2015 ROBOTICON

TAMPA BAY

FIRST

October 10 & 11, 2015
roboticon.net
@RobotiConTampa

Tampa Bay Times NIE
newspaper in education
tampabay.com/nie

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Community Driven Innovation

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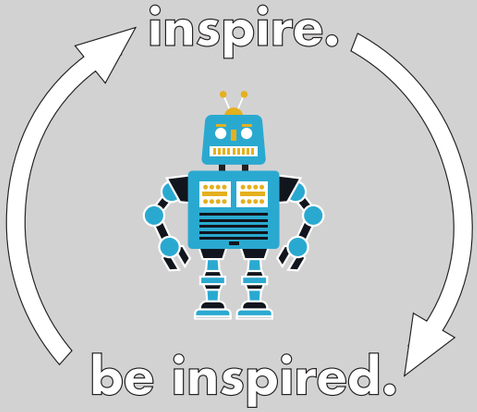
2015 ROBOTICON TAMPA BAY

FIRST

October 10 & 11 • ROBOTICON.net

- Robot displays, games and challenges
- Industrial and commercial robotics and technology fair
- STEM college and career expo
- Workshops for students and educators



OMG — Robots!

What:	ROBOTICON Tampa Bay 2015
When:	October 10 & 11
Where:	University of Tampa Bob Martinez Athletics Center, 401 W Kennedy Blvd, Tampa, FL 33606
Who:	Anyone interested in robotics
How much:	Free!
Why:	ROBOTS! Need we say more?

ROBOTICON Tampa Bay is a free, two-day event focused on STEM – Science, Technology, Engineering and Mathematics.

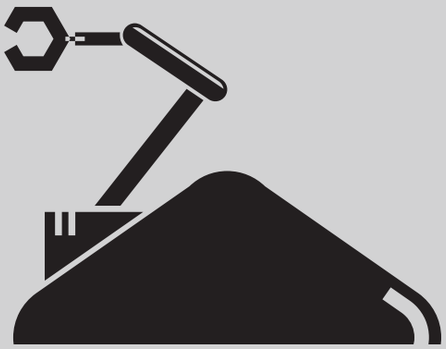
ROBOTICON is a K-12 *FIRST* (For Inspiration and Recognition of Science and Technology) Robotics Showcase featuring competitions between teams of students who design and build robots to solve various challenges. Students ages 6 and up compete in four categories sanctioned by *FIRST*, an international non-profit K-12 STEM education program.

Now in its third year, the mission of ROBOTICON is to provide Tampa Bay-area *FIRST* robotics teams with a high-quality, postseason competitive event that provides opportunities for skill building, networking and college and career readiness experiences.

ROBOTICON also provides a fun and unique way for the general public to enjoy this "Sport for the Mind" and see and enjoy the hands-on Science, Technology, Engineering, and Mathematics (STEM) that *FIRST* offers.

Guests can visit the Team Pits to see team members working on their robots, visit the ROBOTICON Exhibit Hall to enjoy STEM demos, vendors and organizations, and learn more about technical, math and science careers and college opportunities.

Major support for ROBOTICON Tampa Bay is provided by Hillsborough County and the Economic Development Innovation Initiative. The 2015 sponsors include Comcast NBCUniversal, Verizon, Boca Bearing Co., F5 Live: Refreshing Technology, Sumo Software, iR3 Creative and the Foundation for Community Driven Innovation (FCDI).



ROBOTICON Public Agenda:

Saturday, October 10

10 a.m. – Doors open to the public

11 a.m. to 4 p.m. – *FIRST* Robotics Competition (FRC) practice

10 a.m. to 3 p.m. – *FIRST* LEGO League (FLL) practice

11:30 a.m. to 12:30 p.m. – Invited Guests Luncheon

1 p.m. to 4 p.m. – *FIRST* Tech Challenge (FTC) scrimmage

10 a.m. to 12 p.m. – Workshops

1 p.m. to 4 p.m. – Workshops

Sunday, October 11

10 a.m. – Doors open to the public

10 a.m. – FRC opening ceremony

10:15 a.m. – FRC qualification games

11:30 a.m. to 12:30 p.m.– Invited Guests Luncheon

2 p.m. – FRC alliance selection

2:30 p.m. – FRC elimination matches

4:30 p.m. – Closing ceremony

Public workshop: *FIRST* for educators

ROBOTICON Tampa Bay offers a great opportunity for educators to see *FIRST* K-12 STEM education in action and to learn best practices from other schools and educators. Speak to students, teachers and coaches from around the state and learn how to implement *FIRST* programs in the classroom and in after-school environments.

FIRST provides project-based learning in alignment with the Common Core and Florida Standards as well as more than $22 million in scholarships to participating high school students. The programs are inclusive, accessible and affordable, with significant grant funding available to new and existing teams.

Please join us to see how *FIRST* can bring added value to your school program. Educators can RSVP to twillingham@usfirst.org.

Public workshop: Starting a *FIRST* team

Almost everyone agrees that *FIRST* is an awesome youth program, but because it involves robots and tools and funky games and meetings and such, people who would be great at working with kids in this program either don't think they actually would be, or feel it's too daunting to take on. We'll show you that it's neither, and with some organization, a little planning and a collaborative spirit, you can help build the future as you build a *FIRST* Team!

Key to *FIRST* program success is a concept called "Gracious Professionalism."® As defined by Dr. Woody Flowers, who developed the idea, "It is how we should strive to act, whether we are being watched or not, and in a way that would make those we admire most proud. Gracious Professionalism demands that we treat others with kindness and respect, communicate with one another clearly and honestly, and resolve conflicts and misunderstandings immediately." What's not to love here?

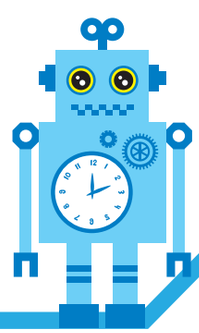
Learning with the *Times*

GRACIOUS PROFESSIONALISM

Knowing how to work with and get along with other people is important. Being successful includes respecting others and doing the best that you can. Those concepts are the basis of Gracious Professionalism. *FIRST* (For Inspiration and Recognition of Science and Technology) incorporates the concept of Gracious Professionalism into its mission.

According to the *FIRST* website, Gracious Professionalism is "a way of doing things that encourages high-quality work, emphasizes the value of others, and respects individuals and the community. With Gracious Professionalism, fierce competition and mutual gain are not separate notions. Gracious professionals learn and compete like crazy, but treat one another with respect and kindness in the process. They avoid treating anyone like losers. No chest thumping tough talk, but no sticky-sweet platitudes, either. Knowledge, competition and empathy are comfortably blended."

Think about what that means in reference to your everyday world. In a small group, discuss these concepts. On one side of a piece of paper, write down examples of Gracious Professionalism that you have seen. On the other side of the paper, write down examples that go against this concept. Next, look for examples showing positive and negative examples of Gracious Professionalism in the *Tampa Bay Times*. Write an argument essay discussing why Gracious Professionalism is a positive concept. Use the examples you have discussed to support your ideas. Present your ideas to your class.



