

# Assessment/Program Evaluation

## Program Evaluation-Research Plan

The Program Evaluation-Research Plan for the Foundations of Science (FoS) QEP Initiative is a recursive five-year strategy for the integrated evaluation of FoS Initiative outcomes, implementation, assessment instruments and assessment processes. The plan blends formative and summative assessment tactics and is designed to encourage improvements in students' science literacy, critical thinking skills & attitudes towards science, in both the FoS Initiative, and the larger institution. The plan provides for timely, iterative reflection upon the results of student learning assessment, within the context of the Initiative's implementation progress. It also provides for self-correcting examination of the assessment processes through which evidence is generated. The University Director of Institutional Research and Assessment will lead the execution of the FoS Program Evaluation Plan, outlined below, in close partnership with the Chair of the QEP Science Committee and designated members of the Science Committee.

Program Evaluation-Research Plan objectives include:

- Assessing the success of the FoS Initiative at improving students' science literacy, critical thinking skills & attitudes towards science...
  - by comparing the measured learning outcomes of its participants to the measured student outcomes identified as a Pre-Treatment Baseline
  - by comparing the measured learning outcomes of its participants to the measured student outcomes of Concurrent Comparison Groups.
  - by comparing the value-added contribution that the FoS Initiative has made to the preexisting knowledge and competence of participating students since their entry into the course.
- Monitoring the consistency of...
  - FoS Initiative implementation strategies
  - assessment procedures and the assessment instruments used
  - potentially influential conditions external to the FS initiative
- Providing integrated feedback on assessment and monitoring
  - to help interpret assessment results
  - to help validate assessment outcomes
  - to explain unexpected outcomes
  - to suggest improvements in initiative strategies, in assessment processes, and in implementation conditions

In addition to assessing FoS student learning outcomes, the Program Evaluation-Research Plan activities will include:

- Periodic observation and regular documentations of FoS implementation strategies and conditions, to capture inadvertent and intentional changes
- Review and evaluation of Assessment tools and procedures at least once each year by their users; by the QEP committee's Student Advisory Committee, and by the FoS Committee, for purpose of assuring validity and reliability, and for improving measurement, if needed.
- Reporting assessment results to the FoS Committee after Fall and Spring semesters, and discussing results in relation to any implementation changes in the Initiative
- Comprehensively reporting assessment results in relation to any changes in Initiative implementation or conditions in an Annual Review Meeting,.
- Assisting the FOS Committee with preparations to share summations of progress discussed at the Annual Review Meeting with the university community for feedback.
- Integrating documentation of the QEP assessment process into the university's ongoing evaluation process, by including the QEP outcomes assessment in the university's Online Assessment Tracking Database (OATDB).
- Contributing, as needed, to plans for improving the FS Initiative, as well as to any institutional plans to build upon FoS strategies,.

- Synthesizing work-in-progress and summative evidence from student outcomes assessment, process evaluation and systemic impact evaluation, with faculty and administrators, to develop reports, papers, presentations and web publications for public dissemination.

### Student Outcome Assessment Instruments and Measures

As mentioned earlier, student learning outcome assessments within the Program Evaluation Research Plan include: pre-testing, post-testing and measuring pre-to-post improvement; comparing FoS Initiative learning outcomes with Pre-FoS student learning outcome baselines; and comparing FoS Initiative student learning outcomes with learning outcomes of comparable students participating in alternative science courses. FoS QEP assessment instruments include two nationally normed instruments, two locally constructed tools, one class-embedded assessment tool and two institutional tracking measures.

The table below lists, and briefly describes the complete list of FoS Assessment Measures included in the Program Evaluation-Research Plan:

