

*FIRST* LEGO League, *FIRST* Vex Challenge, & *FIRST* Robotics Competition  
aligned with Pennsylvania Academic Standards in:

Science & Technology; Mathematics; Career Education & Work; Reading, Writing, Speaking, & Listening; and Arts & Humanities



Prepared by: Rich Kressly, M.Ed.  
PA Educator & *FIRST* Senior Mentor  
[rkressly@usfirst.org](mailto:rkressly@usfirst.org)

v1.3 – 12.18.2006

## FIRST LEGO League, FIRST Vex Challenge and FIRST Robotics Competition Aligned with Pennsylvania Academic Standards

### Introduction:

*FIRST* is a New Hampshire based non-profit organization founded by Dean Kamen (inventor of the Segway) that seeks to inspire an appreciation of science and technology in young people through a variety of robotics competitions. These competitions include the *FIRST* Robotics Competition (FRC) and *FIRST* Vex Challenge (FVC) for high school students, the *FIRST* LEGO League (FLL) for children 9-14 years old, and the Junior *FIRST* LEGO League (JFLL) for 6 to 9 year-olds. The key to *FIRST*'s success is the work of over 20,000 volunteer mentors, professional engineers, teachers, and other adults working with youth across the country. In addition to the thousands of volunteer team mentors, *FIRST* competitions and other events were organized and staffed by over 7000 event and committee volunteers. Through these volunteers, *FIRST* programs engaged over 70,000 youth during the last year. *FIRST* programs are growing rapidly in the United States and Canada, and demand is accelerating in other countries. Please visit <http://www.usfirst.org> for more detailed information.

### FIRST in PA:

Currently Pennsylvania is home to more than 100 FLL teams, 20 FVC teams and 40 FRC teams. JFLL is in it's infancy, but starting to gain interest. These exciting learning experiences support and enrich the PA Department of Education's efforts toward achievement of standards in Science & Technology, Mathematics, Career Education & Work, Reading, Writing, Speaking, & Listening, and The Arts & Humanities. This standards alignment shows what specific academic skills are supported and enriched through *FIRST* participation from age nine through high school. In addition to the standards *FIRST* helps students achieve, more the nine million dollars in college and university scholarships are available to participants as well as countless internships and job opportunities.

### The Document:

This document is aimed at raising awareness in all PA school districts about the impact *FIRST* has in the development of our students so existing *FIRST* programs can strengthen and more can begin across the commonwealth. The document is in the form of a chart showing only those standards that *FIRST* directly supports through its many activities. All PA Standards information contained herein was obtained from the PDE Website at [http://www.pde.state.pa.us/stateboard\\_ed/cwp/view.asp?a=3&Q=76716&stateboard\\_edNav=5467](http://www.pde.state.pa.us/stateboard_ed/cwp/view.asp?a=3&Q=76716&stateboard_edNav=5467). All *FIRST* activities and information was obtained from the most recent FLL, FVC, and FRC competition manuals located at <http://www.firstlegoleague.org/default.aspx?pid=70>, <http://www.usfirst.org/community/fvc/content.aspx?id=962>, and <http://www.usfirst.org/community/frc/content.aspx?id=452> respectively.

### Terminology:

All PA Standards Terminology comes directly from PDE documents and refers to specific standards and benchmarks (ex. "3.1.7.A"). All FLL, FVC and FRC activities have been abbreviated as follows:

FLL Term	FLL Definition	FVC/FRC Term	FVC/FRC Definition
Build	Design, prototype, test, & robot manufacturing	Build	Design, prototype, test, & robot manufacturing
Prog.	Robot programming activities	Prog.	Robot programming activities
Res.	Research assignment associated with the challenge	CAD	Computer Aided Design & related competition
Pres.	Both formal and informal presentations made to judges	PR	All PR activities and competitions including website, fundraising, presentations for judges and in community, and all associated documentation/correspondence
		Pres.	
		Ani.	Animation and associated competition
		Mentor	Events that occur through mentor/student interaction
		Sch. Apps.	Scholarship Applications
		Shadow	Professional visitations and job shadowing
		Intern	Career internships
		Nb	Engineering Notebook

FIRST LEGO League, FIRST Vex Challenge and FIRST Robotics Competition Aligned with Pennsylvania Academic Standards

