When, Why & Where Children & Youth Learn STEM

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When Do Children and Youth Learn STEM?

Nature of Learning in 2014

- Learning is non-stop: 24-7
- <20% of time spent in school
- Traditional gatekeepers – schools, libraries, government – no longer in total control as information becomes increasingly accessible
- The blurring of boundaries between in- and out-of-school learning experiences (particularly for those with privilege) make it increasingly difficult to say this "learning" happened here

STEM Learning is Life Long, Wide & Deep

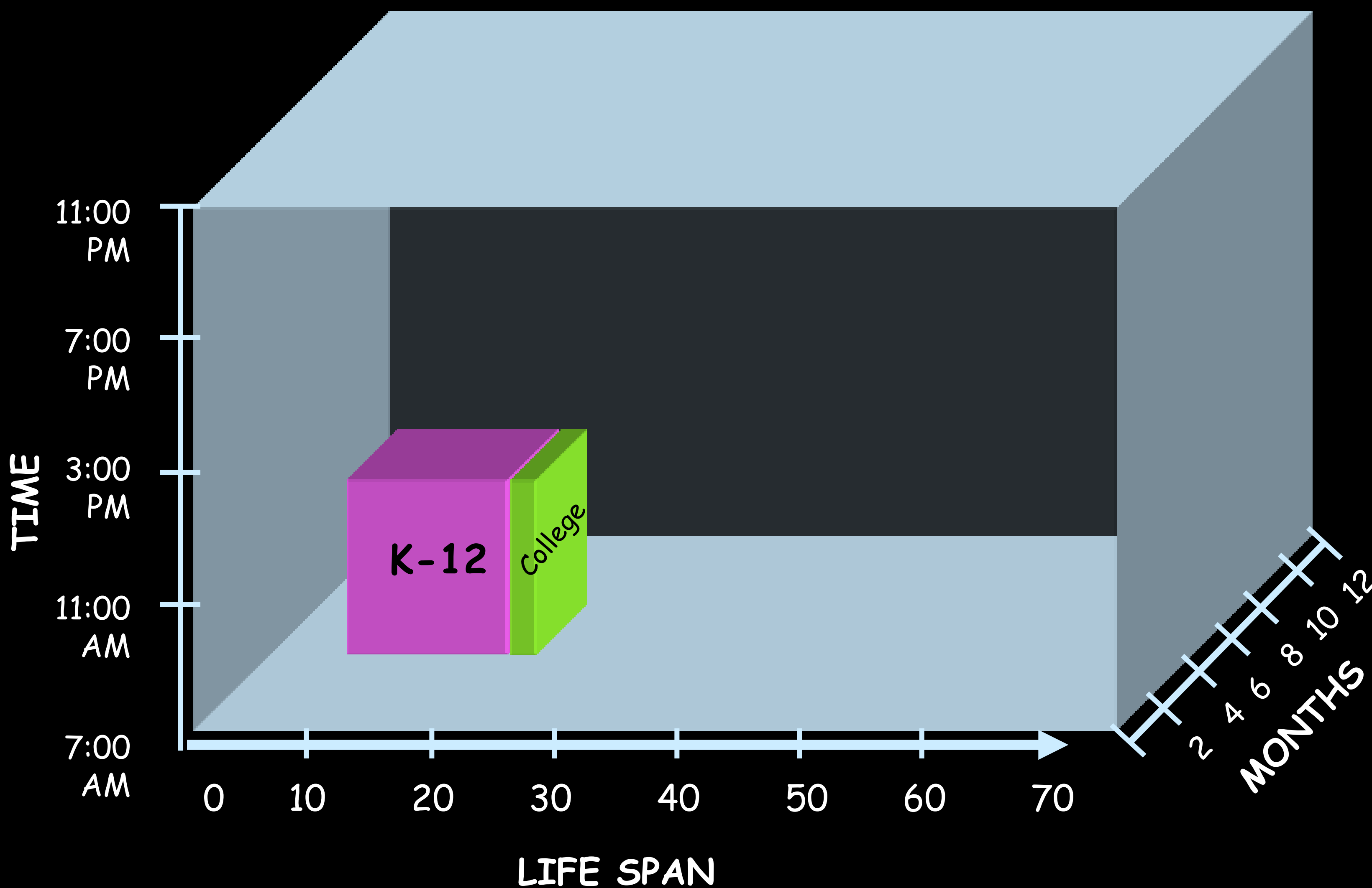
- “Learning is **a** process that takes place across time and settings.”