<b>Foundations of Science Initiative Assessment Instruments and Measures</b>		
<b>CAT</b>	<b>The Critical Thinking Achievement Test (CAT)</b>	Critical thinking Assessment Test (CAT) is a standardized test, externally developed with NSF support, consisting of 15 questions, most of which are short response. These questions involve real-world problems that students find interesting and engaging. The test was designed to measure those components of critical thinking that are considered most important by faculty members across disciplines.
<b>FSE</b>	<b>Locally-developed Foundations of Science Exam (FSE)</b>	The locally developed Foundations of Science Exam (FSE) is a 53-question instrument designed to measure student dispositions toward critical thinking, overall understanding of the scientific method, basic scientific literacy and the nature of science, and critical thinking.
<b>FSCCG</b>	<b>FS/FS-Comparison - Course Grades (FSCCG)</b> <ul style="list-style-type: none"> <li>• <b>Measured Indicator</b></li> </ul>	The academic performance of students in the <i>Foundations of Science</i> course will be compared to both baseline data, as well as to the performance of students in comparison groups who did not take the <i>Foundations of Science</i> course within the same time periods. This will help determine if students in the <i>Foundations of Science</i> course master the learning required of their particular science course better, or as well as, <i>comparable</i> students in comparison courses. FS vs. non-FS students' course grades will be analyzed for students who have been matched and grouped on background and preparation variables (i.e., SAT/ACT; HS %ile rank; major type; previous science; remediation at SHSU; classification; etc.)
<b>FSSS</b>	<b>Foundations of Science Survey of Students (FSSS) -- Dispositions toward Critical Thinking</b> <ul style="list-style-type: none"> <li>• <b>Measurement Instrument</b></li> </ul>	Within the locally developed Foundations of Science Exam (FSE) there are subsets of items in survey form. This sub-section of the FSE, entitled, Foundations of Science Survey of Students (FSSS) contains a subset of questions related to student dispositions toward critical thinking. This subset of questions is designated as the FSSS- <i>Dispositions toward Critical Thinking sub-section</i>

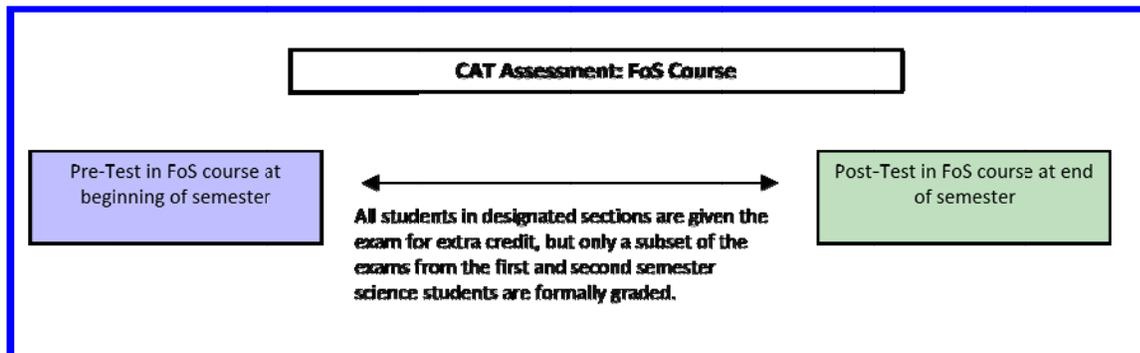
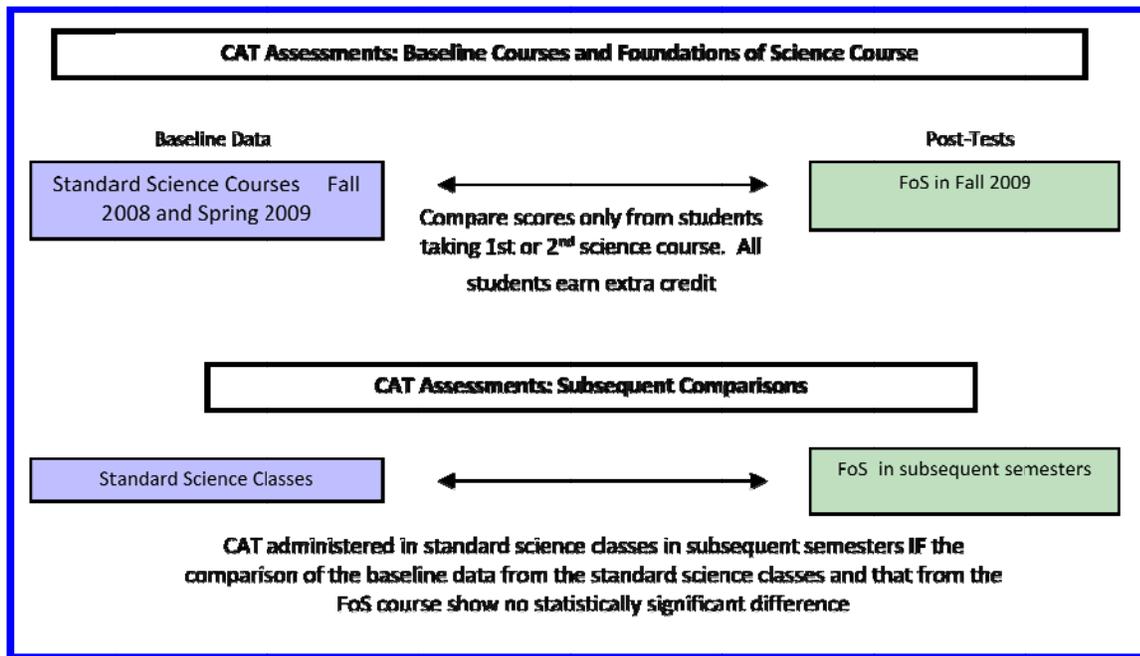
<b>NSG</b>	<b>Grade in Next Core Curriculum Science Course (NSG)</b> <ul style="list-style-type: none"> <li>• <b>Measured Indicator</b></li> </ul>	Students taking the <i>Foundations of Science</i> course for their first science class will be flagged, and their performance in their next Core Curriculum science course will be tracked. These results will be compared to second science course performance of students in the comparison groups, who did not take the <i>Foundations of Science</i> as their first science class. This will help determine if the <i>Foundations of Science</i> course contributed to better performance in the students' second science course.
<b>IDEA</b>	<b>IDEA Survey (IDEA)</b> <ul style="list-style-type: none"> <li>• <b>Measurement Instrument</b></li> </ul>	The IDEA System is a commercial assessment product of the IDEA Center of Kansas State University and is used nationally by hundreds of universities each semester. The IDEA system will be used to measure students' motivation and desire to take the courses in which they are enrolled, as well as their perception of their improvement in critical thinking. IDEA responses in these areas will be compared to existing baseline scores for the standard science courses, as well as with concurrent comparison group responses.
<b>TiLCHeRS</b>	<b>TiLCHeRS embedded assignment (TiLCHeRS)</b> <ul style="list-style-type: none"> <li>• <b>Measurement Instrument</b></li> </ul>	The TiLCHeRS is an embedded classroom homework assignment that will be given on more than one occasion during the semester to students taking the <i>Foundations of Science</i> course. This assignment incorporates five of the six objectives of the course; i.e. all but the objective pertaining to the "appreciation of science."

