Science Curriculum Innovations

“Engaging the next generation in scientific inquiry.”
Mission Statement
Science Curriculum Innovation’s mission is to enhance literacy and writing skills in science classrooms. We support teachers in guiding students on how to write unbiased, original scientific and technical writing pieces with abstracts. LAWS: Literacy and Writing in Science is a supplemental science curriculum, aligned to both Common Core State Standards and the Next Generation Science Standards and designed to enhance 21st century learning skills (communication, collaboration, critical thinking, and creativity).

Writing in Science is Different

| Constructing a Testable Hypothesis       | ✓ |
| Determining Credible Resources           | ✓ |
| Analyzing Evidence that Proves or Refutes a Hypothesis | ✓ |
| Formulating Scientific Conclusions with Supporting Statements | ✓ |
| Avoiding Bias                            | ✓ |
| The Reasoning Linking the Claim to the Evidence is Strong | ✓ |
| All of the Evidence is Used, Not Just Selected Portions of the Evidence | ✓ |
| Appropriate Quality & Quantity of Evidence is Used to Support Explanations | ✓ |
The LAWS curriculum includes:

* CCSS & NGSS alignment with each LAWS problem.

* KUD models based on Tomlinson & McTighe's *Understanding by Design*.

* Differentiated materials to support all learners.

  Supported Analysis
  Critical Analysis
  Open Analysis

* High quality, current research articles in each field of study.

* Maps, charts, and engaging visuals.

* Outlines, rubrics, and writing support tools.
Developed by teachers for teachers...

**LAWS Volume I: Integrated Sciences**

- The SETI Project: Worthwhile or a Waste of Time?
- Nuclear Energy: Environmental Solution or Death Trap?
- Genetically Modified Organisms: Solving World Hunger or Holding the World Hostage?
- Obesity: Life-Threatening Disease or Lifestyle Choice?
- Hydraulic Fracturing: Vehicle to Fuel Independence or Environmental Catastrophe?
- What Are Causes For the Formation of Sinkholes?
- Genetic Engineering: Designing the “Perfect” Child

**LAWS Volume II: Biological Sciences**

- Research Using Human Embryonic Stem Cells: A Social or Scientific Controversy?
- Artificial Sweeteners: Healthy or Harmful?
- Immunizations: Saving or Condemning the Child?
- Industrial Farm Animal Production: Global Solution or Global Affliction?
LAWS Problem
The SETI Project: Worthwhile or a Waste of Time?
What’s All the Hype?

On September 5, 1977 NASA launched a 722 kilogram space probe named Voyager I to study the outer solar system and hopefully interstellar space. Currently, it is the farthest man-made object from Earth.

The Voyager I payload carries a gold-plated audio-visual record carrying photos of Earth and its life-forms, scientific information, sounds of Earth (waves breaking on a shore, a baby crying, whale sounds, etc.), a collection of music from around the globe, and spoken greetings.

If the probe is ever found by intelligent life forms from other planets, the hope is that the life-form could decipher and interpret the recordings.

One of the greetings on the Voyager I gold record was an official statement from the then current president of the United States, Jimmy Carter. Read the President’s message and write your reflections in the chart provided. Be prepared to share out.

“Our cast this message into the cosmos ... Of the 200 billion stars in the Milky Way galaxy, some – perhaps many – may have inhabited planets and space faring civilizations. If one such civilization intercepts Voyager and can understand these recorded contents, here is our message: We are trying to survive our time so we may live into yours. We hope some day having solved the problems we face, to join a community of Galactic Civilizations. This record represents our hope and our determination and our goodwill in a vast and awesome universe.”


<table>
<thead>
<tr>
<th>President Jimmy Carter’s Statement</th>
<th>What is the underlying meaning behind the President’s statement?</th>
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</thead>
<tbody>
<tr>
<td>We are trying to survive our time so we may live into yours...</td>
<td></td>
</tr>
<tr>
<td>We hope some day...to join a community of Galactic Civilizations...</td>
<td></td>
</tr>
<tr>
<td>...our hope...in a vast and awesome universe.</td>
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Research for the Problem
The Search for Extraterrestrial Life

The ancient Greeks, fascinated with observing the night sky, noticed celestial bodies wandering across the heavens and named them planets. In the early understanding of space, philosophers and church leaders embraced Claudius Ptolemy’s geocentric notion of space proposing that our earth is surrounded by the sun and the other planets with God and heaven lying beyond. His theory endured in religious and secular studies until Nicolaus Copernicus proposed his revolutionary heliocentric theory that the sun is the center of the solar system.