FIRST® IMPACT

10 years of evaluation data indicates that with participation in FIRST,® team members are:

STEM MAJOR CITED BY *FIRST* PARTICIPANTS

2x as likely to major in science or engineering

Major in engineering 41%

33% of women major in engineering

Source: Brandeis University, 2005 Evaluation of *FIRST*® Robotics Competition (FRC®) Alumni

SCHOOL ENGAGEMENT INCREASES FOR *FIRST* PARTICIPANTS

More interested in doing well in school

- 87% *FIRST*® LEGO® League
- 86% *FIRST*® Tech Challenge
- 88% *FIRST*® Robotics Competition

Plan to take a more challenging math or science course

- 84% *FIRST*® Tech Challenge
- 90% *FIRST*® Robotics Competition

More interested in going to college

- 88% *FIRST*® LEGO® League
- 87% *FIRST*® Tech Challenge
- 91% *FIRST*® Robotics Competition

Source: Brandeis University, 2011 *FIRST*® Tech Challenge (FTC®) – *FIRST*® Robotics Competition Evaluation and 2013 *FIRST*® LEGO® League (FLL®) Evaluation

21ST CENTURY WORK-LIFE SKILLS GAINED BY *FIRST* PARTICIPANTS

- *Improved problem solving skills* 98%
- *Increased time management skills* 95%
- *Increased conflict resolution skills* 93%
- *Strengthened communication skills* OVER 76%

Source: Brandeis University, 2011 *FIRST*® Tech Challenge – *FIRST*® Robotics Competition Evaluation and 2013 *FIRST*® LEGO® League Evaluation

FIRST ALUMNI IN STEM CAREERS

89.6% of Alumni are in a STEM field as a student or professional

Source: *FIRST*, 2011 Survey of *FIRST*® Robotics Competition and *FIRST*® Tech Challenge Alumni

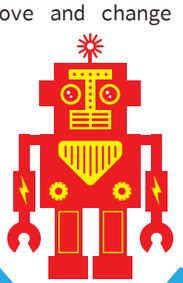
FIRST. FOR INSPIRATION AND RECOGNITION OF SCIENCE AND TECHNOLOGY

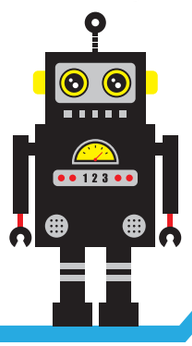
USFIRST.ORG

Learning with the *Times*

DEAN OF INVENTION

Dean of Invention was the name of a 2010 Planet Green television series hosted by Dean Kamen, the founder of *FIRST*, but it is also an apt description of Mr. Kamen's creative career. A modern-day Thomas Edison, Kamen holds more than 440 U.S. and foreign patents, many for innovative medical devices. His latest project is the "Luke Arm," an advanced prosthetic arm in development for the Defense Advanced Research Projects Agency (DARPA) with the goal of improving the quality of life for returning injured soldiers. It is amazing how much technology has improved the quality of life for many people. Take an inventory of technology that is already available in your home, community and school. Look in the *Tampa Bay Times* for examples of how technology is used to improve and change people's lives. While reading through the newspaper articles, think about what other technology could be used to improve people's lives. Write a blog post explaining your thoughts and ideas. Be sure to use specific examples to support your ideas. Share your ideas with your classmates.





FIRST LEGO League Global Innovation Award presented by XPRIZE

The *FIRST* LEGO League Global Innovation Award presented by XPRIZE is a competition designed to showcase the real-world, innovative solutions that *FIRST* LEGO League teams create. The winning team receives a cash prize of $20,000 to develop their invention or to support team activities.

The 2015 Global Innovation Award winner, Indiana's Team Storm, is composed of four girls and three boys ages 10 to 14. Their winning invention, the ROY G. BIV Math System, is an educational app designed to improve the way children who are challenged with dyslexia learn new math concepts.

FIRST®

FIRST (For Inspiration and Recognition of Science and Technology) was founded in 1989 by inventor and entrepreneur Dean Kamen — creator of the Segway – to inspire young people's interest and participation in science and technology.

FIRST K-12 STEM education programs use robot challenges to build science and technology skills as well as leadership and life skills. *FIRST* serves more than 10,000 students in Florida, with about 3,000 of those in the Tampa Bay area.

Compared to their peers, *FIRST* alumni are:

- 50 percent more likely to attend college
- Nine times more likely to have an internship in their freshman year
- Three times more likely to major in engineering
- Four times more likely to pursue a career in engineering.
- Two and a half times more likely to volunteer in the community

The *FIRST* family of programs includes the *FIRST* Robotics Competition for students in grades 9-12; the *FIRST* Tech Challenge for grades 7-12; the *FIRST* LEGO League for grades 4-8; and the Junior *FIRST* LEGO League for grades K-3.

FIRST Robotics Competition (grades 9-12)

usfirst.org/roboticsprograms/frc
twillingham@usfirst.org

Teams of 25 or more students are challenged to raise funds, design a team "brand," hone teamwork skills and build and program a robot to perform prescribed tasks against a field of competitors in a fast-paced, real-world engineering experience. FRC students:

- Work alongside professional engineers
- Build and compete with a robot of their own design
- Learn and use sophisticated hardware and software
- Develop design, project management, programming, teamwork and strategic thinking skills
- Compete for a place in the World Championship
- Qualify for more than $18 million in college scholarships

FIRST Tech Challenge (grades 7-12)

usfirst.org/roboticsprograms/ftc
FTC.flfirst.org in FL
FTC@flfirst.org

Teams of up to 15 students design, build and program a robot to compete on a 12' x 12' field against other teams, developing strategy and using sound engineering principles. FTC students:

- Design, build and program robots
- Apply real-world math and science concepts
- Develop problem-solving, organizational and team-building skills
- Compete for a place in the State and World Championship Tournaments
- Qualify for more than $12 million in college scholarships

FIRST LEGO League (ages 9-16)

usfirst.org/roboticsprograms/fll
suncoastfll.org in west central Florida
suncoastfll@gmail.com

Teams of up to 10 students design their own solution to a current scientific question or problem and build autonomous LEGO MINDSTORMS® robots that perform a series of missions. FLL students:

- Create innovative solutions for challenges facing today's scientists
- Design, build, program and test a robot
- Apply real-world math and science concepts
- Develop critical thinking, time management, collaboration, and communication skills
- Qualify for an invitation to the World Festival.

Junior *FIRST* LEGO League (ages 6-9)

usfirst.org/roboticsprograms/jr.fll
jrfllteams@usfirst.org

Guided by adult coaches, teams of 5 or 6 students use LEGO bricks to build a model that moves and develop a Show-Me poster to illustrate their journey. Junior *FIRST* LEGO League students:

- Design and build a challenge-related model using
- Create a Show-Me poster and practice presentation skills
- Explore challenges facing today's scientists
- Discover real-world math and science
- Develop teamwork skills

FIRST at a Glance

***FIRST* is an international program with growing impact:**

400,000+ students
38,700+ teams
34,000+ robots
90,000+ mentors
90,000+ volunteers
3,500+ sponsors

FIRST in Florida
FIRSTFL.org

Florida _FIRST_ Tech Challenge
FTC.flfirst.org

Orlando FRC Regional
OrlandoFRC.org

South Florida Regional
FIRSTinFlorida.org

Suncoast FLL – Central West FL
SuncoastFLL.org - Hillsborough Community College

Terri Willingham, Central Florida Regional Director
twillingham@usfirst.org

Android

(noun) an·droid \'an-drȯid\
A mobile robot, usually with a human form

Automaton

(noun) au·tom·a·ton \ō-'tä-mə-tən, -mə-ˌtän\
A machine that can move by itself

Gray Eagle Drone (General Atomics)

Drone

(noun) \'drōn\
An unmanned aircraft or ship guided by remote control or onboard computers

NASA Sojourner on Mars (NASA/JPL)

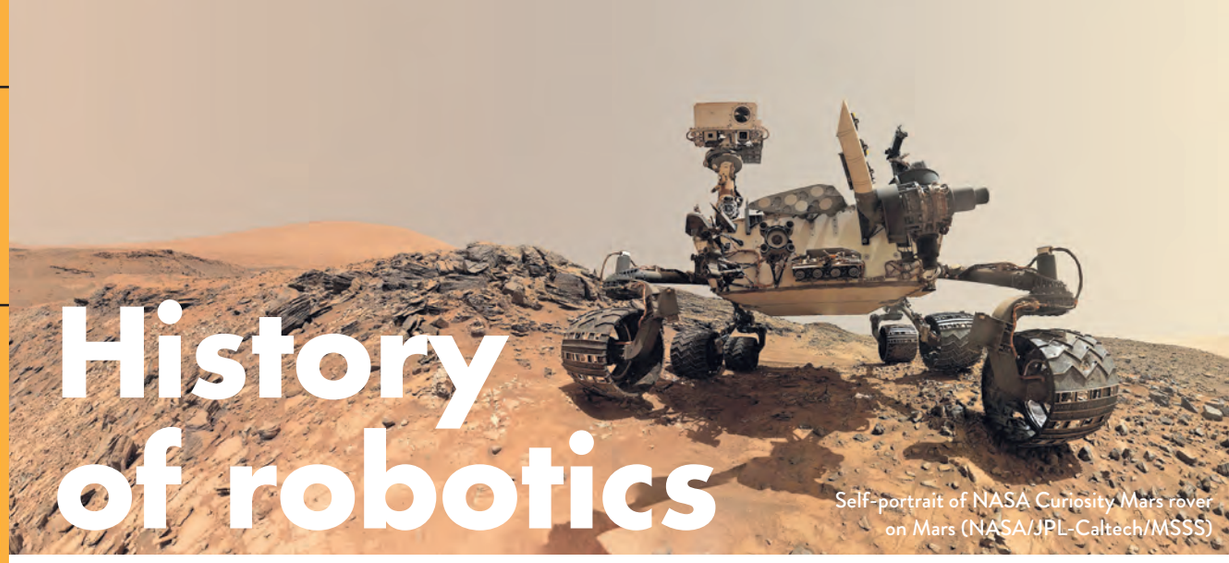
Robot

(noun) ro·bot \'rō-ˌbät, -bət\
1) A real or imaginary machine that is controlled by a computer and is often made to look like a human or animal
2) A machine that can do the work of a person and that works automatically or is controlled by a computer