### Highlights of the Student Outcome Assessment Process

#### **The Critical Thinking Achievement Test (CAT)**

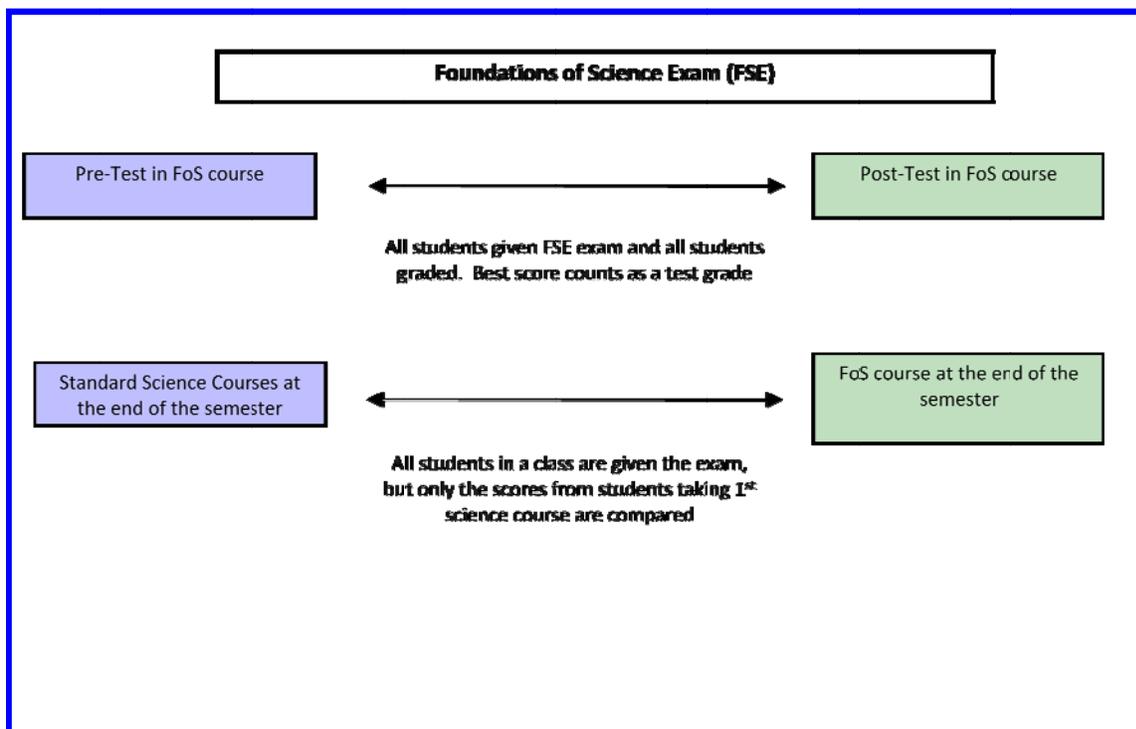
The Critical thinking Assessment Test (CAT) is a nationally normed standardized test, which consists of 15 questions, most of which require a short answer response. The questions on the CAT involve real-world problems that students find interesting and engaging, contributing to their motivation to do well. The test was designed to measure those components of critical thinking that are considered most important by faculty members across disciplines. These critical thinking skills are listed below:

