

Energy Literacy

THE CREATION OF THE ASSESSMENT TOOL AND RESULTS

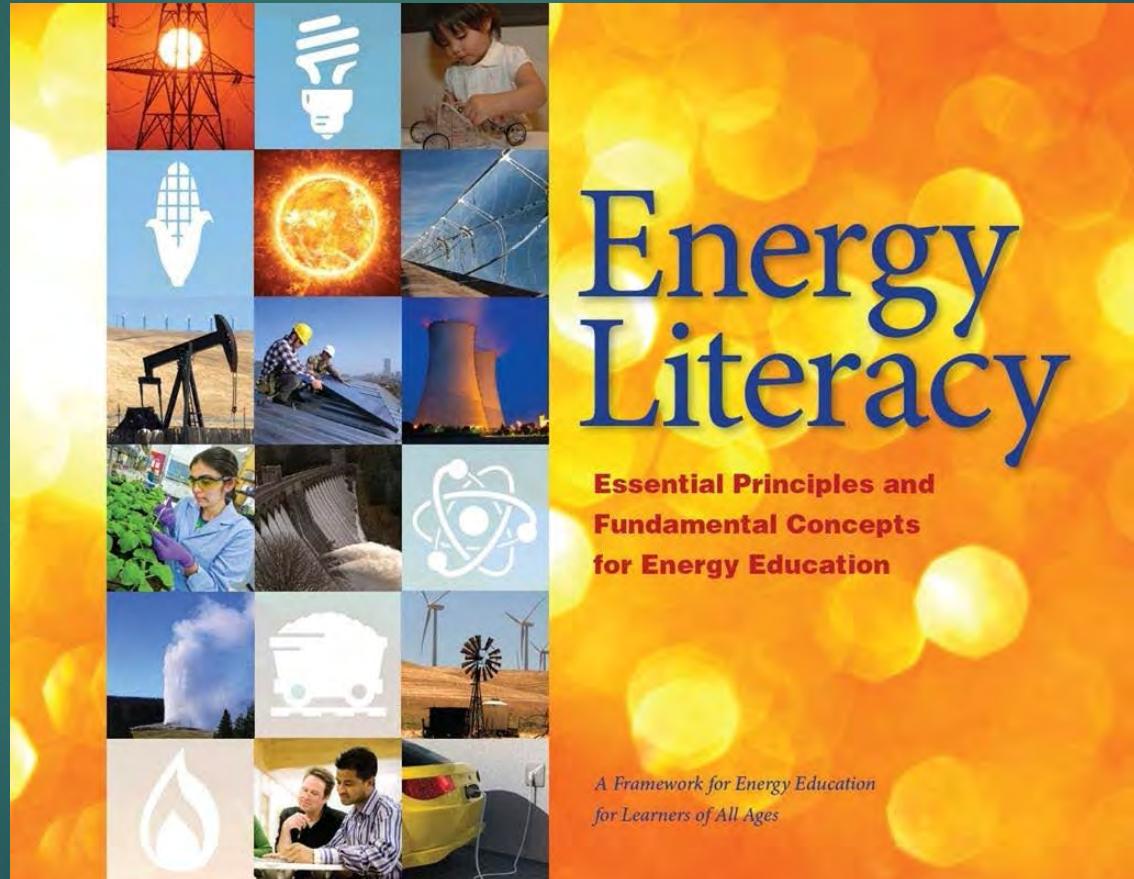
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College of Natural Resources



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What does it mean to be "energy literate"?



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<http://energy.gov/eere/education/energy-literacy-essential-principles-and-fundamental-concepts-energy-educa>

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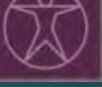
NARA
Northwest Advanced Renewables Alliance

What does it mean to be "energy literate"?

- ▶ Energy Literacy is an understanding of the nature and role of energy in the world and daily lives accompanied by the ability to apply this understanding to answer questions and solve problems (DOE, 2013).
- ▶ An energy-literate person:
 - ▶ Can trace energy flows and think in terms of energy systems.
 - ▶ Knows how much energy they use, for what purpose, and where the energy comes from.
 - ▶ Can assess the credibility of information about energy.
 - ▶ Can communicate about energy and energy use in meaningful ways.
 - ▶ Is able to make informed energy use decisions based on an understanding of impacts and consequences.