Robotics

(noun) ro·bot·ics \rō-ˌbä-tiks\
Technology that is used to design, build and operate robots

Source: *Merrian-Webster* Dictionary



History of robotics

Self-portrait of NASA Curiosity Mars rover on Mars (NASA/JPL-Caltech/MSSS)

The word "robot" was introduced in 1920 by Czech writer Karel Čapek in his play *R.U.R.: Rossum's Universal Robots.* Čapek derived the word from the Czech word "robota, " or "forced labor." The word "robotics" was popularized by science fiction writer Isaac Asimov in the early 1940s.

The concept of artificial beings, however, is very old. The idea of automatons, or animate statues, was known to the ancient Chinese, Greeks, Romans and Egyptians.

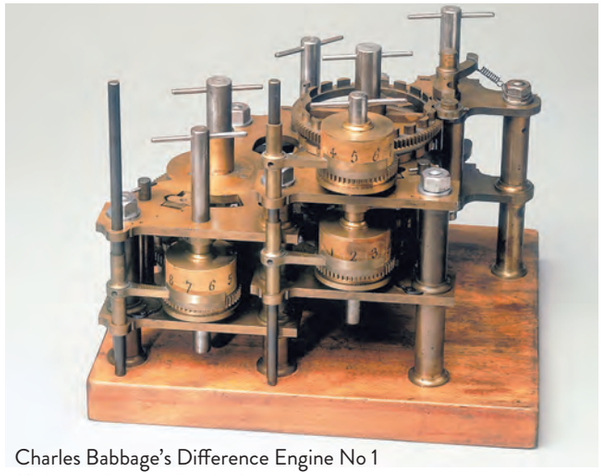
Homer's *Iliad* in the eighth century B.C.E. describes various automatons created out of bronze and gold by Hephaestus, the god of fire, metalworking and stonemasonry. His works included golden mechanical handmaidens who could move and speak, as well as a bronze giant called Talos who guarded the island of Crete for Queen Europa.

By the fifth century B.C.E., Chinese and Greek engineers were designing and building lifelike mechanical automata of animals such as birds and horses. A fourth century B.C.E. Chinese manuscript called the *Liezi* describes a life-sized, humanoid mechanical figure made of leather and wood, built in the tenth century B.C.E. by the mechanical engineer Yen Shi. The figure is described as walking, moving, singing and even winking an eye.

During the Islamic Golden Age, roughly 750 – 1258 C.E., Arabic scientists and engineers made several important advances in the technology of automatons. *The Book of Knowledge of Ingenious Mechanical Devices* by Arab engineer Al-Jazari describes in detail 50 devices, including an automated girl who served drinks and a "robot band" of four automated musicians.

In 1495, Renaissance inventor Leonardo da Vinci designed the first humanoid robot in Western civilization, an artificial man in the form of an armored Germanic knight. Throughout the 16th, 17th and 18th centuries, the science and engineering of autonomous machines continued to advance.

In 1801, the science of robotics – though not yet called that – made the leap from entertainment to industry with the invention by French inventor Joseph Jacquard of an automated loom controlled with punch cards, considered the first programmable machine. In 1822, English mathematician Charles Babbage demonstrated a prototype of his Difference Engine calculating machine, and in 1833, he began work on his Analytical Engine, one of the first computational machines.



Charles Babbage's Difference Engine No 1 (Science Museum London)

The 19th and early 20th centuries saw rapid advances in the fields of engineering and computing. The world's first electronic computer was built in 1943; the first remotely controlled articulated arm and the world's first commercially available computer in 1951; and the world's first industrial robot in 1953. The first industrial robot was installed on an assembly line in 1962. By 1973, robots had made it to space on the Viking 1 and 2 probes. By the 1990s, robots were exploring volcanoes and performing surgery on human patients. In 1997, the *Sojourner* robot rover landed on the moon and transmitted 2.3 billion bits of information to scientists on Earth. In 2004, the Mars Exploration Rovers *Spirit* and *Opportunity* landed on Mars.

Today, robots are used in research, manufacturing, medicine and the military in addition to households and entertainment.

Sources: All On Robots, *Encyclopaedia Britannica,* History of Computers and Computing, HISTORY.com, *Smithsonian* magazine

Robotics pioneers

Archytas' dove

A mechanical wooden dove capable of flapping its wings and flying through the air, created around 350 B.C.E. by the Greek mathematician Archytas of Tarentum, is often cited as the first robot. The dove is thought to have used an air- or steam-powered pulley system, but no schematics or prototypes have survived.

Al-Jazari's floating orchestra

In 1206, Arab engineer Al-Jazari published *The Book of Knowledge of Ingenious Mechanical Devices*, which contained designs for mechanical automatons, including a servant girl who served wine, a hand-washing machine that offered soap and towels, and a water-powered, four-piece automaton band in a boat.

Da Vinci's knight

In the 15th century, Leonardo da Vinci designed an artificial man in the form of an armored Germanic knight. Powered by an external mechanical crank, da Vinci's knight used cables and pulleys to sit, stand, turn its head, cross its arms and lift up its visor. No complete drawings of the automaton exist today, but evidence suggests that da Vinci built a prototype in 1495. In 2002, NASA roboticist Mark Rosheim used da Vinci's notes and sketches to build a fully functional knight.

Mechanical monk

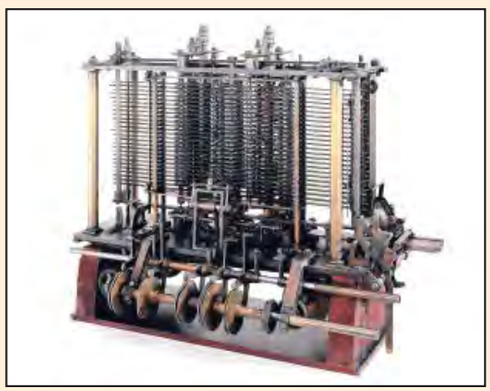
In the 16th century, clockmaker and inventor Juanelo Turriano was commissioned by Spanish King Phillip II to build a lifelike recreation of Franciscan monk Diego de Alcalá. The 15-inch-tall automaton walks in a square, nodding its head, moving its eyes and lips, kissing a rosary and cross, and occasionally beating its chest with its arm. The 450-year-old device, still operational today, is at the Smithsonian in Washington, D.C.

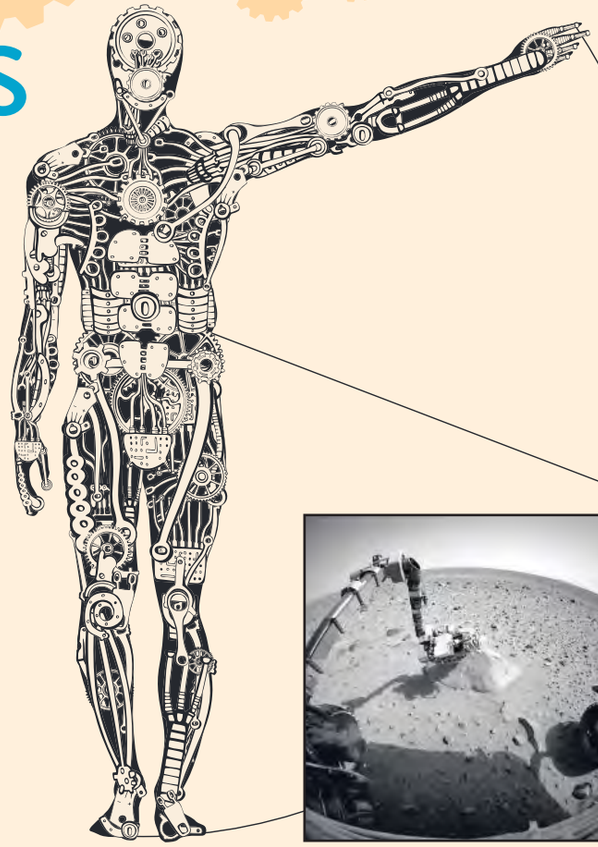
Vaucanson's digesting duck

In the 1730s, French inventor Jacques de Vaucanson created various automatons, including a duck that could quack, flap its wings, paddle in water and "eat" grain and "defecate" preloaded pellets.