- 1) Separate factual information from inferences that might be used to interpret those facts.
- 2) Identify inappropriate conclusions.
- 3) Understand the limits of correlational data.
- 4) Identify evidence that might support or contradict a hypothesis.
- 5) Identify new information that is needed to draw conclusions.
- 6) Separate relevant from irrelevant information when solving a problem.
- 7) Learn and understand complex relationships in an unfamiliar domain.
- 8) Interpret numerical relationships in graphs and separate those relationships from inferences.
- 9) Use mathematical skills in the context of solving a larger real world problem.
- 10) Analyze and integrate information from separate sources to solve a complex problem.
- 11) Recognize how new information might change the solution to a problem.
- 12) Communicate critical analyses and problem solutions effectively.



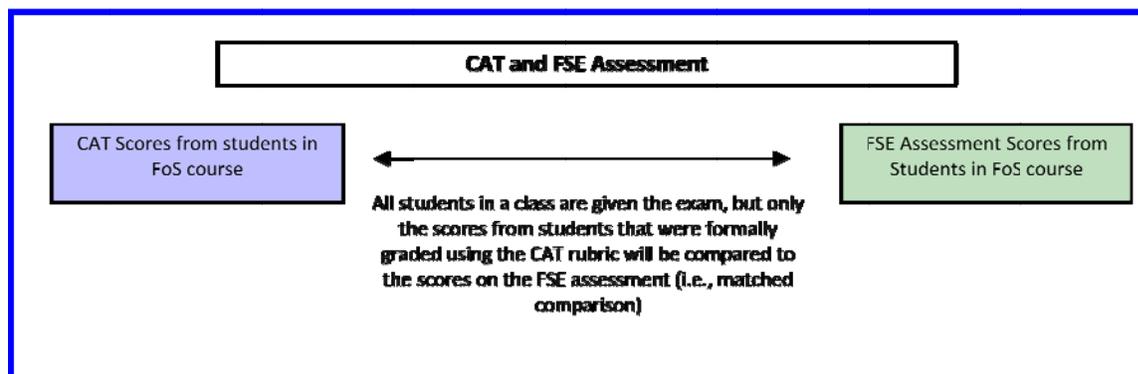
### Locally Developed FoS Assessment (FSE)

In addition to the assessments based on the CAT instrument, the Science Committee developed its own locally developed, multiple-choice instrument called the Foundations of Science Exam (FSE) for measuring overall understanding of the scientific method, the nature of science, and critical thinking. This test will be given to students at the beginning and at the end of the semester and will, therefore, serve as a pre-test/post-test assessment within the FoS course



### Comparing Assessments of Locally Develop FSE to Standardized CAT

In addition, the grades on these exams, taken at the end of the semester, can be compared to those on the CAT exam to determine their level of correlation. This comparison will be a matched comparison; i.e., the scores for the students that were formally-graded using the CAT exam will be compared to the scores of the same students after they have taken the Foundations of Science Exam (FSE) at the end of the semester.