PA Academic Standards	FIRST LEGO League (9-14 yrs. old)			FIRST Vex Challenge & FIRST Robotics Competition (Grade 9-12)		
PA Science & Technology Standards		PA Benchmarks	Related FLL Activities		PA Benchmarks	Related FVC/FRC Activities
<b>3.1 Unifying Theme</b>	<b>X</b>			<b>X</b>		
<i>A. Systems</i>	X	3.1.7.A	Build, Prog.	X	3.1.10.A, 3.1.12.A	Build, CAD, Prog., Nb
<i>B. Models</i>	X	3.1.7.B	Build	X	3.1.10.B, 3.1.12.B	Build, CAD, Prog., Nb
<i>C. Pattern</i>	X	3.1.7.C	Build, Prog.	X	3.1.10.C, 3.1.12.C	Build, CAD, Prog., Nb
<i>D. Scale</i>	X	3.1.7.D	Build	X	3.1.10.D, 3.1.12.D	Build, CAD, Nb
<i>E. Change</i>	X	3.1.7.E	Build, Prog.	X	3.1.10.E, 3.1.12.E	Build, CAD, Prog., Nb
<b>3.2 Inquiry and Design</b>	<b>X</b>			<b>X</b>		
<i>B. Process Knowledge</i>	X	3.2.7.B	Build, Prog.	X	3.2.10.B, 3.2.12.B	Build, CAD, Prog., Nb
<i>C. Scientific Method</i>	X	3.2.7.C	All Aspects	X	3.2.10.C, 3.2.12.C	Build, Prog., Pres., Nb
<i>D. Problem Solving in Technology</i>	X	3.2.7.D	All Aspects	X	3.2.10.D, 3.2.12.D	Build, CAD, Prog., Nb
<b>3.4 Phys. Science, Chemistry &amp; Physics</b>	<b>X</b>			<b>X</b>		
<i>B. Energy</i>	X	3.4.7.B	Build, Prog.	X	3.4.10.B, 3.4.12.B	Build
<i>C. Forces and Motion</i>	X	3.4.7.C	Build, Prog., Pres.	X	3.4.10.C, 3.4.12.C	Build
<b>3.6 Technology Education</b>	<b>X</b>			<b>X</b>		
<i>B. Information Technology</i>	X	3.6.7.B	Prog., Res., Pres.	X	3.6.10.B, 3.6.12.B	CAD, Prog., PR, Pres.
<i>C. Physical Technologies</i>	X	3.6.7.C	Build, Res., Pres.	X	3.6.10.C, 3.6.12.C	Build, CAD, Pres.
<b>3.7 Technological Devices</b>	<b>X</b>			<b>X</b>		
<i>A. Tools</i>				X	3.7.10.A, 3.7.12.A	Build, CAD
<i>B. Instruments</i>				X	3.7.10.B, 3.7.12.B	Build, Prog.
<i>C. Computer Operations</i>	X	3.7.7.C	All Aspects	X	3.7.10.C, 3.7.12.C	CAD, Prog., PR, Pres., Ani.
<i>D. Computer Software</i>	X	3.7.7.D	Prog., Res., Pres.	X	3.7.10.D, 3.7.12.D	CAD, Prog, PR, Pres, Ani.
<i>E. Computer Communication Systems</i>	X		Res., Pres.	X	3.7.10.E, 3.7.12.E	Build, PR, Pres, Ani.
<b>3.8 Sci., Tech., &amp; Human Endeavors</b>	<b>X</b>			<b>X</b>		
<i>A. Constraints</i>	X	3.8.7.A	Res., Pres.	X	3.8.10.A, 3.8.12.A	PR, Pres., Nb
<i>B. Meeting Human Needs</i>	X	3.8.7.B	Res., Pres.	X	3.8.10.B, 3.8.12.B	PR, Pres., Nb
<i>C. Consequences and Impacts</i>	X	3.8.7.C	Res., Pres.	X	3.8.10.C, 3.8.12.C	PR, Pres., Nb

FIRST LEGO League, FIRST Vex Challenge and FIRST Robotics Competition Aligned with Pennsylvania Academic Standards