Babbages's Difference Engine

Charles Babbage designed the Difference Engine in 1822. Described as "an automatic, mechanical calculator designed to tabulate polynomial functions," it is considered one of the earliest programmable machines. In 1991, the London Science Museum built a functional Difference Engine based on Babbage's plans.





Left to right:

- Al-Jazari's Elephant Clock from *The Book of Knowledge of Ingenious Mechanical Devices* (Metropolitan Museum of Art metmuseum.org)
- Charles Babbage's Analytical Engine (Science Museum London)
- Viking 1 Spacecraft (NASA)
- NASA Mars Exploration Rover Spirit with robotic arm extended (NASA-JPL)

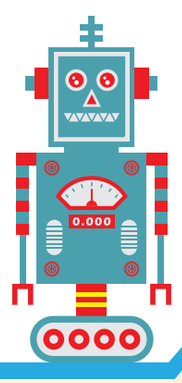
Learning with the *Times*

READ LIKE A DETECTIVE. WRITE LIKE A REPORTER.

Robotics has a long and diverse history. With a partner, research one of the ideas presented on these pages to learn more about the subject or pioneer. Be sure to answer the who, what, when, why and how of the topic. Make sure you document all of your sources. Present what you have learned to your class, emphasizing the new information you learned from your research.

Certain functions, such as defusing a bomb or exploring a volcano, seem better suited for robots than humans. But would you want a robot pitcher on your favorite baseball team? A robot teacher in your classroom? A robot president? A robot parent? A robot best friend? What qualities do humans have that you think could never be replaced by robots? Look for articles in the *Tampa Bay Times* that have examples that would support your ideas. Write an argument essay explaining your perspective. Use the specific examples from the *Times* to support your ideas.

Activity adapted from "Robots," Discovery Education



ABOUT ROBOTS

Senior airman Rachel Redel demonstrates how an F6A robot works May 12, 2009 during an explosive ordnance disposal demonstration at Manas Air Base, Kyrgyzstan. The robot is used by the EOD (Explosive Ordinance Disposal) flight for exploration of suspicious items. Airman Redel is assigned to the 377th Mission Support Group at Kirtland Air Force Base, N.M. (U.S. Air Force photo/Tech. Sgt. Elizabeth Weinberg)

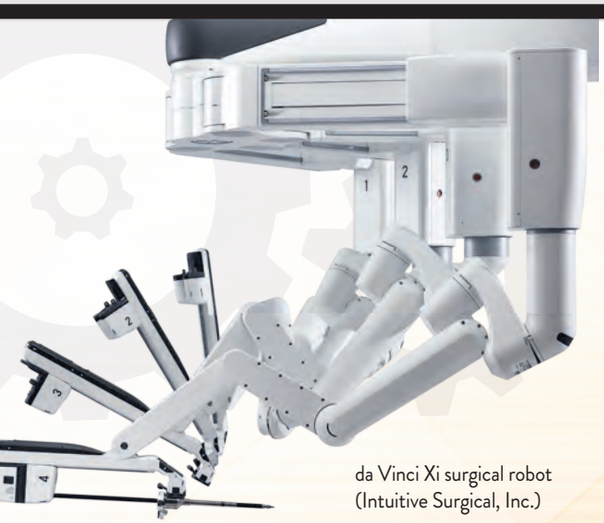
When most people hear the word "robot," what likely comes to mind are android-type machines – human analogs of varying degrees of authenticity, such as those portrayed in the films *I, Robot* or *Ex Machina*. However, most robots are actually far from human-like.

Robots can be stationary, such as those used on manufacturing assembly lines, or mobile, such as surveillance drones. Robots are in use in just about every industry and facet of modern life: from interactive toys to planetary rovers. As How Stuff Works notes, robots "handle tasks that are difficult, dangerous or boring to human beings."

- **Industrial robots** are commonly used in manufacturing, and include robotic arms employed in painting, welding and assembly work and autonomous vehicles that perform the functions of unmanned warehouse work.
- **Domestic or household robots** include robotic vacuums and pool cleaners, surveillance and telepresence robots, and personal service robots that are used in working with the elderly and children.
- **Medical robots** are used in fields including surgery, radiation therapy, telemedicine and simulation.
- **Service robots** can do things like gather data and demonstrate technologies. Service robots also can be deployed for research purposes, especially to places difficult or impossible for humans to visit, such as the deep ocean or other planets.

Components in defense missiles, Mars Rovers, fighter planes and life-saving military devices are manufactured by robotic automated machines at Southern Manufacturing Technologies in Tampa, Fla.

- **Military or defense robots** are typically used in search-and-rescue operations, bomb disposal and reconnaissance. This class of robots also includes transportation robots and drones.
- **Entertainment robots** include programmable toys, personal drones and other robots created primarily for entertainment, rather than utilitarian, purposes.
- **Hobby and competition robots** are made by people for fun, academic or competitive purposes. This class of robots includes fighting robots, line followers, sumo-bots and *FIRST* robots.



da Vinci Xi surgical robot (Intuitive Surgical, Inc.)

Robo motion

As the Tech Museum of Innovation notes, "Robots are defined in part by their ability to move; it's what sets them apart from computers." Robots move in lots of different ways:

- **Robotic arms** move jointed metal segments from a stationary base
- **Wheeled robots** roll on one or more wheels
- **Tracked robots** use a continuous track in the form of a metal or rubber belt looped over several wheels
- **Legged robots** can be bipedal, like people; quadrupedal, like four-legged mammals; hexapodal; or have even more legs

- **Swimming robots** can use thrusters, as submarines do, or imitate the movements of fish, eels or swimming humans
- **Flying robots** include helicopters, quadcopters, propeller aircraft and jet aircraft
- **Swarm robots** are collections of large numbers of simple robots that work together

Bipedal locomotion (walking on two legs) is inherently unstable and very difficult to implement in robots. Recent research has shown that when humans walk, they are constantly correcting tiny falls to stay upright. Many robot designers look to animal or insect models instead.

Sources: How Stuff Works, the Tech Museum of Innovation

Robo senses

In the same way that humans rely on our five senses to gather information about our environment, robots rely on sensors that measure their environment and produce an electric signal. Some robots' sensors mimic aspects of our own senses – such as touch (pressure) or motion – but not all of them. Few robots have the ability to see, hear, smell or taste. Some robots can sense things that humans cannot, such as magnetic fields, infrared light or ultrasonic sound waves.

Common types of robot sensors include: light sensors, typically used for basic navigation; pressure sensors, used to detect contact with physical objects (for example, when a robot hits a wall or grips an object); and ultrasound, infrared and radar sensors, used for navigation and collision avoidance.

Sources: ElectronicsTeacher.com, How Stuff Works, the Tech Museum of Innovation

Building a Robot

Whether you're building a hobby robot with LEGO bricks or a commercial robot for industry, there are certain things that always need to be taken into consideration.

The engineering design process is a series of steps that engineers follow to come up with a solution to a problem – such as designing a robot that meets certain criteria and/or accomplishes a certain task.

Steps of the engineering design process:

1. Define the problem
2. Do background research
3. Specify requirements
4. Brainstorm solutions
5. Choose the best solution
6. Do development work
7. Build a prototype
8. Test and redesign

The design process for *FIRST* robotics teams usually requires some wide-open brainstorming to consider the challenge at hand and the various solutions to solve it. No idea is ever considered impractical or silly at this stage of the design process. In fact, some of the most innovative solutions are often some of the most simple and basic, and team members with non-engineering backgrounds often come up with the best solutions.