Department of Energy: Energy Literacy Essential Principles

Energy Literacy Principles

- 1 Energy is a physical quantity that follows precise natural laws. 
- 2 Physical processes on Earth are the result of energy flow through the Earth system 
- 3 Biological Processes depend on energy flow through the Earth System 
- 4 Various sources of energy can be used to power human activities, and often this energy must be transferred from source to destination. 
- 5 Energy decisions are influenced by economic, political, environmental, and social factors. 
- 6 The amount of energy used by human society depends on many factors. 
- 7 The quality of life of individuals and societies is affected by energy choices. 

How do we measure it?

- ▶ Drafted questions related to Energy Literacy Principles
- ▶ Aligned with NGSS and set outcome statements
- ▶ Shared with teachers for review
- ▶ Readability test
- ▶ Content Validity tested with students (think-a-loud)
- ▶ Pilot tested on students
- ▶ Checked for misleading, distracting or confusing answer choices
- ▶ Checked for even distribution of answer selection, test validation

Methods: Pilot test & Validity test

- ▶ 22 question test with 3 answer choices per question (middle school version)
- ▶ Tested on 304 5th/6th graders fall 2014 using a pre, post, one-month post test model
- ▶ Test included 22 energy literacy questions and 15 science identity questions
- ▶ Tested on 508 5th/6th graders in spring 2015 to test for validity & reliability
- ▶ Test included only the 22 energy literacy questions

Fall 2014 results, n= 304

- ▶ Pre, post, one-month post test

Construct	Mean pre-test score	Std. Dev. pretest	Mean post-test score	Std. Dev. posttest	Mean one-month post-test score	Std. Dev. One-month posttest	Sig* pretest vs. posttest	Sig* posttest vs. one-month posttest	Sig* pretest vs. one-month posttest
Science Identity (75 points possible)	50.86	12.62	58.38	11.15	57.08	11.52	.000	.003	.000
Energy literacy (15 points possible)	6.70	2.72	7.50	2.71	8.12	2.98	.000	.000	.000

Fall 2014 results, n= 304

- ▶ Pre, post, one-month post test

Construct	Mean pre-test score	Std. Dev. pretest	Mean post-test score	Std. Dev. posttest	Mean one-month post-test score	Std. Dev. One-month posttest	Sig* pretest vs. posttest	Sig* posttest vs. one-month posttest	Sig* pretest vs. one-month posttest
Science Identity (75 points possible)	50.86	12.62	58.38	11.15	57.08	11.52	.000	.003	.000
Energy literacy (15 points possible)	6.70	2.72	7.50	2.71	8.12	2.98	.000	.000	.000

Spring 2015 results, n=508: Reliability

Mean	Median	Mode	Std deviation	Std error	Cronbach's alpha
10.86	11.0	11.0	3.01	0.135	0.473

22 points possible

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Mean	Median	Mode	Std deviation	Std error	Cronbach's alpha
10.86	11.0	11.0	3.01	0.135	0.473

22 points possible

Spring 2015 results, n=508

Question #	% correct	Question #	% correct	Question #	% correct
EL1	43.9	EL9	29.5	EL16	44.91
EL2	54.3	EL10	82.3	EL17	13.4
EL3	29.9	EL11	72.2	EL18	52.4
EL4	67.1	EL12	46.1	EL19	36.2
EL5	45.1	EL13	70.7	EL20	51
EL6	64.2	EL14	46.3	EL21	52
EL7	61.2	EL15	38	EL22	33.3
EL8	50			Average % Correct	52.24

Spring 2015 results, n=508: Item discrimination & reliability

- ▶ Measuring how well students score on questions based on their overall score
- ▶ Point biserial score was statistically significant for each question
- ▶ Item analysis by gender indicated only three questions resulted a statistically significant difference in which gender answered correctly
- ▶ Examined non-distractors (answer choices that were not selected/ too obviously incorrect). None!