PA Academic Standards	FIRST LEGO League (9-14 yrs.)			FIRST Vex Challenge & FIRST Robotics Competition (Grade 9-12)		
PA Mathematics Standards		PA Benchmarks	Related FLL Activities		PA Benchmarks	Related FVC/FRC Activities
<b>2.1 Numbers, Number Systems and Number Relationships</b>	<b>X</b>			<b>X</b>		
	X	2.1.5.A, 2.1.8.A	Build, Prog.	X	2.1.11.A	Build, Prog.
	X	2.1.5.B, 2.1.8.B	Build, Prog.			
	X	2.1.5.F	Build, Prog.			
	X	2.1.5.G	Build, Prog.			
<b>2.2 Computation and Estimation</b>	<b>X</b>			<b>X</b>		
	X	2.2.5.A, 2.2.8.A	Build, Prog.	X	2.2.11.A	Build, Prog., CAD, Nb
	X	2.2.8.B	Build, Prog.	X	2.2.11.B	Build, Prog., CAD, Nb
	X	2.2.5.D	Build, Prog.	X	2.2.11.C	Build, Prog.
	X	2.2.5.E, 2.2.8.E	Build, Prog.	X	2.2.11.D	Build, Prog.
	X	2.2.5.F, 2.2.8.F	Build, Prog.	X	2.2.11.E	Build, Prog.
	X	2.2.5.G	Build, Prog.	X	2.2.11.F	Build, Prog.
	X	2.2.5.I	Build, Prog.			
<b>2.3 Measurement and Estimation</b>	<b>X</b>			<b>X</b>		
	X	2.3.5.A	Build, Prog.	X	2.3.11.A	Build, Prog., CAD, Nb
	X	2.3.5.B, 2.3.8.B	Build, Prog.	X	2.3.11.B	Build, Prog.
	X	2.3.5.C, 2.3.8.C	Build, Prog.	X	2.3.11.C	Build, Prog., CAD, Nb
	X	2.3.5.D, 2.3.8.D	Build, Prog.			
	X	2.3.5.E	Build, Prog.			
<b>2.4 Mathematical Reasoning and Connections</b>	<b>X</b>			<b>X</b>		
	X	2.4.5.A	Build, Prog.			
	X	2.4.5.B, 2.4.8.B	Build, Prog., Pres.	X	2.4.11.B	Build, Prog., CAD, Nb
	X	2.4.5.C, 2.4.8.C	Build, Prog.	X	2.4.11.C	Build, Prog., CAD, Nb
	X	2.4.5.D	Build, Prog.			
	X	2.4.5.E	Prog.	X	2.4.11.E	Build, Prog., CAD, Nb

FIRST LEGO League, FIRST Vex Challenge and FIRST Robotics Competition Aligned with Pennsylvania Academic Standards

PA Academic Standards	FIRST LEGO League (9-14 yrs.)			FIRST Vex Challenge & FIRST Robotics Competition (Grade 9-12)		
PA Mathematics Standards (continued)		PA Benchmarks	Related FLL Activities		PA Benchmarks	Related FVC/FRC Activities
<b>2.5 Mathematical Problem Solving and Communication</b>	<b>X</b>			<b>X</b>		
	X	2.5.5.A, 2.5.8.A	Build, Prog., Pres.	X	2.5.11.A	Build, Prog.
	X	2.5.5.B, 2.5.8.B	Build, Prog., Pres.	X	2.5.11.B	Build, Prog., CAD, Nb
	X	2.5.5.C, 2.5.8.C	Build, Prog., Pres.	X	2.5.11.C	Build, Prog.
	X	2.5.5.D, 2.5.8.D	Build, Prog.	X	2.5.11.D	Build, Prog., Pres.
	X	2.5.5.E	Build, Prog., Pres.			
	X	2.5.5.F	Build, Prog., Pres.			
<b>2.6 Statistics and Data Analysis</b>	<b>X</b>			<b>X</b>		
	X	2.6.5.A, 2.6.8.A	Build, Prog.	X	2.6.11.B	Build, Prog., Pres., Nb
	X	2.6.5.B, 2.6.8.B	Build, Prog.	X	2.6.11.D	Build, Prog., Pres., Nb
	X	2.6.5.D	Build, Prog.	X	2.6.11.H	Build, Prog., Pres.
	X	2.6.5.E	Build, Prog.	X	2.6.11.I	Build, Prog., Pres.
	X	2.6.8.F	Build, Prog.			
<b>2.7 Probability and Predictions</b>	<b>X</b>			<b>X</b>		
	X	2.7.8.B	Build, Prog., Pres.	X	2.7.11.B	Build, Prog.
	X	2.7.5.C	Build, Prog.	X	2.7.11.C	Build, Prog.
	X	2.7.8.E	Build, Prog.	X	2.7.11.E	Build, Prog., CAD, Nb
	X	2.7.5.F	Build, Prog.			
	X	2.7.5.G	Build, Prog., Pres.			
	X	2.7.5.H	Build, Prog.			
	X	2.7.5.I	Build, Prog.			
<b>2.8 Algebra and Functions</b>	<b>X</b>			<b>X</b>		
	X	2.8.5.A; 2.8.8.A	Build, Prog.	X	2.8.11.B	Build, Prog., Nb
	X	2.8.5.B	Build, Prog.	X	2.8.11.C	Build, Prog., Nb
	X	2.8.5.F	Build, Prog.	X	2.8.11.E	Build, Prog., Nb
				X	2.8.11.P	Build, Prog.
				X	2.8.11.Q	Build, Prog.

