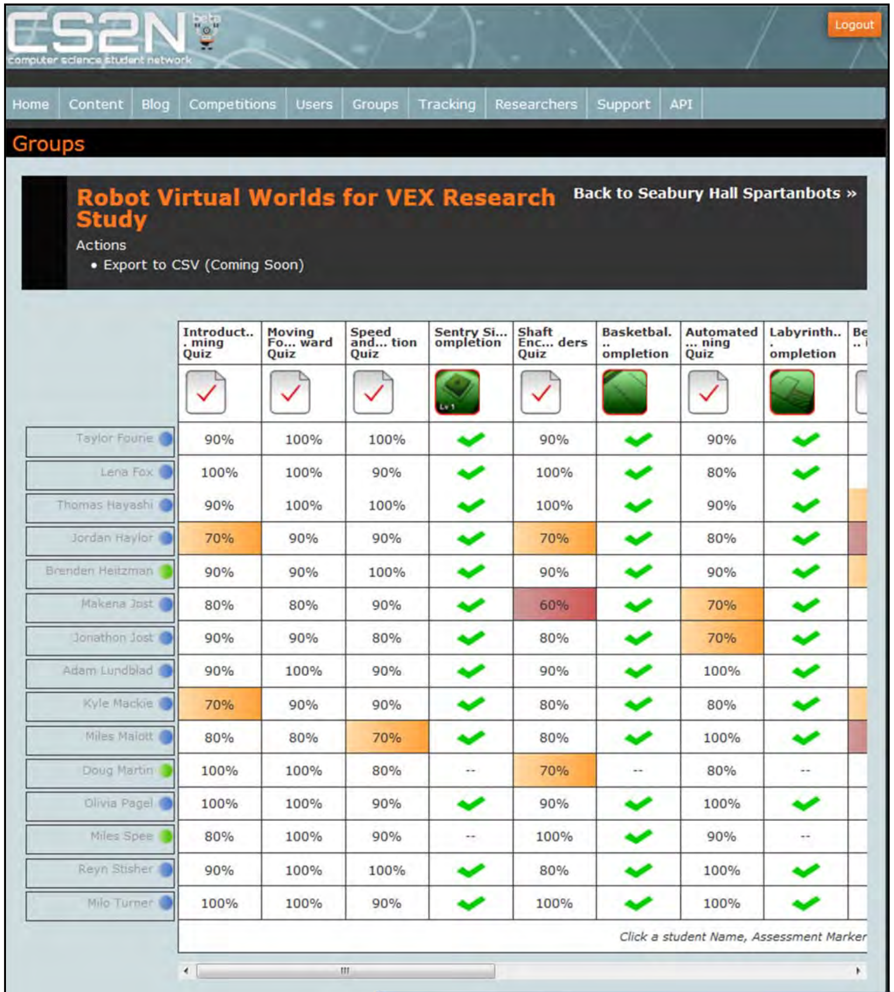
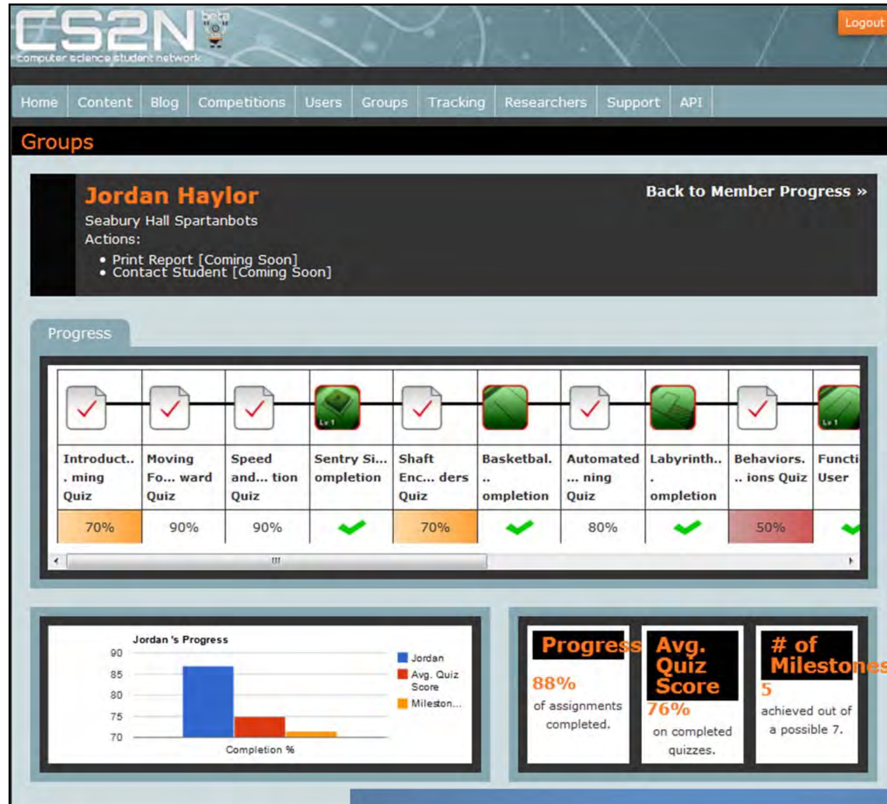
Teacher/Mentor Classroom View