Spring 2015 results, n=508: Item discrimination & reliability

No	Correct Group Responses			Point Biserial	Correct Group Responses			Point Biserial	Correct Answer	Response Frequencies - * indicates correct answer			Non Distractor
	Total %	male %	female %		upper 27%	lower 27%	A			A	B	C	
1	43.9	44.5	43	-0.041	62.8	27	0.306 a	224*		186		95	
2	54.3	53.7	54.9	0.041	71.7	36.5	0.31 a	276*		104		125	
3	29.9	30.5	29.4	52	39.3	19	0.167 a	153*		207		142	
4	67.1	69.1	64.7	-0.077	89	43.1	0.356 b		123 342*			42	
5	45.1	46	44.3	-0.043	55.2	29.2	0.204 a	229*		59		217	
6	64.2	67.3	60.4	-0.085	77.9	52.6	0.188 a	326*		62		119	
7	61.2	62.9	59.1	-0.066	82.8	40.1	0.351 b		118 311*			77	
8	50	52.9	46.4	0.007	70.3	34.3	0.31 a	254*		118		130	
9	29.5	33.5	25.1	-0.068	43.4	21.9	0.236 a	149*		303		52	
10	82.3	81.6	83	0.026	89.7	71.5	0.199 b		35 417*			52	
11	72.2	75	68.9	-0.009	85.5	51.8	0.333 b		59 368*			77	
12	46.1	46.3	46	-0.037	60.7	27	0.289 a	234*		99		166	
13	70.7	76.1	64.3	-0.038	86.9	55.5	0.311 b		98 359*			48	
14	46.3	50	41.7	-0.075	64.8	29.2	0.284 b		185 236*			83	
15	38	44.5	30.6	-0.098	57.9	20.4	0.311 b		66 194*			241	
16	44.9	46.7	42.6	-0.054	65.5	26.3	0.321 a	228*		211		63	
17	13.4	19.9	6	-0.113	22.8	10.9	0.179 c		262	167 69*			
18	52.4	47.2	56.6	-0.009	73.8	35.8	0.317 c		174				
19	36.2	33.2	39	-0.057	52.4	21.9	0.281 a	185*					
20	51	50.7	51.5							130			
21	52	59	43.4							88			
22	33	30	30.2							155			

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4	67.1	69.1	64.7	-0.077	89	43.1	0.356 b		123 342*			42	
5	45.1	46	44.3	-0.043	55.2	29.2	0.204 a	229*		59		217	
6	64.2	67.3	60.4	-0.085	77.9	52.6	0.188 a	326*		62		119	
7	61.2	62.9	59.1	-0.066	82.8	40.1	0.351 b		118 311*			77	
8	50	52.9	46.4	0.007	70.3	34.3	0.31 a	254*		118		130	
9	29.5	33.5	25.1	-0.068	43.4	21.9	0.236 a	149*		303		52	
10	82.3	81.6	83	0.026	89.7	71.5	0.199 b		35 417*			52	
11	72.2	75	68.9	-0.009	85.5	51.8	0.333 b		59 368*			77	
12	46.1	46.3	46	-0.037	60.7	27	0.289 a	234*		99		166	
13	70.7	76.1	64.3	-0.038	86.9	55.5	0.311 b		98 359*			48	
14	46.3	50	41.7	-0.075	64.8	29.2	0.284 b		185 236*			83	
15	38	44.5	30.6	-0.098	57.9	20.4	0.311 b		66 194*			241	
16	44.9	46.7	42.6	-0.054	65.5	26.3	0.321 a	228*		211		63	
17	13.4	19.9	6	-0.113	22.8	10.9	0.179 c		262	167 69*			
18	52.4	47.2	56.6	-0.009	73.8	35.8	0.317 c		174	66 265*			
19	36.2	33.2	39	-0.057	52.4	21.9	0.281 a	185*		178		139	
20	51	50.7	51.5	-0.035	70.3	27.7	0.352 c		130	112 260*			
21	52	59.2	43.4	-0.115	82.1	25.5	0.448 b		88 264*			146	
22	33.3	36	30.2	0.024	43.4	20.4	0.223 b		155 169*			177	

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What does this all mean?

- ▶ We can measure energy literacy in a few minutes!
- ▶ Students need energy education, mean literacy is 10.86/22
- ▶ Students gain from energy literacy education, both immediately after programming but continue to improve a month later!
- ▶ A little goes a long way!

Thank you! Questions?