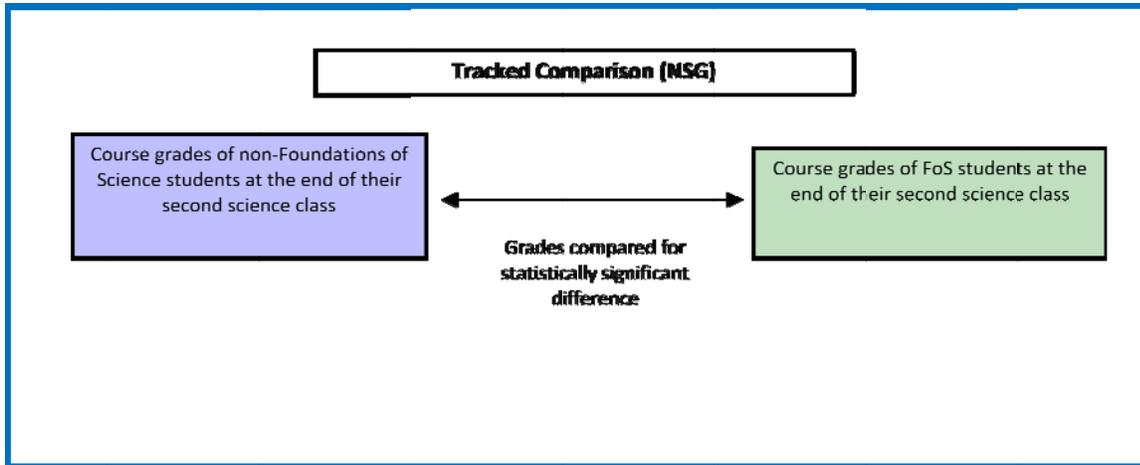
### Embedded Assessments (TiLCHeRS)

As with any course, students in the FoS course will be given a combination of homework assignments and tests during the semester, which also will serve to indicate their level of learning. These tests and assignments will include both critical thinking components and specific questions concerning the science content of the course.

One of the key assignments that will be given during the course is the TiLCHeRS assignment, which incorporates five of the six objectives of the course. It is an excellent means of evaluating students' understanding of course material.

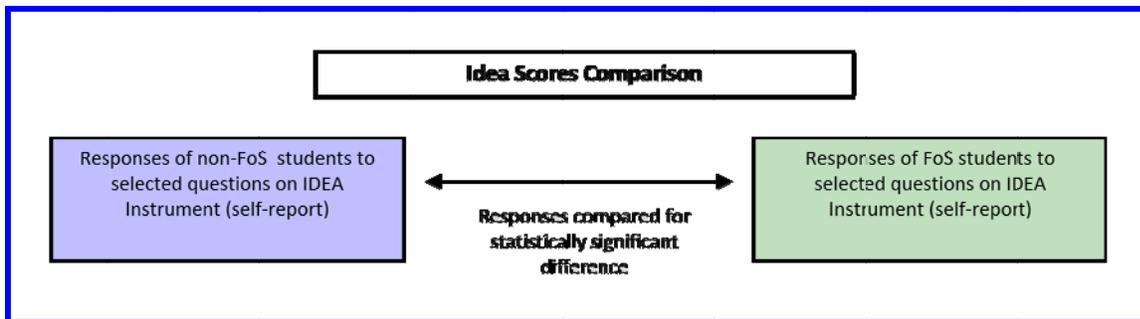
### Tracking and Comparing Student Performance in Subsequent Science Classes (NSG)

The academic performance of students that take the FoS course as their first science class will be subsequently compared to that of students that did not take the course. This assessment will employ a measured indicator, descriptively entitled “Grade in Next Core Curriculum Science Course” (NSG) in the Program Evaluation-Research Plan. This assessment will require a form of ‘tracked assessment’ in which the grades earned by FoS students in their second science course are compared to those of students who are also in their second science course, but who did not take the FoS course. This will be done to determine if the FoS course resulted in better performance in the second science course. This assessment will require that the FoS students be ‘tagged’ so that they can be tracked and distinguished from those students who did not take the course, but who are also completing their second science course.



### Comparing Student Attitudes in FoS Classes with Baseline Attitudes in Pre-FoS Classes (IDEA)

Finally, as an indicator of enthusiasm for the course, the responses on the IDEA course evaluation instrument concerning the students’ motivation and desire to take the course, as well as their perception of their improvement in critical thinking, will be compared to the existing, baseline scores for the standard science course.



### Overview of All Student Outcome Assessment

A comprehensive view of all student outcome assessment in the FOS Program Evaluation-Research Plan is presented in the table below:

## Program Evaluation-Research Plan

### Student Outcomes Assessment Plan

Goal: Improvement of Students' Science Literacy, Critical Thinking Skills & Attitudes Towards Science.