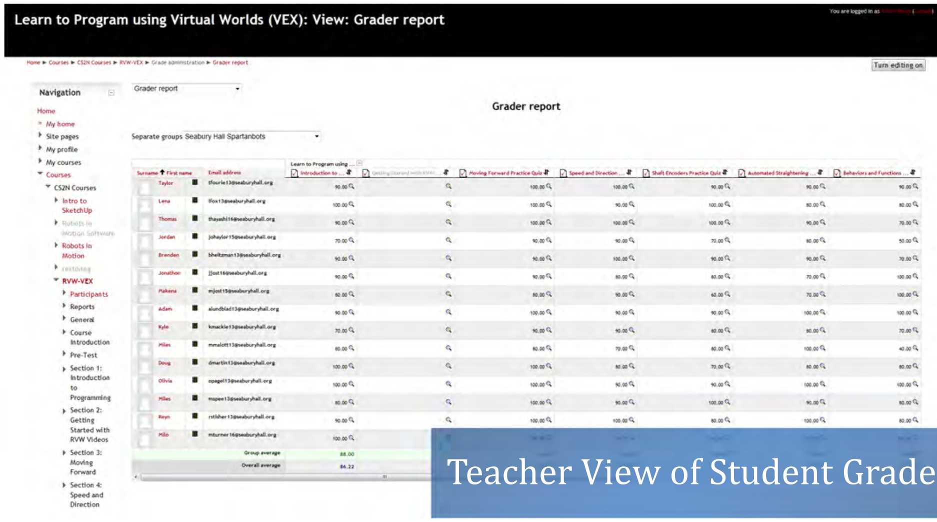
	Introduct.. . ming Quiz	Moving Fo... ward Quiz	Speed and... tion Quiz	Sentry Si... ompletion	Shaft Enc... ders Quiz	Basketbal. .. ompletion	Automated ... ning Quiz	Labyrinth.. . ompletion
Taylor Fourie	90%	100%	100%	✓	90%	✓	90%	✓
Lena Fox	100%	100%	90%	✓	100%	✓	80%	✓
Thomas Hayashi	90%	100%	100%	✓	100%	✓	90%	✓
Jordan Haylor	70%	90%	90%	✓	70%	✓	80%	✓
Brenden Heitzman	90%	90%	100%	✓	90%	✓	90%	✓
Makena Jost	80%	80%	90%	✓	60%	✓	70%	✓
Jonathon Jost	90%	90%	80%	✓	80%	✓	70%	✓
Adam Lundblad	90%	100%	90%	✓	90%	✓	100%	✓
Kyle Mackie	70%	90%	90%	✓	80%	✓	80%	✓
Miles Malott	80%	80%	70%	✓	80%	✓	100%	✓
Doug Martin	100%	100%	80%	--	70%	--	80%	--
Olivia Pagel	100%	100%	90%	✓	90%	✓	100%	✓
Miles Spee	80%	100%	90%	--	100%	✓	90%	--
Reyn Stisher	90%	100%	100%	✓	80%	✓	100%	✓
Milo Turner	100%	100%	90%	✓	100%	✓	100%	✓