Since then, humankind has been seeking to answer questions about space and whether we are alone in the universe. Given the number of solar systems and exoplanets currently being discovered, exobiologists, astrophysicists, and mathematicians all agree that statistically there should be planets in the universe other than Earth that sustain some type of life. In order to make contact with these other civilizations requires the development of technology and the capital to fund these projects.

In the early 1900’s, Giuglielmo Marconi, inventor of the first wireless telegraph, was conducting tests for long range terrestrial communication using a technological device of his time known as the radio. With this device, Marconi believed that he had observed radio signals coming from space. This belief sparked the search to find extraterrestrial intelligent life (ETI) in the cosmos and the fervor to discover alien life-forms began.

In 1975, NASA began the modern Search for Extraterrestrial Intelligence (SETI) program aimed at listening for radio signals from outer space. The hope was the discovery of civilizations that have evolved and currently occupy other planets within our celestial neighborhood. In the 1980’s the validity of both the science and the search for ETI were called into question and congressional funding was suspended. At this time, the SETI Institute (located in Northern California) was formed with the help of private donations. However after the science was determined to be sound and considered worthwhile, the funding was reinstated only to be cancelled again in the early 1990’s amid a federal budget crisis.

After congressional funding was pulled, The Institute began a new program, in 1995 using borrowed time on various deep space radio antennae operating around the world. In 2007, their own listening equipment called the Allen Telescope Array (ATA) was built with a private donation from Paul Allen (co-founder of Microsoft) and began operating.

While the search for ETI is ongoing worldwide in Russia, China, Italy, and most recently in Great Britain to name a few, many debates continue regarding whether or not listening for and sending Earth’s own signals out into space is worthwhile or a waste of time. LAWS poses the following scientific writing challenge: 1. Create a hypothesis answering the problem: The SETI Project: Worthwhile or a Waste of Time? 2. Read and analyze the Data Files presented in order to answer the question. 3. Write your arguments to support or refute your hypothesis.
<table>
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<tr>
<th>Text Dependent Questions…</th>
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<tr>
<td>Analysis of the Research and Student Hypothesis</td>
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1. Define the following terms:
   - Celestial bodies
   - Geocentric
   - Heliocentric
   - Exoplanets
   - Exobiologists
   - Capital
   - Terrestrial
   - Extraterrestrial
   - Cosmos
   - Array

2. Who proposed the geocentric model of the solar system?

3. What is the modern model of the solar system that we use today?

4. What did Marconi believe he had observed with his radio communications tests?

5. What was the result of NASA losing its congressional funding for the SETI program?

Student Hypothesis
**Data File #3: Beneficial, Neutral, or Harmful?**

**Source:** Seth D. Baum et. al. *Would Contact with Extraterrestrials Benefit or Harm Humanity? A Scenario Analysis.* Department of Geography, Pennsylvania State University. 2011.

<table>
<thead>
<tr>
<th>Beneficial</th>
<th>Neutral</th>
<th>Harmful</th>
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<tbody>
<tr>
<td><strong>Mere Detection</strong></td>
<td><strong>Invisible to Us</strong></td>
<td><strong>Intentional Harm</strong></td>
</tr>
<tr>
<td>-Philosophical implications</td>
<td>-Intentionally Hiding</td>
<td>-Selfish ETI</td>
</tr>
<tr>
<td><strong>Cooperative extraterrestrials</strong></td>
<td>-Unintentionally escape our Notice</td>
<td>ETI eat us</td>
</tr>
<tr>
<td>-Discussion of science and mathematics</td>
<td>-Different Form of existence</td>
<td>ETI enslave us</td>
</tr>
<tr>
<td>-Advice for avoiding global catastrophe</td>
<td>-No Desire to Communicate</td>
<td>ETI attack us</td>
</tr>
<tr>
<td>-Solutions to problems on Earth</td>
<td></td>
<td>-Universalist ETI</td>
</tr>
<tr>
<td><strong>Uncooperative Extraterrestrials</strong></td>
<td><strong>Noticeable but indifferent</strong></td>
<td>-To improve galactic Infrastructure</td>
</tr>
<tr>
<td>-Humanity successfully overcomes a threat</td>
<td>-Uninteresting and non-useful</td>
<td>-To more efficiently use our Resources</td>
</tr>
<tr>
<td></td>
<td>-Mild nuisance</td>
<td>-If we are seen as a threat</td>
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**Supported Analysis:**

1. List and compare the hypothetical ways extraterrestrials would cause harm to humans?

2. Explain the meaning of “uninteresting and non-useful.”

3. Explain what “philosophical implications” could exist for the existence of extraterrestrial life.

4. Based on this *Data File*, what argument can be made that the SETI Project is worthwhile?

5. Based on this *Data File*, what argument can be made that the SETI Project is a waste of time?
**Scaffolding to Support All Learners…**