FIRST LEGO League, FIRST Vex Challenge and FIRST Robotics Competition Aligned with Pennsylvania Academic Standards

PA Academic Standards	FIRST LEGO League (9-14 yrs.)			FIRST Vex Challenge & FIRST Robotics Competition (Grade 9-12)		
PA Mathematics Standards (continued)		PA Benchmarks	Related FLL Activities		PA Benchmarks	Related FVC/FRC Activities
<b>2.10 Trigonometry</b>	X			X		
	X	2.10.8.B	Build, Prog.	X	2.10.11.B	Build, Prog., CAD, Nb
<b>2.11 Concepts of Calculus</b>	X			X		
	X	2.11.5.A, 2.11.8.A	Build, Prog., Res.	X	2.11.11.A	Prog.
	X	2.11.5.B	Build, Prog.	X	2.11.11.B	Build, Prog., Nb
	X	2.11.5.C	Build, Prog.			
PA Career Education and Work Standards		PA Benchmarks	Related FLL Activities		PA Benchmarks	Related FVC/FRC Activities
<b>13.1 Career Awareness and Preparation</b>				X		
				X	13.1.11.A	Mentor, Sch. Apps.
				X	13.1.11.B	Mentor, Sch. Apps.
				X	13.1.11.C	Intern, Vol., Shadow
				X	13.1.11.D	Mentor
				X	13.1.11.E	Mentor
<b>13.2 Career Acquisition</b>	X			X		
	X	13.2.5.A	Res., Pres.	X	13.2.11.A	PR, Pres.
<b>13.3 Career Retention &amp; Advancement</b>	X			X		
	X	13.3.5.A, 13.3.8.A	All Aspects	X	13.3.11.A	All Aspects
	X	13.3.5.B, 13.3.8.B	All Aspects	X	13.3.11.B	All Aspects
	X	13.3.5.C, 13.3.8.C	All Aspects	X	13.3.11.C	All Aspects
				X	13.3.11.D	Intern
	X	13.3.5.E, 13.3.8.E	All Aspects	X	13.3.11.E	All Aspects
				X	13.3.11.F	All Aspects

FIRST LEGO League, FIRST Vex Challenge and FIRST Robotics Competition Aligned with Pennsylvania Academic Standards

PA Academic Standards	FIRST LEGO League (9-14 yrs.)			FIRST Vex Challenge & FIRST Robotics Competition (Grade 9-12)		
PA Career Education and Work Standards (continued)		PA Benchmarks	Related FLL Activities		PA Benchmarks	Related FVC/FRC Activities
<b>13.4 Entrepreneurship</b>				<b>X</b>		
				X	13.4.11.A	PR, Pres.
				X	13.4.11.B	PR, Pres.
				X	13.4.11.C	Build, PR, Pres.
PA Reading, Writing, Speaking, And Listening Standards		PA Benchmarks	Related FLL Activities		PA Benchmarks	Related FVC/FRC Activities
<b>1.1 Learning to Read Independently</b>	<b>X</b>			<b>X</b>		
<i>Purposes for Reading</i>	X	1.1.5.A, 1.1.8.A	Build, Prog., Res.	X	1.1.11.A	All Aspects
<i>Word Recognition Skills</i>	X	1.1.5.B, 1.1.8.B	Build, Prog., Res.	X	1.1.11.B	All Aspects
<i>Vocabulary Development</i>	X	1.1.5.C, 1.1.8.C 1.1.5.E, 1.1.8.E 1.1.5.F, 1.1.8.F	Build, Prog., Res.	X	1.1.11.C 1.1.11.E 1.1.11.F	All Aspects
<i>Comprehension and Interpretation</i>	X	1.1.5.D, 1.1.8.D 1.1.5.G, 1.1.8.G	Build, Prog., Res.	X	1.1.11.D 1.1.11.G	All Aspects
<i>Fluency</i>	X	1.1.5.H, 1.1.8.H	Build, Prog., Res.	X	1.1.11.H	All Aspects
<b>1.2 Reading Critically in All Content Areas</b>	<b>X</b>			<b>X</b>		
<i>Detail</i>	X	1.2.5.A, 1.2.8.A 1.2.5.B, 1.2.8.B	Build, Prog., Res.	X	1.2.11.A 1.2.11.B	Build, Prog., CAD, PR, Ani., Pres.
<i>Inferences</i>	X					
<i>Fact from Opinion</i>	X					
<i>Comparison</i>	X					
<i>Analysis and Evaluation</i>	X					
<b>1.4 Types of Writing</b>	<b>X</b>			<b>X</b>		
<i>Narrative</i>	X	1.4.5.A	Res.	X	1.4.11.A	PR, Pres.
<i>Informational</i>	X	1.4.5.B, 1.4.8.B 1.4.8.D	Build, Prog., Res.	X	1.4.11.B 1.4.11.D	Build, Prog., CAD, PR
<i>Persuasive</i>	X	1.4.5.C, 1.4.8.C	Res.	X		PR (Fundraising)