After the initial brainstorming sessions, teams winnow the ideas down to the most practical option, taking into consideration the realities of:

- **TIME** – Some *FIRST* robotics competitions limit the time that teams have to build their robots, just as real-world engineering projects have deadlines. So, while some ideas may be full of exciting possibilities and would clearly work, they might take too much time to implement. The final design idea has to be something that has a realistic chance of being completed and tested within the given timeframe.
- **BUDGET** – While there's funding for new *FIRST* teams that pays for most if not all of the costs, elaborate design ideas that necessitate expensive capital outlay may not be a good idea. However, if an idea is really stellar but costly, teams can consider ways to finance their needs through sponsors, donors and fundraising efforts.
- **REQUIREMENTS** – Robots in *FIRST* and the real world need to be designed to certain specifications, such as size and weight. Design ideas have to align with those requirements.
- **CAPABILITIES** – Design teams, whether *FIRST* or real-world, need to consider whether they have all the necessary tools, resources, skill sets and professional support to achieve their design goals. Lack of some capabilities shouldn't be a deterrent to pursuing an idea, but the team needs to be aware of where they'll need more support or resources and know where to find them.

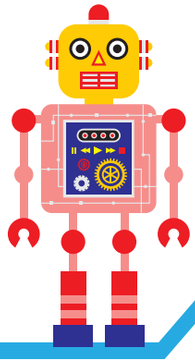
Sources: *FIRST*, Science Buddies

Learning with the *Times*

CREATING AN ALTERNATE WORLD

In science fiction movies, television shows and books, robots are often (though not always) portrayed as frightening and threatening to humankind. Why do you think science fiction writers depict robots like this? What are the qualities that make these fictional robots scary or dangerous to humans? Working in small groups, create a future world that has robots. Write a paragraph describing the roles of robots in your world. Using the front page of the *Tampa Bay Times* as a model, create a newspaper for this science fiction world you have created. Each student in your group should be responsible for writing a story that gives the reader a good view of this new world. You can use the printing press interactive tool at readwritethink.org/files/resources/interactives/Printing_Press to lay out your front page. Share the description of your world and your stories with your classmates.

Activity adapted from "Robots," Discovery Education



Robots and Artificial Intelligence

Artificial intelligence

"The theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making and translation between languages."

Source: Oxford Dictionary

Turing Test

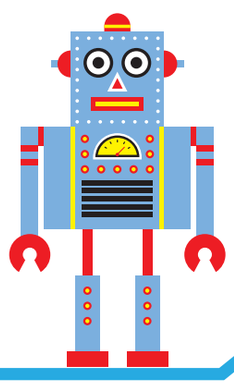
"A test for intelligence in a computer, requiring that a human being should be unable to distinguish the machine from another human being by using the replies to questions put to both."

Source: Oxford Dictionary

Learning with the *Times*

IMPLICATIONS OF AI

Now that you know more about artificial intelligence and have thought about the implications, it is time to apply your thoughts to current events and the world around you. Look for articles in the *Tampa Bay Times* that relate to this topic. How would AI affect the outcome of the event presented in the article? Would the ability to use AI have a negative or positive effect? Using the editorials and columns in the *Times* as models, write an editorial or column elaborating on your ideas. Share your article with your classmates.



In science fiction, computers and robots routinely possess artificial intelligence: Think of the HAL 9000 from *2001: A Space Odyssey*; R2-D2 and C-3PO from *Star Wars*; or Roy, Pris and Rachael from *Blade Runner*.

Mathematician Alan Turing predicted that computers would pass his "imitation game" – now known as the Turing Test – by the year 2000. However, true artificial intelligence – a machine that has the ability to learn, to reason, to communicate and to formulate original ideas – does not yet exist.

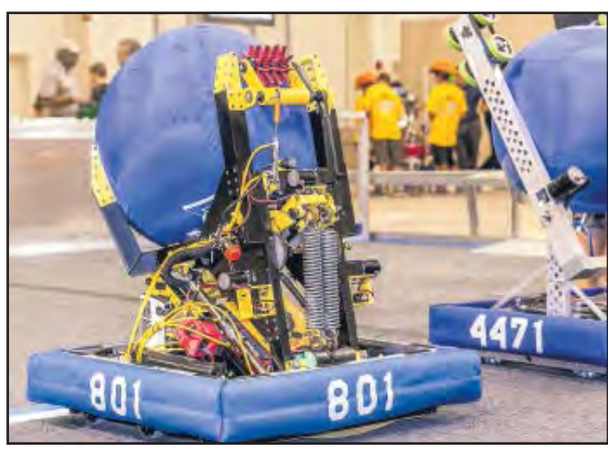
Today's AIs can replicate specific elements of intellectual ability. For example, in 1997, IBM's Deep Blue became the first computer to beat a chess grandmaster, and in 2011, its successor, Watson, "appeared" on the television game show *Jeopardy!* and beat two of the all-time most successful human players of the game. These were significant achievements in computer science – but they weren't true AI.

As How Stuff Works notes, "The basic idea of AI problem-solving is very simple, though its execution is complicated." The first step is to program the AI with as much information about your chosen "problem" – in the examples above, chess and trivia – as possible. As the AI is presented with a new fact, such as a chess move or trivia question, it runs through its huge store of data to predict which action or answer will be most successful. Although this type of AI, known as an "expert system," can know more facts than any person, it still can only solve the problem it has been programmed to solve, and it can't learn.

Some modern robots do have a limited ability to learn. Some can learn to perform a specific task, such as dancing or folding laundry, by observing humans demonstrating it and then mimicking their actions. They don't need to be programmed with step-by-step instructions. Others can recognize if a certain action (such as moving in a certain way) achieved a desired result (such as navigating an obstacle). The robot stores this information and attempts the successful action the next time it encounters the same situation. However, these robots can only "learn" to do specific tasks in limited situations. They can't absorb or analyze any other information.

Finally, some robots can interact socially. They are programmed to recognize human language and expressions and respond appropriately.

Cutting-edge research on AI is taking place around the world. According to a 2014 *Wired* magazine article, "Private investment in the AI sector has been expanding 62 percent a year on average for the past four years, a rate that is expected to continue."



A 2014 survey of experts by the Pew Research Center found that the vast majority anticipate that robotics and artificial intelligence will permeate nearly every aspect of daily life by 2025, with huge implications for industry and society.

Sources: How Stuff Works, Pew Research Center, the Tech Museum of Innovation

The Top Ten

Robotic Trends for the 21st Century

1. Robots in both physical and electronic forms will become integrated into our society.
2. Robots will demonstrate functional emotions and reasoning.
3. Advanced robots – androids – will appear similar to human beings and fill roles in commerce, community and government.
4. Robotic efficiency and precision will transform manufacturing, medicine, space travel, research and industry, and will displace skilled human labor.
5. The robotics industry will become a multibillion-dollar global business, spawning many new careers and business opportunities.
6. Human beings will adopt robotic human enhancements to achieve superhuman capabilities.
7. Cyborgs – part human, part robot – will develop skills superior to natural humans to meet the demand of specialized jobs.
8. We will encounter serious ethical, security and social issues due to our robotic creations.
9. Robots will provide convenience, safety and productivity that will benefit humanity and profoundly impact lifestyles.
10. Androids will achieve a basic level of self-awareness.

Source: Institute for Global Futures

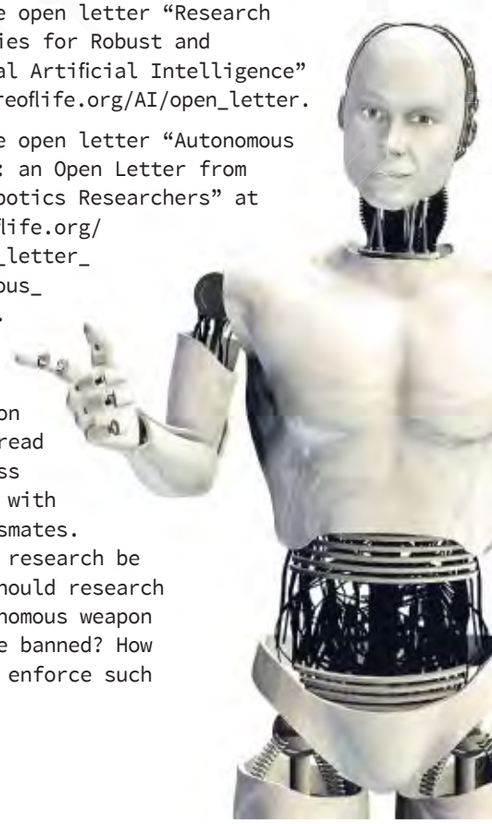
ARTIFICIAL INTELLIGENCE

In early 2015, a group of scientists and entrepreneurs including Elon Musk and Stephen Hawking signed an open letter warning of the risks inherent in AI research and calling for oversight.