Member Progress Teacher View



Individual Student Progress View

Teacher Grade Book View

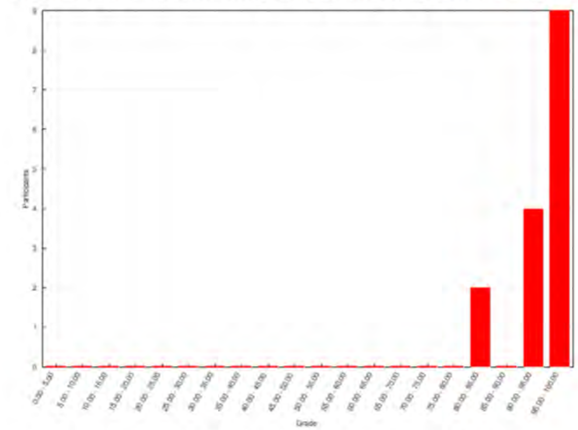


Teacher View of Student Grades

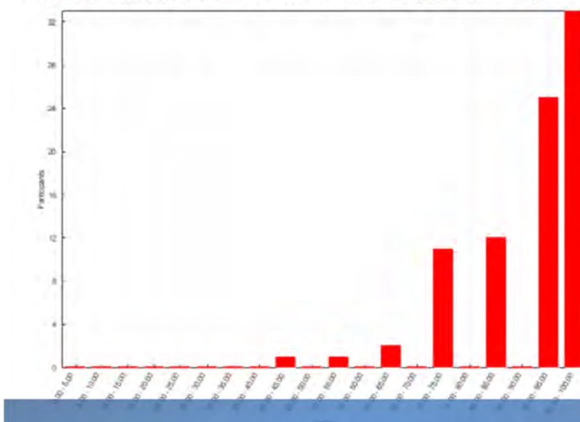
Teacher View of Student Quiz Results

Grade Distribution

Number of students in group achieving grade ranges



Overall number of students achieving grade ranges



Teacher View of Overall Results

Over 240 Colleges Use ROBOTC!