FIRST LEGO League, FIRST Vex Challenge and FIRST Robotics Competition Aligned with Pennsylvania Academic Standards

PA Academic Standards	FIRST LEGO League (9-14 yrs.)			FIRST Vex Challenge & FIRST Robotics Competition (Grade 9-12)		
PA Reading, Writing, Speaking, And Listening Standards (continued)		PA Benchmarks	Related FLL Activities		PA Benchmarks	Related FVC/FRC Activities
<b>1.5 Quality of Writing</b>	<b>X</b>	1.5.5.E, 1.5.8.E 1.5.5.G, 1.5.8.G	Res., Pres.	<b>X</b>	1.5.11.E 1.5.11.G	PR, Pres.
<i>Focus</i>	X	1.5.5.A, 1.5.8.A	Res.	X	1.5.11.A	PR
<i>Content</i>	X	1.5.5.B, 1.5.8.B	Res.	X	1.5.11.B	PR
<i>Organization</i>	X	1.5.5.C, 1.5.8.C	Res.	X	1.5.11.C	PR
<i>Style</i>	X	1.5.5.D, 1.5.8.D	Res.	X	1.5.11.D	PR
<i>Conventions</i>	X	1.5.5.F, 1.5.8.F	Res.	X	1.5.11.F	PR
<b>1.6 Speaking and Listening</b>	<b>X</b>			<b>X</b>		
<i>Listening Skills</i>	X	1.6.5.A, 1.6.8.A	All Aspects	X	1.6.11.A	All Aspects
<i>Speaking Skills</i>	X	1.6.5.C, 1.6.8.C	Pres.	X	1.6.11.C	Pres.
<i>Discussion</i>	X	1.6.5.D, 1.6.8.D	All Aspects	X	1.6.11.D	All Aspects
<i>Presentation</i>	X	1.6.5.E, 1.6.8.E 1.6.5.F, 1.6.8.F	Pres.	X	1.6.11.E 1.6.11.F	Pres.
<b>1.8 Research</b>	<b>X</b>			<b>X</b>		
<i>Selection</i>	X	1.8.5.A, 1.8.8.A	Res.	X	1.8.11.A	PR
<i>Location of Information</i>	X	1.8.5.B, 1.8.8.B	Res.	X	1.8.11.B	PR
<i>Organization</i>	X	1.8.5.C, 1.8.8.C	Res., Pres.	X	1.8.11.C	PR, Pres.
<b>PA Arts and Humanities Standards</b>						
<b>9.1 Production, Performance and Exhibition of Dance, Music, Theatre and Visual Arts</b>	<b>X</b>			<b>X</b>		
<i>A. Elements and Principles in each Art Form</i>	X	9.1.8.A	Res., Pres.	X	9.1.12.A	PR, Pres., Ani.
<i>B. Demonstration of Dance, Music, Theatre and Visual Arts</i>				X	9.1.12.B	PR, Pres., Ani
<i>C. Vocabulary Within each Art Form</i>				X	9.1.12.C	Ani.
<i>D. Styles in Production, Performance and Exhibition</i>				X	9.1.12.D	Ani.
<i>E. Themes in Art Forms</i>	X	9.1.8.E	Res., Pres.	X	9.1.12.E	PR, Pres., Ani
<i>J. Technologies in the Arts</i>				X	9.1.12.J	Ani.

FIRST LEGO League, FIRST Vex Challenge and FIRST Robotics Competition Aligned with Pennsylvania Academic Standards

PA Academic Standards	FIRST LEGO League (9-14 yrs.)		FIRST Vex Challenge & FIRST Robotics Competition (Grade 9-12)		
PA Arts and Humanities Standards (continued)	PA Benchmarks	Related FLL Activities		PA Benchmarks	Related FVC/FRC Activities
<b>9.2 Historical and Cultural Contexts</b>			X		
<i>E. Historical and Cultural Impact on Works in the Arts.</i>			X	9.2.12.E	Ani.
<b>9.4 Aesthetic Response</b>					
<i>B. Aesthetic Interpretation</i>			X	9.4.12.B	Ani.
<i>D. Artistic Choices</i>			X	9.4.12.D	Ani.