The letter reads, in part, "There is now a broad consensus that AI research is progressing steadily, and that its impact on society is likely to increase. The potential benefits are huge, since everything that civilization has to offer is a product of human intelligence; we cannot predict what we might achieve when this intelligence is magnified by the tools AI may provide, but the eradication of disease and poverty are not unfathomable. Because of the great potential of AI, it is important to research how to reap its benefits while avoiding potential pitfalls."

Later that same year, the group released another open letter, this time warning of the danger posed by a "military AI arms race" and calling for a ban on offensive autonomous weapons beyond meaningful human control.

- Read the article "Machine ethics: The robot's dilemma" by Boer Deng in *Nature* at nature.com/news/machine-ethics-the-robot-s-dilemma-1.17881.
- Read the article "Transcending Complacency on Superintelligent Machines" by Stephen Hawking, Max Tegmark, Stuart Russell and Frank Wilczek in the Huffington Post at huffingtonpost.com/stephen-hawking/artificial-intelligence_b_5174265.
- Read the open letter "Research Priorities for Robust and Beneficial Artificial Intelligence" at futureoflife.org/AI/open_letter.
- Read the open letter "Autonomous Weapons: an Open Letter from AI & Robotics Researchers" at futureoflife.org/AI/open_letter_autonomous_weapons.



Think about the information you have read and discuss the ideas with your classmates. Should AI research be banned? Should research into autonomous weapon systems be banned? How would you enforce such a ban?

Machine ethics and AI

Machine ethics has to do with how intelligent machines should behave. As computers and robots become more and more autonomous, it is inevitable that they will be presented with ethical dilemmas that require life-or-death decisions. They need to be programmed to behave in an "ethical" way. But this is harder than it sounds.

Humans make ethical choices every day. Some are easy; for example, whether or not to steal your neighbor's newspaper from his driveway. But others are difficult; for example, the famous "trolley problem," in which a runaway trolley car is about to hit and kill five innocent people on the tracks. You can save them only if you pull a lever that diverts the train onto another track, where it will hit and kill one innocent bystander. What choice do you make?

As engineer Karl-Josef Kuhn, a participant in a May 2015 panel discussion at a Washington, D.C., think tank, asks, "How can researchers equip a robot to react when it is making the decision between two bad choices?"

What if a driverless car faced the choice of hitting a pedestrian in front of it, causing a collision with the vehicles behind it by braking suddenly or risk hitting a bicyclist by swerving?

How should a companion robot programmed to remind its owner to take her pills every day proceed if the patient refuses her medication?

How should an autonomous robot on a military mission choose between saving a soldier or going after an enemy combatant?

Should a robot involved in disaster recovery tell people the truth about what is happening if that risks causing a panic?

Should a drone fire on a house where an enemy target is known to be hiding, which may also contain civilians?

In early 2015, a group of scientists and entrepreneurs including Elon Musk and Stephen Hawking signed an open letter warning of the risks inherent in AI research and calling for oversight.

The letter reads, in part, "There is now a broad consensus that AI research is progressing steadily, and that its impact on society is likely to increase. The potential benefits are huge, since everything that civilization has to offer is a product of human intelligence; we cannot predict what we might achieve when this intelligence is magnified by the tools AI may provide, but the eradication of disease and poverty are not unfathomable. Because of the great potential of AI, it is important to research how to reap its benefits while avoiding potential pitfalls."

Later that same year, the group released another open letter, this time warning of the danger posed by a "military AI arms race" and calling for a ban on offensive autonomous weapons beyond meaningful human control.

Science fiction author Isaac Asimov invented his Three Laws of Robotics, a set of rules intended to govern machine behavior, in 1942. But his famous laws seem insufficient to govern the behavior of our increasingly intelligent and autonomous machines, which will have the ability to work without human supervision and make independent decisions.

Sources: *Nature*, the *Economist*, the Huffington Post, the Future of Life Institute, the Tech Museum of Innovation

Isaac Asimov's Three Laws of Robotics

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.

2. A robot must obey orders given it by human beings except where such orders would conflict with the First Law.

3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

Learning with the *Times*

ETHICS

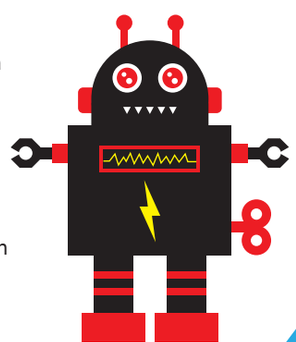
Ethics is an important and often controversial topic, especially in the worlds of science and journalism. Charles Overby, the chief executive officer and president of the Freedom Forum, writes that ethics in journalism involves the journalists' – reporters and editors – pursuit of stories. Oftentimes, editorial viewpoints influence content, placement of articles, photos and headlines. Look through the *Tampa Bay Times* and find at least three newspaper articles and two photographs that are interesting to you.

On a piece of paper, write down why you have chosen these articles and photos. Next, respond to the following questions about each of the articles and photos:

1. Is this a story that the public needs to know? Why or why not?
2. Does the information in the story affect a lot of people or only a few?
3. Is this a story about an event that already happened or a future event?
4. Is the photograph needed to tell the story?
5. Does the story contain more rumors than facts?
6. Does the story or photograph invade someone's privacy?
7. Is the story or photograph sensational or does it blow something out of proportion?

Discuss what you have learned and the concept of ethics in regard to the news with your class.

Activity adapted from the Newseum, Media Ethics



Going beyond the text

ROBOTICS AND ETHICS

Technological innovation often results in disruption in industry and society. For example, the invention of cellphones has led to major disruption in the telecommunications industry; online shopping through sites such as Amazon and eBay has had a major impact on "brick and mortar" stores; and transportation apps such as Uber and Lyft are causing upheaval in the taxi industry.

Robots have had an enormous impact on society and industry since they came into wide use in the 1960s, and as researchers move closer to AI, this impact will only grow larger.

According to the Tech Museum of Innovation, "The development of every new technology raises questions that we, as individuals and as a society, need to address. Will this technology help me become the person that I want to be? Or that I should be? How will it affect the principle of treating everyone in our society fairly? Does the technology help our community advance our shared values?"

To help answer these questions, the museum asked researchers, scientists, labor leaders, artists and others to respond to four questions related to robotics and ethics.

1. If, in the future, machines have the ability to reason, be self-aware and have feelings, then what makes a human being a human being and a robot a robot?
2. If you could have a robot that would do any task you like, a companion to do all the work that you prefer not to do, would you? And if so, how do you think this might affect you as a person?
3. Is there any kind of robot that shouldn't be created, or that you wouldn't want to see created? Why?
4. Automation and the development of new technologies like robots are viewed by most people as inevitable. But many workers who lose their jobs consider this business practice unfair. Do you think the development of new technologies, and their implementation, is inevitable? What, if anything, should we as a society do for those people who lose their jobs?

In small groups, discuss and respond to each of these questions. Write down the group's responses and be sure to use specific examples to support your ideas. To hear the audio responses collected by The Tech Museum of Innovation, visit thetech.org/exhibits/online/robotics/ethics/index.html.