### Data File #4: Are We Alone?

<table>
<thead>
<tr>
<th><strong>Source:</strong> From SETI Institute website, <em>Zookeepers, Alien Visitors, or Simple Life: How Can We Explain Our Isolation?</em> SETI Institute, 2013.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Source:</strong> Moskowitz, Clara. Senior Writer at Space.com. <em>Do We Dare Let Aliens Know We’re Here?</em> 2010.</td>
</tr>
</tbody>
</table>

We seem to have the Galaxy to ourselves. At least, that’s the obvious conclusion from the apparent lack of aliens in the neighborhood. But this conclusion might be a bit too obvious, and possibly wrong. In previous articles, we’ve considered why extraterrestrial intelligence even if common would have restrained itself from spreading to every half-decent star system in the Galaxy. Its possible that the aliens have done cost-benefit analyses that show interstellar travel to be too costly or too dangerous to warrant ambitious colonization efforts. An alternative suggestion that would explain our apparent solitude is that the Galaxy is urbanized, and we’re in a dullsville suburb.

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**Critical Analysis:**

1. Using the *Data File* as evidence, what argument can be made that the SETI Project is worthwhile?

2. Using the *Data File* as evidence, what argument can be made that the SETI Project is a waste of time?
File the Data Sample:
The SETI Project: Worthwhile or a Waste of Time?

Read each of the following Data Files. Ponder, discuss, and determine which category the evidence should be placed into and place a tic mark in the appropriate box. After you analyze the evidence, create purpose statements in your own words for each file. Then list the data file that will give support to the validity of each purpose statement.

**Evidence is recorded as students analyze the Data Files. Scientific decisions should be determined based on the weight of the evidence.**

**Students determine a conclusion to the hypothesis based on the amount of supporting or discrediting evidence from Data File analysis.**

**Purpose statements are formed as Data Files are analyzed.**

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<table>
<thead>
<tr>
<th>Evidence</th>
<th>Purpose Statement</th>
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<tbody>
<tr>
<td>✓✓✓✓✓</td>
<td>SETI will help us increase our knowledge and understanding about extrasolar</td>
</tr>
<tr>
<td>✓✓✓✓✓</td>
<td>We still have not found any life after more than half a century.</td>
</tr>
<tr>
<td>✓✓✓✓✓</td>
<td>Based on Sagan, we have not researched thoroughly; if we do not look, we will not know if they are out there.</td>
</tr>
<tr>
<td>✓✓✓✓✓</td>
<td>Ernst Mayr saw that there were no results and the probability of getting results is low.</td>
</tr>
<tr>
<td>✓✓✓✓✓</td>
<td>ETI can help us benefit by leading us to solving earthly problems, etc.</td>
</tr>
<tr>
<td>✓✓✓✓✓</td>
<td>The ETI can harm us and be a huge threat to the human race.</td>
</tr>
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“...By addressing the science practices standards together with discipline-specific concepts, teachers help students to deepen their understanding of the science content knowledge and to use this knowledge to think about new situations and novel problems — an important skill for college success. The integration of these two dimensions of scientific knowledge will also help students understand and engage in the science practices that develop, extend and refine the science content knowledge they are learning — key goals set by both the National Science Education Standards (National Research Council, 1996) and the Benchmarks for Science Literacy (American Association for the Advancement of Science, 1993).”

“Whether asked to justify, explain, predict, or describe, students must clearly articulate their understanding of the key biological principle(s) or concept(s) underlying the phenomenon being investigated. In short, to be successful on the AP Biology Exam, students must clearly connect a biological concept to a larger big idea or enduring understanding while using designated science practices and skills. On the exam, students must make claims and defend them — providing evidence as part of their reasoning. This should include making appropriate and insightful connections across big ideas and/or enduring understandings.”

Professional Development Available to Support Teachers

Professional development is highly encouraged to support teachers in effectively implementing LAWS curriculum for ultimate success. Training is available for districts in a variety of delivery methods.

- **On-Site Professional Development:** Presented by the creators of the LAWS curriculum. LAWS On-site professional development is an intensive training opportunity designed to ensure confidence and success in implementing the LAWS curriculum. Participants will be taken step-by-step through the LAWS curriculum process on a multi-day, hands-on training experience. This option is the ideal training opportunity for small groups or even an entire staff.

- **On-Going Coaching Support:** Ongoing coaching support is provided to target specific professional learning goals. On going coaching is designed to keep educators on the path to success. The option is suitable for smaller intimate groups who wish to delve into hands on training.

For more information
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