2016 Summary of Key Evidence for UCORE
Science Literacy Concept Inventory - Spring 2016

Prepared by the Office of Assessment of Teaching and Learning (ATL)

Background

Citizen-level science literacy involves being able to use scientific reasoning, assess the quality of sources of scientific information, understand the nature of scientific evidence and processes, and recognize how science literacy affects everyday life. WSU includes scientific literacy as one of its Seven Learning Goals for all undergraduates.

WSU's Science Literacy Goal and Outcomes of the Bachelor's Degree

Goal: Graduates will have a basic understanding of major scientific concepts and processes required for personal decision-making, participation in civic affairs, economic productivity and global stewardship.

Outcomes:

1. Identify scientific issues underlying global, national, local and personal decisions and communicate positions that are scientifically and technologically informed.
2. Evaluate the quality of scientific and health-related information on the basis of its source and the methods used to generate it.
3. Pose and evaluate arguments based on evidence and apply conclusions from such arguments appropriately.
4. Recognize the societal benefits and risks associated with scientific and technological advances.

Science Literacy Concept Inventory

The Science Literacy Concept Inventory (SLCI) measures the degree to which students recognize science as a way of knowing and employ science's framework of reasoning under circumstances that a citizen may encounter in everyday life. The SLCI was developed and validated by a multi-disciplinary team, from four California State University campuses and five science disciplines (Nuhfer et al. 2016), which distilled science literacy to twelve core concepts. Concepts and questions do not require specific knowledge in any science discipline, making it appropriate for any student regardless of major.

12 Concepts in the Science Literacy Concept Inventory:

1. Science explains physical phenomena based upon *testable* information about the physical world.
2. In modern life, science *literacy* is important to both personal and collective decisions that involve science content and reasoning.
3. *Doubt* plays necessary roles in advancing science.
4. Scientists use *evidence-based reasoning* to select which among several competing working hypotheses best explains a physical phenomenon.
5. A *theory* in science is a unifying explanation for observations that result from testing several hypotheses.
6. *Peer review* generally leads to better understanding of physical phenomena than can the unquestioned conclusions of involved investigators.
7. Science can test certain kinds of hypotheses through controlled *experiments*.
8. All science rests on fundamental assumptions about the *physical world*.
9. Science differs from *technology*.
10. Scientific knowledge is *discovered*, and some discoveries require an important history.
11. Science employs *modeling* as a method for understanding the physical world.
12. Scientific knowledge imparts power that must be used *ethically*.

SLCI Results Spring 2016

Context: A total of 461 students in 12 courses from Pullman, Tri-Cities and Vancouver campuses took the SLCI in Spring 2016. The results presented in this section represent the highest overall score of all unique individual students who submitted the SLCI in the Spring 2016. The results reported are not longitudinal, but represent a cross-section of students.

Science Literacy Concept Scores: Overall, seniors scored higher than freshman (average +12%) on the twelve science literacy concepts (Table 1).

Table 1

SLCI Average Score by Concept and Class Rank Spring 2016, All Unique WSU Participants (N=461)			
Science Literacy Concept	**Percent Correct Responses on SLCI**		
	Freshman (N=158)	**Senior (N=79)**	**Overall (N=461)**
1. Science explains physical phenomena based upon testable information about the physical world.	68%	85%	72%
2. In modern life, science literacy is important to both personal and collective decisions that involve science content and reasoning.	66%	74%	66%
3. Doubt plays necessary roles in advancing science.	77%	84%	77%
4. Scientists use evidence-based reasoning to select which among several competing working hypotheses best explains a physical phenomenon.	74%	88%	74%
5. A theory in science is a unifying explanation for observations that result from testing several hypotheses.	89%	89%	87%
6. Peer review generally leads to better understanding of physical phenomena than can the unquestioned conclusions of involved investigators.	66%	77%	65%
7. Science can test certain kinds of hypotheses through controlled experiments.	64%	79%	70%
8. All science rests on fundamental assumptions about the physical world.	68%	72%	69%
9. Science differs from technology.	33%	57%	39%
10. Scientific knowledge is discovered, and some discoveries require an important history.	69%	78%	71%
11. Science employs modeling as a method for understanding the physical world.	68%	82%	69%
12. Scientific knowledge imparts power that must be used ethically.	69%	84%	72%
Average Score	**67%**	**79%**	**69%**

Science Literacy Misconceptions: Concept inventories are often designed to reveal common misconceptions. Incorrect responses on the SLCI indicate student misconceptions about science literacy concepts (Table 2).

Table 2

Science Literacy Misconceptions Spring 2016, All Unique WSU Participants (N=461)	
Science Literacy Misconception	**Percent Incorrect Responses on SLCI**
Confuse science for technology	69%
Unable to identify an example of science generating better technology	52%
Unable to recognize assumptions important to all science given list of statements	49%
Unable to interpret results from a scientific study	41%
Fail to understand how scientists use reproducible experiments to confirm hypotheses	37%
Fail to understand the development of theory in science	37%
Cannot perceive the role of peer review in science.	35%
Fails to perceive relevance of understanding science's way of knowing to everyday life	34%
Fails to recognize modeling as a method of knowing in science	31%
Cannot distinguish science as the method of knowing and/or explaining the physical world through testable information	31%
Unable to distinguish an ethical response given an ethical dilemma	28%
Unable to explain how science employs the method of reproducible experiments to understand the physical world	24%
Misunderstands the role of doubt in science	23%
Fails to comprehend the nature of "theory" in science	16%
Misunderstands hypotheses: given several approaches to testing a hypothesis, one cannot discern which approach constitutes a legitimate test	15%
Fails to comprehend that human thoughts/beliefs about physical reality do not alter or suspend physical law	13%
Misunderstands hypotheses: given several statements, a person cannot discern which is a testable statement about the physical world	10%