Activity adapted from "Machines and man: Ethics and robotics in the 21st century," the Tech Museum of Innovation

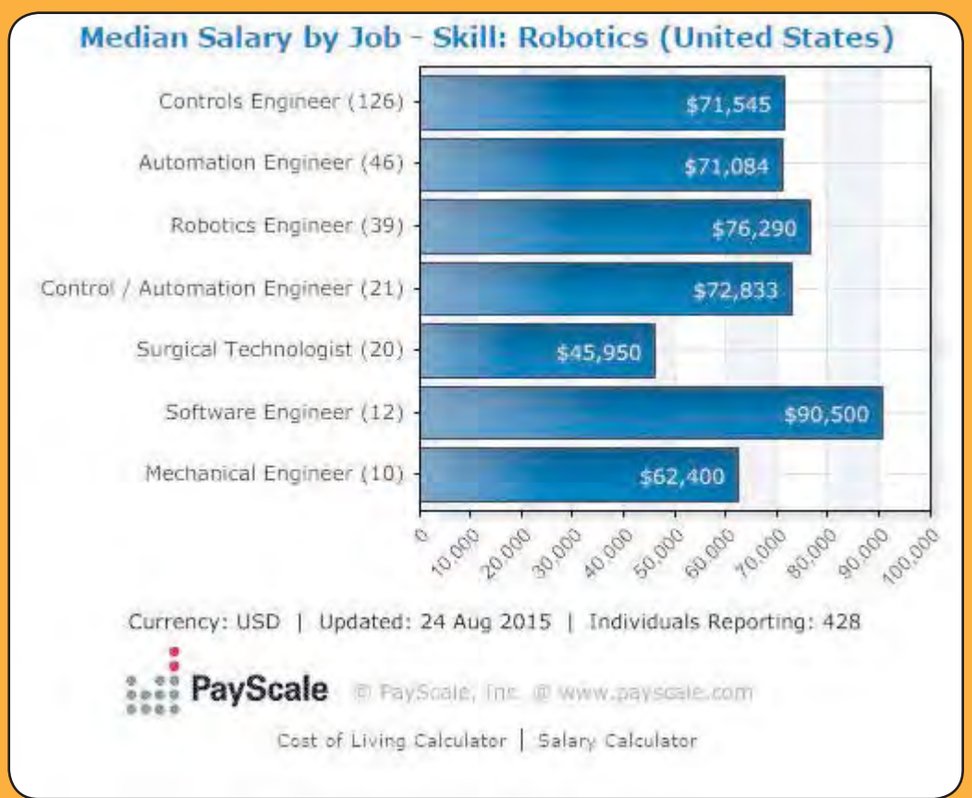
> *Our future depends on reaffirming America's role as the world's engine of scientific discovery and technological innovation. And that leadership tomorrow depends on how we educate our students today, especially in math, science, technology and engineering."*
>
> – President Barack Obama

> *We have a country that celebrates almost to obsession the world of sports and entertainment. They're all great things, but I said if we could create — using sports and entertainment — an environment in which kids, particularly women and minorities, could see the world of science and technology is every bit as fun, rewarding and exciting as bouncing a ball, and through that passion they can become superstars in science, technology and innovation, they would give this country the opportunity to remain a leader in the world and establish a quality of life and a standard of living that would continue to be a model for the world."*
>
> – Dean Kamen,
> inventor and founder of *FIRST*

Florida will add more than 100,000 new STEM jobs by 2024

Eight of the 10 highest-paying careers in Florida are in STEM fields

Florida ranks 4th in the nation in the number of high-technology jobs



Why STEM?

There's no denying that sports and entertainment are big industries, and that a lot of youth would love to become media celebrities or sports stars.

But while it's great to be athletically capable or theatrically talented, the fact is that very few people ever have successful careers in sports and entertainment, and both industries are highly dependent on a very specific set of skills that exclude the majority of people.

Public high schools in the United States invest a lot of money in their sports programs, spending, on average, between $50,000 and $75,000 per year, per school, on football alone. Despite this huge investment of tax dollars in school sports, hardly anyone will ever play professionally.

According to the NCAA, of the nearly 8 million students currently participating in high school athletics in the U.S., only 460,000 – less than 1 percent – will go on to compete at NCAA schools. And, only a fraction of those NCAA athletes will ever realize their goal of playing sports professionally.

The Bureau of Labor Statistics doesn't provide a much cheerier picture for the entertainment industry, with projected employment growth of less than 4 percent and only about 80,000 available jobs in the industry by 2022, with low median pay and unsteady work.

On the other hand, science and technology is a booming field in 21st-century America. As the workplace evolves, the demand for skilled workers in STEM fields continues to grow exponentially.

According to the Robotics Industry Association, "A record 14,232

robots, valued at $840 million, were ordered from North American robotics companies in the first half of 2015." That's a lot of robots! Some people are concerned that the growth in robotics will mean a loss of jobs. In some cases it may. But the growth of the robotics industry also means the creation of new and exciting career tracks and fields. Humans have to design the robots, build them, program them, repair them and "train" them. And those jobs pay well: Salaries for those involved in robotics-industry jobs range from more than $45,000 a year for surgery techs to more than $90,000 a year for software engineers.

According to the Florida STEM Strategic Plan developed by the Florida Center for Research in Science, Technology, Engineering and Mathematics at Florida State University:

- Eight of the 10 highest-paying careers in Florida are in STEM fields
- Florida ranks fourth in the nation in the number of high-technology jobs
- Industry leaders consistently report a shortage of qualified professionals to fill STEM positions and note the increasing need for employees in all positions who are STEM literate

According to the Alliance for Science & Technology Research in America, Florida will add more than 100,000 new jobs in STEM fields by 2024, with an average wage of almost $30/hour. Some of the fastest-growing among Florida's projected top 40 STEM jobs in 2024:

- Aircraft mechanics and technicians
- Automotive mechanics and technicians
- Computer and information systems workers
- Finance professionals
- Medical scientists
- Graphic designers
- Civil engineers
- Dietitians and nutritionists
- Industrial engineers
- Psychologists

What's more, science and technology necessarily involve a lot of complementary fields of knowledge, skills and expertise that cross over into the arts, communications, multimedia production and more. Those who are well-rounded across multiple fields, are technically literate, are adaptable and have strong communications skills will do well in the future economy.

Sources: Florida Center for Research in Science, Technology, Engineering and Mathematics; NCAA; the Alliance for Science & Technology Research in America; the U.S. Bureau of Labor Statistics

STEM CAREER RESOURCES

Career Cornerstone Center
careercornerstone.org

Cool Science Careers
coolsciencecareers.rice.edu

IEE TryComputing.org
trycomputing.org

IEE TryEngineering.org
tryengineering.org

IEEE TryNano.org
trynano.org

PBS NOVA Labs Career Resources
pbs.org/wgbh/nova/labs/opportunities/resources

Science Buddies Careers in Science
sciencebuddies.org/science-engineering-careers

STEM Career
stemcareer.com

STEM Career Paths
stemcp.com

STEM Florida
stemflorida.net

STEM-Works
stem-works.com/cool_jobs

Take IT & Go Anywhere
takeitgoanywhere.org

Technology Student Association
tsaweb.org

TypesofEngineeringDegrees.org
typesofengineeringdegrees.org

U.S. Department of Labor CareerOneStop
careeronestop.org

U.S. Bureau of Labor Statistics Occupational Outlook Handbook
bls.gov/ooh

WeUseMath.org
weusemath.org

MILITARY CAREER RESOURCES

STEM careers in the Air Force
airforce.com/careers

STEM careers in the Army
goarmy.com/careers-and-jobs/about-army-stem/technology-jobs

STEM careers in the Coast Guard
gocoastguard.com/active-duty-careers/enlisted-opportunities/view-job-descriptions
uscg.mil/civilian/cp_technical

STEM careers in the Marines
marines.com/being-a-marine/roles-in-the-corps/career-tool

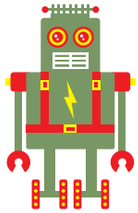
STEM careers in the Navy
navy.com/stem/technology-careers.html#navy-careers
navy.com/careers/information-and-technology

Learning with the *Times*

ROBOTS IN THE WORKFORCE

Since the 1960s, robots and computers have been replacing human workers in many areas of business and industry. What careers are you considering? Look at the articles and classified employment listings in the *Tampa Bay Times* and make a list of careers that are of interest to you. Next, list the ways in which machines may make parts of those jobs no longer necessary for humans to perform. How will you have to educate yourself or otherwise adjust in order to remain relevant in a workforce that will employ an ever-growing number of robots and computers?