Targeted Student Learning Outcomes (SLOs)	SLO Assessment Instruments & Indicators <sup>3</sup>	Who will be Measured?					
		Pre-Treatment Baseline Comparison Group		Foundations of Science Course Treatment Group		Concurrent Foundations of Science Comparison Course Group	
		Measures Used	When?	Measures Used	When?	Measures Used	When?
1. Apply scientific terminology pertaining to the nature and conduct of science	<ul style="list-style-type: none"> <li>Locally-developed Foundations of Science Exam (FSE)</li> <li>The Critical Thinking Achievement Test (CAT)</li> <li>TiLCHeRS embedded assignment (TiLCHeRS)</li> </ul>	FSE  CAT	F08,S09  F08,S09 Pre-Post	FSE  CAT  TiLCHeRS	F09-F13  F09-F13 Pre-Post  F09-F13	FSE  CAT	F09-F13  F09-S10 Pre-Post
2. Apply methods of reasoning used by scientists	<ul style="list-style-type: none"> <li>Locally-developed Foundations of Science Exam (FSE)</li> <li>The Critical Thinking Achievement Test (CAT)</li> <li>IDEA Survey (IDEA)</li> <li>TiLCHeRS embedded assignment (TiLCHeRS)</li> </ul>	FSE  CAT  IDEA	F08,S09  F08,S09 Pre-Post  F05-S08	FSE  CAT  IDEA  TiLCHeRS	F09-F13  F09-F13 Pre-Post  F09-F13  F09-F13	FSE  CAT  IDEA	F09-F13  F09-S10 Pre-Post  F09-F13
3. Analyze and evaluate common logical fallacies and perceptual biases that interfere with the ability to draw reasonable and/or correct conclusions	<ul style="list-style-type: none"> <li>Locally-developed Foundations of Science Exam (FSE)</li> <li>The Critical Thinking Achievement Test (CAT)</li> <li>Foundations of Science Survey of Students (FSSS)- <i>Dispositions toward Critical Thinking</i></li> </ul>	FSE  CAT  FSSS	F08,S09  F08,S09 Pre-Post  F08,S09	FSE  CAT  FSSS	F09-F13  F09-F13  F09-F13	FSE  CAT  FSSS	F09-F13  F09-S10 Pre-Post  F09-F13

4. Understand key concepts and theories from a variety of scientific disciplines	<ul style="list-style-type: none"> <li>Locally-developed Foundations of Science Exam (FSE)</li> <li>TiLCHeRS embedded assignment (TiLCHeRS)</li> <li>IDEA Survey (IDEA)</li> <li>FS/FS Comparison -Course Grades (FSCCG)</li> <li>Grade in Next Core Curriculum Science Course (NSG)</li> </ul>	FSE	F08,S09	FSE	F09-F13	FSE	F09-F13
				TiLCHeRS	F09-F13		
		IDEA	F05-S08	IDEA	F09-F13	IDEA	F09-F13
		FSCCG	AY04-08	FSCCG	F09-F13	FSCCG	F09-F13
				NSG	F09-F13	NSG	F09-F13
5. Apply knowledge about science to evaluation of extraordinary claims	<ul style="list-style-type: none"> <li>Locally-developed Foundations of Science Exam (FSE )</li> </ul>	FSE	F08,S09	FSE	F09-F13	FSE	F09-F13
6. Distinguish science from pseudoscience by scientifically evaluating a wide variety of extraordinary claims	<ul style="list-style-type: none"> <li>Locally-developed Foundations of Science Exam (FSE)</li> <li>Foundations of Science Survey of Students (FSSS)- <i>Dispositions toward Critical Thinking</i></li> </ul>	FSE	F08,S09	FSE	F09-F13	FSE	F09-F13
		FSSS	F08,S09	FSSS	F09-F13	FSSS	F09-F13
7. Appreciate the role of science in our lives and the need for scientific literacy and critical thinking	<ul style="list-style-type: none"> <li>IDEA Survey (IDEA)</li> <li>Foundations of Science Survey of Students (FSSS)- <i>Dispositions toward Critical Thinking</i></li> </ul>	IDEA	F05-S08	IDEA	F09-F13	IDEA	F09-F13
		FSSS	F05-S08	FSSS	F09-F13	FSSS	F09-F13

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