Using Robots to Build STEM-loving Students

by Gavin Wood - STEAM Director / Educator + Robotics Coach

World One:
VEX Robotics
Three main options for using VEX Robotics

World Two:
BEST Robotics
Activity: The 3 Levels of Robotics

Why Competition Matters
Self-motivation
Self-enhancement
Teamwork

Why do we compete?
World One: Robot Scoring:

FIRST Tech Challenge (FTC)

FIRST Robotics Competition (FRC)

World Two:
The World of FIRST Robotics

FIRST Leap League (FLL)

What do I mean by "Robots?"
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World One: VEX Robotics

Three main options for using VEX Robotics

- VEX Vetter
- VEX Robotics Competition
- VEX STEM Learning System

World Two: BEST Robotics

- BEST Robotics Competition
- BEST Robotics Program
- BEST Robotics Team

The World of FIRST Robotics

- FIRST Tech Challenge (FTC)
- FIRST Robotics Competition (FRC)

Activity

Why Competition Matters

- Self-directed learning
- Self-motivated students
- Handling setbacks and failure
- Building resilience

Excited yet? Where do you start?

World Three:

- FIRST Lego League (FLL)
- FIRST Robotics Competition (FRC)
- FIRST Tech Challenge (FTC)
What do I mean by ‘Robotics?’

- Competition-based, but...NOT about destruction
- Students learn to be Technologically Literate
- Strategic Design and Problem Solving Skills
- Tool use, safety practices, CAD, 3D printing
- Website Design, Video Production, Photography, Graphic Design
- Sportsmanship, Teamwork, and Professionalism
- Presentation and Writing Skills
- As students build their robots, they also build leadership and technical skills that will make them valuable citizens.
- Let's hear what my students have to say...
Students learn to be technologically literate

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Why Competition Matters

• Self-motivating
• Self-rewarding
• Students learn to handle both success and failure
• Students stay on-task due to time restraints of competition
Let's test this!
Amazon had a "Why Competition Matters" moment recently when Beta testing its AWS DeepRacer, which teaches machine learning with a fully autonomous 1/18th scale car...
Excited yet?
Where do you start?
Pick Your Platform: The 3 Worlds of Robotics
World One: VEX Robotics

Three main options for using VEX Robotics

**VEX IQ**
- For elementary & middle school
- Includes curriculum: https://www.vexrobotics.com/overview/curriculum
- 5,500 teams from 45 countries, 900 events worldwide
- One kit ~ $150
- Classroom bundle ~ $350 for 12 kits
- Game field can be used with afforded ~ Half Field for $100 or a whole field for $200
- COMETITION REGISTRATION $495 for first team and $100 for each additional team.

**VEX Robotics Competition (VRC)**
- High school competition overview: https://www.roboticseducation.org/competition-teams/vex-robotics-competition/
- Starter kit range in cost from $499 to $1,499, or classroom bundles with 6 kits for $3,599
- 20,000 teams from 50 countries playing in over 1,700 competitions worldwide
- VEX Code Studio - Progressive coding curriculum. Starts with Modkit Blocks and works up to C++ Pro
- This year’s game is VEX Turning Point.
- Game is released in April – Smaller competitions are in January and February
- States/Regions have championships to determine qualifiers for World Championship.
- VEX World Championships is in April – new game is announced at that competition
- Competition Registration is $100 - Teams can register additional robots for $50 each.

**VEX STEM Labs / PLTW**
- Teachers can create their own classroom VEX competition!
- Need one kit for every 2-3 students – Classes with more than 10 teams need extra teacher help.
- Can still use VEX Code Studio
- VEX STEM Labs Curriculum: https://education.vex.com/edu/vex/edr/stem-labs/
- Can also be used with Project Lead The Way curriculum

For more information see: Vexrobotics.com
Three main options for using VEX Robotics

**VEX IQ**

- For elementary & middle school students
- Online curriculum: [https://www.vexrobotics.com/vexiq/](https://www.vexrobotics.com/vexiq/)
- 500 teams from 45 countries, 900 events worldwide
- The kit is $330
- Classroom bundle is $3,850 for 12 kits
- Game field (can be re-used each season) = Half field for $100 or whole 4' x 6' field for $200
- COMPETITION REGISTRATON = $150 for first team and $100 for each additional team.
- COMPETITION PART 1: TEAMWORK CHALLENGE - Two teams work together to compete in a game. This year’s game is called Next Level
- COMPETITION PART 2: SKILLS CHALLENGE - One robot playing alone against the clock
- COMPETITION PART 3: STEM RESEARCH PROJECT - Students use the scientific method to research and solve a challenge