SLCI Results 2013-2016

Context: A total of 3221 students from the Pullman, Vancouver and Tri-Cities campuses participated in Fall 2013, Spring 2014, Spring 2015, and Spring 2016. Participating courses at the 100/200-level included fourteen UCORE *inquiry in the natural sciences* [BSCI] [PSCI] [SCI] courses and three other courses in science disciplines. Participating courses at the 300/400-level included five UCORE *integrative capstone* [CAPS] courses in science disciplines, six other courses in science disciplines, and three courses in non-science disciplines. The results represented below are the highest overall score of all unique students. The results reported are not longitudinal, but represent a cross-section of students.

Science Literacy Concept Scores by Class Rank and Major: Seniors scored higher than freshmen on all twelve science literacy concepts (Table 3). This difference was true of both science majors and non-majors.

Table 3

SLCI Average Score by Concept, Class Rank, and Major 2013-2016*, All Unique WSU Participants (N=3221)

Science Literacy Concept	Percent Correct Responses on SLCI				
	Freshman Non-Science Major (N=560)	Freshman Science Major (N=476)	Senior Non-Science Major (N=196)	Senior Science Major (N=323)	Overall: All Majors/ Levels (N=3221)
1. Science explains physical phenomena based upon testable information about the physical world.	66%	70%	77%	87%	71%
2. In modern life, science literacy is important to both personal and collective decisions that involve science content and reasoning.	63%	67%	70%	78%	67%
3. Doubt plays necessary roles in advancing science.	72%	75%	79%	88%	76%
4. Scientists use evidence-based reasoning to select which among several competing working hypotheses best explains a physical phenomenon.	66%	75%	77%	88%	72%
5. A theory in science is a unifying explanation for observations that result from testing several hypotheses.	84%	84%	89%	93%	85%
6. Peer review generally leads to better understanding of physical phenomena than can the unquestioned conclusions of involved investigators.	63%	63%	75%	78%	65%
7. Science can test certain kinds of hypotheses through controlled experiments.	62%	64%	71%	81%	67%
8. All science rests on fundamental assumptions about the physical world.	66%	68%	74%	72%	69%
9. Science differs from technology.	31%	38%	39%	51%	37%
10. Scientific knowledge is discovered, and some discoveries require an important history.	66%	68%	73%	82%	70%
11. Science employs modeling as a method for understanding the physical world.	60%	70%	71%	85%	67%
12. Scientific knowledge imparts power that must be used ethically.	65%	67%	76%	84%	70%
Average Score	**64%**	**67%**	**73%**	**81%**	**68%**

**Includes all unique students from Fall 2013, Spring 2014, Spring 2015, and Spring 2016*

Science Literacy Concept Scores by Number of Science Courses Completed: Scores on all twelve science literacy concepts increased with the number of science courses completed (Table 4).

Table 4

SLCI Average Score by Concept and Number of Science Courses Completed 2013-2016*, All Unique WSU Participants (N=3221)					
Science Literacy Concept	**Percent Correct Responses on SLCI**				
	None Completed (N=544)	**One/Two Completed (N=1349)**	**Three/Four Completed (N=578)**	**More than Four Completed (N=726)**	**Overall (N=3221)**
1. Science explains physical phenomena based upon testable information about the physical world.	64%	67%	75%	83%	71%
2. In modern life, science literacy is important to both personal and collective decisions that involve science content and reasoning.	59%	66%	67%	76%	67%
3. Doubt plays necessary roles in advancing science.	69%	72%	78%	85%	76%
4. Scientists use evidence-based reasoning to select which among several competing working hypotheses best explains a physical phenomenon.	64%	68%	75%	84%	72%
5. A theory in science is a unifying explanation for observations that result from testing several hypotheses.	79%	84%	87%	91%	85%
6. Peer review generally leads to better understanding of physical phenomena than can the unquestioned conclusions of involved investigators.	60%	62%	66%	73%	65%
7. Science can test certain kinds of hypotheses through controlled experiments.	60%	64%	70%	77%	67%
8. All science rests on fundamental assumptions about the physical world.	63%	67%	72%	73%	69%
9. Science differs from technology.	31%	34%	36%	45%	37%
10. Scientific knowledge is discovered, and some discoveries require an important history.	62%	67%	71%	80%	70%
11. Science employs modeling as a method for understanding the physical world.	59%	64%	67%	80%	67%
12. Scientific knowledge imparts power that must be used ethically.	61%	67%	71%	80%	70%
Average Score	**61%**	**65%**	**70%**	**77%**	**68%**

**Includes all unique students from Fall 2013, Spring 2014, Spring 2015, and Spring 2016*

Science Literacy Scores Compared to National Study: Overall SLCI scores at WSU were similar to those of the 2011-13 National Study and increased with class rank and the number of science courses completed (Table 5).

Table 5

WSU SLCI Average Score Compared to National Study 2013-2016*, All Unique WSU Participants (N=3221)		
Category	**Average SLCI Score**	
	WSU (2013-2016*)	**National (2011-2013)**
Class Rank		
Freshman/Sophomore	65%	68%
Junior/Senior	72%	72%
Number of Science Courses Completed		
None	61%	66%
One/Two	65%	69%
Three/Four	70%	70%
More than Four	77%	77%

**Includes all unique students from Fall 2013, Spring 2014, Spring 2015, and Spring 2016*