  - *Bransford , Brown & Cocking (1999)*

- “Values, beliefs, interests, and understandings are developed in many places. They also fluctuate and may evolve into sustained “lines of practice.”

  - *Azevedo (2011)*

- “… engagement with out-of-school science also contain indicators of future distinctions (particularly classed distinctions) in terms of patterns of achievement and engagement in science.”
- - *Archer, et al., 2010.*


TIME
11:00 PM
7:00 PM
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11:00 AM
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K-12
College
0
10
20
30
40
50
60
70
LIFE SPAN
MONTHS
2
4
6
8
10
12

Why Do Children and Youth Learn STEM?

Children & Youth Learn STEM:

1) Satisfy Personal Curiosity/Interest
   – Hobbies and Free-Choice Pursuits
2) Through Experiences & Needs
   – Do things with family or friends
   – Participate in after-school or summer programs
   – Solve problems
3) Economic/Compulsory Needs
   – Succeed at school
   – To get or retain a job

Where Do Children and Youth Learn STEM?

STEM Learning Ecosystem

International Science Center Impact Study

- Youth & adults who use science centers are significantly more likely than those who do not to have high levels of:
  - Knowledge and Understanding of science & tech.;
  - Interest and Curiosity in science & technology;
  - Engagement with and interest in science as a school subject (youth);
  - Participation in science careers (adults);
  - Engagement with science and technology-related activities out-of-school; and
  - Confidence in pursuing science and technology topics.

- Falk, Dierking, Needham & Prendergast (2014)

L.A. Science Literacy Research

What are the relative contributions made to public science knowledge by:

- Formal schooling?
- Childhood informal/free-choice experiences?
- Adult informal/free-choice experiences?
- Workplace experiences?
- Socioeconomic privilege?

L.A. Science Literacy Research

- Schooling, Childhood and Adult Out-of-School Learning Experiences, Workplace and Privilege all highly significant contributors to public science literacy.
- In terms of variance explained, the order is Adult OS **>** Privilege = Workplace **>** Childhood OS **=** Schooling
- Healthy networks of out-of-school learning organizations within a community represent a vital mechanism for creating and maintaining a scientifically literate public.

- Falk & Needham (2013)

Conclusions

Given that children and youth learn STEM across a lifetime, from many places and for many reasons:

- Need to design educational efforts in ways that support learning continuously and synergistically across the whole learning ecosystem – encourage diversity & redundancy
- Need to design assessments that accommodate the life-long, life-wide & life-deep nature of learning

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Contribution of Youth Visits to Science Center (in past year) and STEM Learning

	Never Visited (53%)	0 Visits (24%)	1 Visit (13%)	2-4 Visits (7%)	5+ Visits (2%)	p-value	Eta
Knowledge & Understanding	2.45	2.49	2.57	2.70	2.95	< .001	.16
Interest & Curiosity	0.09	0.09	0.12	0.18	0.08	< .001	.10
Out-of-School Engagement	3.86	3.61	3.84	4.02	4.34	< .001	.11
Vocations	3.63	3.45	3.76	4.08	4.51	< .001	.11
Avocations	3.97	3.63	3.90	4.18	4.48	< .001	.12
Sci. Confidence	--	3.66	3.96	4.22	4.29	< .001	.20

Regression Analysis of Contribution to Adult Science Knowledge

	R^2	X^2-value	p-value
Formal Education Model	0.17	133.08	< .001
Childhood Free-Choice Learn. Model	0.17	122.61	< .001
Workplace Model	0.20	152.61	< .001
Privilege Model	0.23	152.95	< .001
Adult Free-Choice Learning Model	0.39	323.95	< .001

Only statistically significant ($p < .05$) independent variables shown for full model. Adjusted $R^2 = 0.51$, $X^2 = 369.43$, $p < .001$