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VEX Robotics Competition
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World Two:

BEST Robotics

- Kickoff is in the fall, usually September – Regionals are in late fall, Championships are in the following April
- 42 Day build season
- No fee to participate!
- Equipment and materials are provided free of charge to teams.
- Robots are often built from inexpensive and recycled materials.
- Games can be complex!
- There is a fee to be a “hub” to host competitions. First year costs $17 to $20k, but drops significantly after that.
- Not a very popular robotics competition in the Missouri and Kansas area, but much more popular in the South (Around 1000 schools total)

For More Information: www.bestinc.org
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My thoughts about BEST Robotics

BEST may be the most cost effective form of competitive robotics. However, the curriculum support and number of teams competing is much lower than VEX or FIRST.
World Two:

The World of FIRST Robotics

**FIRST Lego League (FLL)**
- Designed for kids ages 9 to 14
- Team size is 10 or less
- The game is released in the fall with competitions in the late fall and early December.
- Robots are built out of Legos – making them easy to modify quickly.
- Lego EV3 and Arduino are used as the “brains” of the robot.
- Robots can be surprisingly complex and there are a large array of sensors for autonomous movement.
- Mindstorms set.
- Total estimated startup costs are about $1200
- Most teams meet 6 to 8 weeks, twice a week.
- There are around 20,000 teams worldwide.

**FIRST Tech Challenge (FTC)**
- Uses Tetrix Materials from Pitsco with Lego Mindstorms Bricks for processing.
- Recommended team size is 10 students.
- Grades 7-12
- Lower cost and more easily accessible than FRC.
- Game is announced in September, no deadline. Can work up until competition.
- Tournament season is from November to March. with Championships in April.
- $275 Registration fee, plus other fees for parts and materials.
- Estimated $1500 to $2000 to field a competitive robot.
- Similar to VEX Competition in size and complexity, great way to get started in FIRST.

**FIRST Robotics Competition (FRC)**
- The Varsity Sport for the mind - Worldwide competition.
- Grades 9 - 12
- Nearly 4,000 teams worldwide.
- Teams of students build robots (usually about 120 lbs and 5 feet tall...the robot, not the students).
- Teams work in two alliances of 3 during competition, 6 robots on the field at a time. Schools cooperate with each other.
- Game is announced in early January with a 6 week build season.
- Teams recruit engineers, business people, and other professionals to help.
- Spirit as well as electrical, programming, and mechanical components.
- Grants are available for rookies through NASA and other organizations.
- Can be expensive – Registration is $5000, and it could total $10,000 or more to field a competitive robot. Teams often seek corporate sponsors.
- Intensely challenging, time consuming, and REWARDING.

Competitions are in March and early April with Championships in late April.
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Needs: Team Registration ($225), Field Setup Kit, Lego Mindstorms set.
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My Thoughts on This World
FLL: FIRST Lego League

- Excellent for introducing young students to robotics. Would be ideal for an elementary school/summer intro activity.
- I find that middle schoolers have a strong desire to step up to at least the VEX/FTC level, so if I had a choice, I'd do that instead.
FTC: FIRST Tech Challenge

- Provides a lot of the technical challenge of FRC, but with lower cost and less stressful timelines
- Not as prestigious or challenging as FRC
- In addition to FTC, Tetrix robotics materials are ideal for an in-class competition similar to VEX or as a junior program that feeds to a high school level FRC team
FRC: FIRST Robotics Competition

- The **pinnacle of high school robotics programs**
- In my opinion, any high school that is serious about STEM should have a robotics team that is treated similarly to sports teams.
- FRC is a big, expensive challenge, but there is no better way to prepare students to solve the problems of our future
- $80 Million in student scholarships and opportunities associated with FRC!
Conclusions

Why should I do this?
1. Engineering and STEM is everywhere! Look around you, think about where you would be sitting if engineers and problem solvers didn't exist. Help create the next generation of thinkers.

2. Philosophy on Robotics and STEM - I believe that engineering/robotics classes should be offered as an elective in every school, just like art or band, or a foreign language.


4. Keep a fresh mind, create a challenge to rise to.

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