



(which includes: Science, Technology, Engineering, and Applied Math)

Situation

There is a concern that the United States is not preparing a well-trained and highly prepared workforce to work in the fields of science, technology, engineering, and mathematics (STEM). Several studies and databases have highlighted the plight from elementary students to the university level students.

According to the recently released *Nation's Report Card* for science (National Assessment of Educational Progress, 2009, http://nces.ed.gov/nationsreportcard/), American students are still struggling with science proficiency. At grade 4, 34% of students are considered proficient in science (proficient represents solid academic performance and the demonstrated competency over challenging subject matter), 30% of 8th graders are considered proficient, and only 21% of 12th graders are considered proficient. In fact, 60% of 12th graders performed at a basic level (denoting only partial mastery of fundamental knowledge and skills). The 2009 NAEP data also shows us that 4th grade students in Georgia are performing at a lower level than the national average, our 8th graders are performing on par with the national average, and a comparison of Georgia 12th graders against the national average is not available.

Information allowing for the comparison of U.S. students and other international students is available from Trends in International Mathematics and Science Study (TIMSS - http://nces.ed.gov/timss/). In the most recent study of 2007, 4th grade students scored lower in science than those in 4 other countries (all in Asia) and 8th grade the students scored lower in science than those in 9 other countries (all in Asia or Europe).

The Program for International Student Assessment (PISA, http://www.pisa.oecd.org) also implements an assessment that measures the competency of 15 year old students around the world (this would be an average of the end of compulsory education). The 2009 PISA results indicate that U.S. high school students scored behind those in 22 other countries.

National Science Board (http://www.nsf.gov/statistics/seind10/) released the *Science and Engineering Indicators of 2010* report which states that of the first university degrees awarded in science and engineering in 2006, only 11% were earned in the United States. This is compared with 21% in China and 19% in the European Union. Additionally, of the degrees earned around the world in 2002, the average international percentage of STEM first university degrees is 26.4% while the U.S. percentage of STEM first university STEM degrees earned is only 16.8%.

In response, 4-H has set about to engage one million new scientists in STEM programming by the year 2013 to contribute to global competitiveness and prepare the next generation of scientists, engineers, and technology leaders.

4-H Science Programs

These existing 4-H opportunities are a natural fit for 4-H Science programming because of their content, duration, and delivery methods:

AgriScience Curriculum





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- National Youth Science Day/National Science Experiment
- Project Achievement (depending on project)
- Georgia 4-H Environmental Education Program
- Junior Master Gardener
- Garden Earth Naturalist

Many of the following could be 4-H Science Programs if care was given to accomplish items on the attached 4-H Science checklist:

- Judging Contests: Dairy, Forestry, Horse, Land, Livestock, Poultry, Wildlife, & Hippology
- Beef School
- Horse School
- Rivers Alive
- School/Community Gardens
- Day camps
- GPS/GIS work
- Robotics/rocketry
- Appropriate classes at 4-H summer camp
- UGA programs (Young Scholars, Camps, Science Fair, etc.)

Outcomes

The recently released study entitled *Evaluating the 4-H Science Initiative: The 2010 Youth, Engagement, Attitudes and Knowledge Survey Results* concludes that:

"Taken altogether, the evaluation findings reported indicate that 4-H is indeed implementing its rich and abundant variety of science, engineering and technology programs/activities to 4-H youth successfully. By providing engaging out-of-school programming, 4-H Science programs have the potential to bolster participants' interest in pursuing education and careers in the STEM fields."

To be more specific, when 4-H Science respondents were compared with a national sample:

- 76% of 4th grade 4-H respondents agreed with the statement "I like science" compared with 64% from the national sample
- 74% of 8th grade 4-H respondents agreed with the statement "I like science" compared with 50% from the national sample
- 86% of 12th grade 4-H respondents agreed with the statement "I like science" compared with 31% from the national sample

Additionally, the following information is provided in the report:

- Over 80% of respondents intend to finish college or continue to get more education after college
- 50% of respondents want to pursue a science career
- 71% of 4-H Science participants said science is one of their favorite subjects
- 68% do science-related activities that are not for school work
- 59% would like to have a job related to science when they graduate from school





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4-H Science Checklist

A "SET Ready" 4-H experience is a program that is framed in SET concepts, based on SET standards and intentionally targets the development of SET abilities and the outcome articulated by the 4-H SET Logic Model. Additionally, it integrates the Essential Elements and engages participants in experiential and inquiry based learning. In addition to the following criterion below, it also recommended that SET programs offer a sustained learning experience which offers youth the opportunity to be engaged in programs with relevant frequency and duration. Utilize the following checklist to self assess the program you deliver.

To meet the needs of children, youth and the nation with high-quality science, engineering and technology programs...