Activity adapted from "Robots," Discovery Education



EUREKA! FACTORY™

COMMUNITY DRIVEN INNOVATION

EurekaFactory.Net

The Eureka! Factory is a collaboration of creative individuals and business partners who believe in the power of community driven innovation to help people move from passive consumption to empowered and active creation of their future and ours. Together, we work as consultants and program developers for libraries and other organizations throughout Tampa Bay.

The Eureka! Factory designs innovative makerspaces and community-driven programming for libraries and other organizations, including the 10,000-square-foot HIVE Community Innovation Center at the John F. Germany Library in Tampa. The Eureka! Factory also offers an extensive library of free online tools and resources for education, entrepreneurship and Making.

Eureka! Factory productions include Gulf Coast MakerCon, Tampa Bay's annual Maker Festival, and ROBOTICON Tampa Bay, a premier K-12 *FIRST* robotics showcase event.

The Eureka! Factory is also a proud sponsor of *FIRST* Tech Challenge (FTC) Team Duct Tape, a Tampa Bay-area community-based *FIRST* team, and of the Orlando Regional, Florida's oldest and largest *FIRST* Robotics Competition Regional event, held each spring in Orlando. The Eureka! Factory is also a partner in Code for Tampa Bay Brigade, a local chapter of Code for America, and TEDxTampaRiverwalk and TEDxYouth@TampaRiverwalk.

In 2015, Eureka! Factory partner Terri Willingham co-authored the book *Makerspaces in Libraries* (Rowman & Littlefield Publishers, 2015).

For more information about the Eureka! Factory, visit EurekaFactory.net.

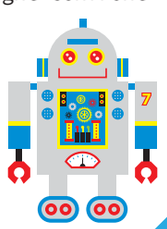
Learning with the *Times*

MEDICAL TECHNOLOGY

Medical technologies that extend or enhance the quality of human life are becoming available at a pace that is faster than the ethics of their use can be debated or laws passed to govern their use.

Look for articles in the *Tampa Bay Times* that focus on or relate to this issue. Write down the main points of the articles. What are some of the economic and sociological problems that might confront the next generation of Americans as these technologies become available? Consider possible solutions to each problem and write a blog post explaining your ideas. Share your thoughts with your class.

Activity adapted from "Robots," Discovery Education



Newspaper in Education

Tampa Bay Times NIE newspaper in education tampabay.com/nie

The Tampa Bay Times Newspaper in Education program (NIE) is a cooperative effort between schools and the Times Publishing Co. to encourage the use of newspapers in print and electronic form as educational resources – a "living textbook." Our educational resources fall into the category of informational text, a type of nonfiction text. The primary purpose of informational text is to convey information about the natural or social world.

Since the mid-1970s, NIE has provided schools with class sets of the daily newspaper plus award-winning original educational publications, teacher guides, lesson plans, educator workshops and many more resources at no cost to schools, teachers or students. Each year, more than 5 million newspapers and electronic licenses are provided to Tampa Bay-area teachers and students free of charge thanks to our generous individual, corporate and foundation sponsors. NIE teaching materials cover a variety of subjects and are correlated to the Florida Standards.

For more information about NIE, visit tampabay.com/nie, call 800-333-7505, ext. 8138 or email ordernie@tampabay.com. Follow us on Twitter at Twitter.com/TBTimesNIE.

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Florida Standards

By emphasizing analytical thinking and problem-solving skills rather than rote memorization, the Florida Standards are intended to reflect the knowledge and skills that students need for success in college and careers and to prepare them for success in the future. This publication and the activities focus on the following Florida Standards for middle and high school: Language Arts: LAFS.6-12.RI.1.1; LAFS. 6-12.RI.1.2; LAFS.6-12.RI.1.3; LAFS.6-12.RI.2.4; LAFS.6-12.RI.2.5; LAFS.6-12.RI.2.6; LAFS.6-12.RI.3.7; LAFS.6-12.RI.3.8; LAFS.6-12.W.1.1; LAFS.6-12.W.1.2; LAFS.6-12.W.1.3; LAFS.6-12.W.2.4; LAFS.6-12.W.2.5; LAFS.6-12.W.2.6; LAFS.6-12.W.3.7; LAFS.6-12.W.3.8; LAFS.6-12.W.3.9; LAFS.6-12.W.4.10; LAFS.6-12.SL.1.1; LAFS.6-12.SL.1.2; LAFS.6-12.SL.1.3; LAFS.6-12.SL.2.4; LAFS.6-12.SL.2.5; LAFS.6-12.SL.2.6; LAFS.6-12.L.1.1; LAFS.6-12.L.1.2; LAFS.6-12.L.3.4; LAFS.6-12.L.3.5; LAFS.6-12.L.3.6; LAFS.6-12.RH.1.1; LAFS.6-12.RH.1.2; LAFS.6-12.RH.1.3; LAFS.6-12.RH.2.4; LAFS.6-12.RH.2.5; LAFS.6-12.RH.2.6; LAFS.6-12.RH.3.7; LAFS.6-12.RH.3.8; LAFS.6-12.RH.3.9; LAFS.6-12.RST.1.1; LAFS.6-12.RST.1.2; LAFS.6-12.RST.1.3; LAFS.6-12.RST.2.5; LAFS.6-12.RST.2.6; LAFS.6-12.RST.2.7; LAFS.6-12.RST.2.8; LAFS.6-12.RST.2.9; LAFS.6-12.RST.3.7; LAFS.6-12.WHST.1.1; LAFS.6-12.WHST.1.2; LAFS.6-12.WHST.2.4; LAFS.6-12.WHST.2.5; LAFS.6-12.WHST.2.6; LAFS.6-12.WHST.3.7; LAFS.6-12.WHST.3.8; LAFS.6-12.WHST.3.9; LAFS.6-12.WHST.4.10; LAFS.K12.L.1.1; LAFS.K12.L.1.2; LAFS.K12.L.1.3; LAFS.K12.L.1.4; LAFS.K12.L.1.5; LAFS.K12.L.1.6; LAFS.K12.R.1.1; LAFS.K12.R.1.2; LAFS.K12.R.1.3; LAFS.K12.R.2.4; LAFS.K12.R.2.6; LAFS.K12.R.3.7; LAFS.K12.R.3.8; LAFS.K12.R.3.9; LAFS.K12.R.4.10; LAFS.K12.SL.1.1; LAFS.K12.SL.1.2; LAFS.K12.SL.1.3; LAFS.K12.SL.2.4; LAFS.K12.SL.2.5; LAFS.K12.SL.2.6; LAFS.K12.W.1.1; LAFS.K12.W.1.2; LAFS.K12.W.1.3; LAFS.K12.W.2.4; LAFS.K12.W.2.5; LAFS.K12.W.2.6; LAFS.K12.W.3.7; LAFS.K12.W.3.8; LAFS.K12.W.3.9; LAFS.K12.W.3.10 **Science:** SC.6.N.1.5; SC.6.N.2.3; SC.7.N.1.7; SC.7.N.3.2; SC.8.E.5.10; SC.8.N.4.2; SC.912.E.5.7; SC.912.N.1.1; SC.912.N.1.4; SC.912.N.1.5; SC.912.N.1.7; SC.912.N.2.5; SC.912.N.4.1; SC.912.N.4.2 **Social Studies:** SS.6.W.1.4; SS.6.W.1.6; SS.7.C.2.11; SS.7.C.2.13; SS.8.A.1.2; SS.8.A.1.3; SS.8.A.1.4; SS.8.A.4.6; SS.8.C.1.5; SS.8.E.2.1; SS.8.FL.1.2; SS.8.FL.6.7; SS.912.A.1.2; SS.912.A.1.4; SS.912.A.1.5; SS.912.A.1.7; SS.912.A.3.10; SS.912.A.3.2; SS.912.A.3.4; SS.912.A.3.5; SS.912.A.3.6; SS.912.A.7.12; SS.912.C.2.12; SS.912.C.2.13; SS.912.C.2.7; SS.912.C.3.11; SS.912.C.3.13; SS.912.E.2.2; SS.912.G.5.3; SS.912.H.2.3; SS.912.H.3.1; SS.912.H.3.2; SS.912.S.5.9; SS.912.S.6.11; SS.912.S.6.4; SS.912.S.6.5; SS.912.S.6.6; SS.912.S.6.8; SS.912.S.6.9; SS.912.S.8.4; SS.912.W.4.3