Alfred State College	European University at St.Petersburg	Missisipi State University	Sacred Heart College	University Of Detroit Mercy
All Saints' College	Fairmont State University	Montana State University	San Bernardino College	University of Hawaii-Hilo
American University Of Sharjah,	FAMU-FSU College of Engineering	Montgomery County Community College	Southeast Missouri State University	University of Houston
Andrews University	Falukner State Community College	MT MAUNGANUI COLLEGE	Southern Polytechnic State University	University of Ljubljana
Baltimore City Community College	Florence-Darlington Technical College	Mt St Michael's College	St Louis Community College	University of Maryland
BARADENE COLLEGE OF THE SACRED HEART	Florida State University	Mt. San Antonio College	ST VIRGIL'S COLLEGE	University of Maryland Eastern Shore
Berkeley City College	Fox Valley Technical College	Murdoch University	St. Mary's University Texas	University of Minnesota
Broome Community College	Garrett College	NC A&T State University	ST. MICHAEL'S COLLEGE SCHOOL	University of Mississipi
Brown University	Georgia Tech - CEISMC Dep	NC State University	St. Peter's College	University Of North Carolina
Butler County Community College	Gonzaga University	New Mexico State University	State Center Community College District	University of North Florida
Butte College	GRAZ UNIVERSITY OF TECHNOLOGY	New York City College of Technology	Swinburne University of Technology	University of North Texas
Cal Poly Pomona,	Great Oaks Institute of Technology	New York Institute of Technology	Taft College	UNIVERSITY OF NOTRE DAME
California Luthern University	Hamilton College	Niagara County Community College	Technical Career Institutes, Inc.	University of Nottingham
California University of PA	Hampton University	North Idaho College	Temple University	UNIVERSITY OF OTAGO
Campus School of Carlow Univeristy	HAWKER COLLEGE	Northern Alberta Institute of Technology	Texas A&M University	University of Passau/Germany
Canberra College	Herkimer		l College	University Of Pittsburgh
Carnegie Mellon	Houston C		gy Center @ Pulaski	UNIVERSITY OF REGINA
Casper College	IMPERIAL		SITY	University of San Diego
Community College Allegheny College	Imperial Valley College	Nova Scotia Community College	The Community College of Baltimore Co	University of South Carolina
Cecil College PA	Indian Hills Community College	Numazu College of Technology	The University of Texas	University of South Florida Lakeland
CECIL COLLEGE MD	Iowa State University	NYU-POLY	TOKYO INSTITUTE OF TECHNOLOGY	University of the West of England
Central Community College	Jackson State University	Oakland Community College	Tokyo Polytechnic University	UNIVERSITY OF THE WITWATERSRAND
Central Virginia Community College	Jacksonville State University	Oglala Lakota College	Trinity College	UNIVERSITY OF TOKYO
CENTRALIAN SENIOR COLLEGE	KEIO UNIVERSITY	Okanagan College	Tufts University	UNIVERSITY OF VICTORIA
Chicago State University	Kettering University	OKAYAMA UNIVERSITY OF SCIENCE	TUGGERANONG COLLEGE	University of Waterloo
Chisholm Catholic College	Kirkwood Community College	Oregon State University	University of CA DAVIS	University of West Georgia
City College of New York	Klamath Community College	Ormiston College	UCLA	University of Wisconsin-Eau Claire
Cleveland Heights-University	Lewis University	Owensboro Community & Technical College	UCSD	University of Wollongong in Dubai
College of Eastern Utah	LONE STAR COLLEGE-NORTH HARRIS	Pacific Technology School Santa Ana	Universidad Autonoma de Manizales	UNIVERSITY OF ZARAGOZA
COLLEGE OF ST. SCHOLASTICA	LONG BAY COLLEGE	Packer Collegiate Institute	UNIVERSIDAD DE GUADALAJARA	UPPSALA UNIVERSITET Phillipines
College of William and Mary	Longwood University	Palomar College	Universidad Politecnica de Valencia	UPPSALA UNIVERSITY Sweden
Colorado Academy	Los Angeles Harbor College	Passaic County Community College	UNIVERSIDAD TECNOLOGICA DE ALTAMIF	US NAVALACADEMY
Columbia State Community College	Los Angeles Harbor College	Passaic County Technical Institute	UNIVERSITAS SURABAYA	UTAH VALLEY UNIVERSITY
Community College of Beaver County	Lule University of Technology	Penn State	UNIVERSITÄT BREMEN, ZETEM	Victoria University of Wellington
Community College of Rhode Island	MAIZURU NATIONAL COLLEGE OF TECHNOL(	Polk State College	University of Alaska Fairbanks	Villanova University
Contra Costa College	MANCHESTER METROPOLITAN UNIVERSITY	PORTLAND STATE UNIVERSITY	University of Alberta	Waseda University
CSU, Bakersfield	Marist College	Purdue University	University of Auckland	Wayne State College
Cuyahoga Community College	MIT Lincoln Laboratory	Queen's University	UNIVERSITY OF BRADFORD	WELLINGTON INSTITUTE OF TECHNOLOG
De La Salle Institute	McGill University	Queens College	University of Bridgeport	Wentworth Institute of Technology
DEL MAR COLLEGE	McHenry County College	Queensborough Community College	UNIVERSITY OF CALGARY	West Virginia University
Devry University	Medgar Evers College, CUNY	Rancho Santiago Community College	UNIVERSITY OF CAMBRIDGE	Westchester Community College
Drake University	Metropolitan Community College	Ranken Technical College	UNIVERSITY OF CANTABRIA	Western Kentucky University
Drexel University	Miami Dade College	Red Deer College	University of Central Oklahoma	Western Washington University
Duke University	MICHIGAN TECHNOLOGICAL UNIVERSITY	Reykjavik Technical College	University of Cincinnati	Westmoreland County Community Coll
Dutchess Community College	Mid-State Technical College	Rhode Island College	University Of Crete	Wheeling Jesiut University
Eastern Michigan University	Milwaukee School of Engineering	RIDLEY COLLEGE	UNIVERSITY OF DELAWARE	Widener University
ELON UNIVERSITY	Fond Du Lac Tribal & Community College	Rutgers University	University of Derby	Wodonga Senior Secondary College

Supporting Classrooms

Curriculum and RVW Curriculum Companion

Available for free online at www.robotc.net allowing students to complete homework. Most schools purchase the software for quick access to over 80 high resolution videos.

87 page curriculum guide that provide step-by-step instructions for teachers using the ROBOTC Curriculum

The Curriculum Companion includes over 40 virtual programming challenges that align with the robot programming challenges found in the ROBOTC Curriculum at the left.

Carnegie Mellon Robotics Academy