Are you providing science, engineering and technology programs based on National Science Education Standards - Science education standards are criteria to judge quality: the quality of what young people know and are able to do; the quality of the science programs that provide the opportunity for children and youth to learn science; the quality of science teaching; the quality of the system that supports science leaders and programs; and the quality of assessment practices and policies. http://www.nap.edu/readingroom/books/nses/



Are you providing children and youth opportunities to improve their SET Abilities?

Predict, Hypothesize, Evaluate, State a Problem, Research Problem, Test, Problem Solve Design Solutions, Measure, Collect Data, Draw/Design, Build/Construct, Use Tools, Observe, Communicate, Organize, Infer, Question, Plan Investigation, Summarize/Relate, Invent/Implement Solutions, Interpret/Analyze/Reason, Categorize/Order/Classify, Model/Graph/Use Numbers, Troubleshoot, Redesign, Optimize, Collaborate, Compare



Are you providing opportunities for youth to experience and improve in the Essential Elements of Positive Youth Development?

Do youth get a chance at mastery – addressing and overcoming life challenges in your programs?

Do youth cultivate independence and an opportunity to see oneself as an active participant in the future?

Do youth develop a sense of **belonging** within a positive group? Do youth learn to share a spirit of **generosity** toward others?



Are learning experiences led by trained, caring adult staff and volunteers acting as mentors, coaches, facilitators and co-learners who operate from a perspective that youth as partners and resources in their own development?



Are activities led with an experiential approach to learning?



Are activities using inquiry to foster the natural creativity and curiosity of vouth?



Does your program target one or more of the outcomes on the SET Logic Model and have you considered the frequency and duration necessary for youth to accomplish those outcomes?





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4-H Science Logic Model		Conditions		Occur when a societal	due to a participant's	action taken in the	previous column.	-Increased number and	more diverse pool of	yourn pulsuing	in science related fields.		- Increased and more diverse nool of frained	teachers, educators.	scientists	-Increased science	literacy in general	population		- Increased Innovation addressing social	problems using science												(
	Outcomes	Actions		Occur when there is a	the participants act	upon what they've	learned and:	Youth apply	science learning to	4-H courses (e.g.	school classes,	science fairs,	invention contests,	etc.)	-Youth adopt and use	new methods or	improved	technology	Youth demonstrate	use of life skills		- roum express interest/demonstrate	aspirations towards	science careers (career fairs, job	shadowing, volunteer	work or intemships)	Youth raise	questions and	identify problems to be addressed using	science			
		Knowledge		Occurs when there is	a change in knowledge or the	participants leam:		Increased awareness of	science among youth	Innovation believes	eniproved science skills (crientific methods) and	mowledge (content	areas) among youth		Increased awareness of	to society using science	skills.		Increased	me skills (ser-emcacy)	and Brown												
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	Outputs			What we produce:	- 4-H Science curricula	Mess inchastican	methods	Trained other panel	volunteers		 Adult participants 	engaged	- Youth participants	engaged		- Partners (Other	recent agencies,	vouth organizations.	etc.) collaborating		 Marketing materials 	 Evaluation materials 											
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	Activities			What we do::	-Select and develop 4-H	Science curricula	-Select and train volunteers	The state of the s	increase interest	participation		- Conduct non-formal	education (learning and teaching facilitated inquired	and discovery)		- Facilitate question	tormation and problem	soving mough guided		-Provide or supplement	math programming	-Teach youth about	academic and career	GIOLOS, requienten	Who we reach	(Participation): - Extension administrators.	LGU and Extension faculty	and staff)	12)	 Federal, state & private funders 	- Partners - Public		
	Inputs			What we invest:	- Federal, state	and private	Spin	-4-H	almon age IIII	 Land Grant Univ. 	Support		- County Extension	administrators	and agents,	program	coordinators, and	skupusk	- Training		-Knowledge	-Collaborations	with external	C DI DI DOCO	-Collaborations	with science industry leaders							
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	Situation		Description of	challenge, problem, or opportunity:		- Unsolved	worldwide social	problems need to	science		-In the US, shortage	of scientists &	understanding	science		Under-	women and	minorities in science	careers		nool of trained	scientists to frame	& adjuste others		-General population in the US	(& worldwide) lacks	basic understanding	of science methods and content	("science literacy")			4	

EXTERNAL FACTORS — Youth experience in schools including [with] solence & mathematics, No Child Left Behind (course content, testing, tutoring provided in school), changing landscape of schools, community and family influence (e.g., religious teaching on Creationism), population changes, immigration, global economy and competition in science education and science pursuits. ASSUMPTIONS – 4-H non-formal experientially based programming addresses science abilities, concepts and content under guidance of trained (scientifically able) 4-H learning facilitator, 4-H develops appropriate science abilities to emphasize in non-formal education; 4-H essential elements create optimal youth development context for learning; 4-H reaches diverse population; and increased awareness of science skills, content, and career possibilities increases engagement of youth in

Note: 4-H Science encompasses science, engineering, technology and applied math.