EDUCATOR'S GUIDE

Astrobiology: Does Extraterrestrial Life Exist?

Disney Presents the Eyes of Nye

For six seasons, millions of students came to understand, appreciate and enjoy the exploration of science through the series, *Bill Nye the Science Guy*. Bill returns with *The Eyes of Nye*, a more in-depth look at science subjects making news, changing lives, and impacting policy. From the future of alternate fuel sources and genetic engineering to population growth trends and issues of race, Bill and his expert cohorts bring science to life right in your classroom, helping you **Motivate** investigation; **Assess** available information; and **Propose** lines of argumentation.

This Educator's Guide includes:

- An **Introduction** that clearly defines the subject and offers an overview of the issue objectives of the guide; how it relates to science from both a social and personal perspective; as well as pertinent questions and insights regarding the topic.
- A listing of all **National Science Education Standards Addressed**.
- Detailed procedures highlighted in the MAP Framework (**Motivate, Assess, Propose**).
- Illustrative **Video Clips** from *The Eyes Of Nye* DVDs with pinpoint chapter cues.
- **Web Site Resources** to help students further investigate and locate research, charts, data as well as experts featured in the program material.
- Easily downloadable **Support Materials** that include articles, transparencies, charts, and much more.

Introduction:

"Astrobiology" refers to the search for life on other planets. *The Eyes of Nye - Astrobiology: Does Extraterrestrial Life Exist?* describes requirements for life as we know it (especially water and the ability to withstand extreme conditions), the methods employed in the search for life, evidence uncovered, and how these impact our view of our place in the universe.

Questions and ponderings regarding the possibilities of life "out there" have been an issue in societies since early mankind—first over the next horizon, then across seas, and in more recent decades, in outer space. The issue is timeless. When (not if) students consider the possibilities of life elsewhere, they will need to be able—in keeping with the objectives of this guide—to understand that our questions, methods, and evidence are based on our experience (*our* paradigm of life). They must also be able and willing to bring a rational approach to dealing with the age-old notion that perhaps we are not alone.

*Check the **MAP Teaching and Learning Framework** to explore the phases (motivate, assess, and propose) used in this guide.*

National Science Education Standards Addressed

Science As Inquiry

- Abilities necessary to do scientific inquiry

    Identify questions and concepts that guide scientific investigations

    Recognize and analyze alternative explanations and models

    Communicate and defend a scientific argument

    Understanding about scientific inquiry

Physical Science

- Chemical reactions
- Motions and forces
- Interactions of energy and matter

Life Science

- Matter, energy, and organization in living systems

Earth and Space Science

- The origin and evolution of the earth system
- The origin and evolution of the universe

Science and Technology

- Understandings about science and technology

Science in Personal and Social Perspectives

- Science and technology in local, national, and global challenges

History and Nature of Science

- Science as a human endeavor
- Nature of scientific knowledge

Disney Presents the Eyes of Nye

On the DVD:

Astrobiology: Does Extraterrestrial Life Exist? – Chapters

Chapter 1: ***Astrobiology Preview***
Beginning to 1:45
Ends with title screen.

Chapter 2: ***The Never Ending Quest***
2:00—7:13
Starts with Bill saying, "Since we could first form the question..."

Chapter 3: ***At the Limits of Life***
7:13—11:17
Starts with Bill saying, "What we consider the limits of life…"

Chapter 4: ***Defining the Search***
11:17—15:01
Starts with Bill saying, "This is sodium bicarbonate…"

Chapter 5: ***Planetary Research: Putting Physics to Work***
15:00—19:35
Starts with Dr. Fischer saying, "I'm Dr. Debra Fischer…"

Chapter 6: ***The Unanswered Question***
19:35—end of program
Starts with Dr. Fischer and Bill walking up the stairs.

Astrobiology: Does Extraterrestrial Life Exist? – Activity Clips

An Age-Old Question
2:06—2:48
(referenced in Educator's Guide step 2)
Starts with Bill saying, "Since we could first form the question…" Ends with Bill saying, "…other life on other worlds."

Just Add Water
11:17—12:00
(referenced in Educator's Guide step 5)
Starts with Bill saying, "This is sodium bicarbonate…" Ends with him saying, "…just add water."

Red Rover, Red Rover
20:18—23:11
(referenced in Educator's Guide step 8)
Starts with NASA animated simulation of Mars rover. Ends when Bill says, "…well, a question."

Plying for Planets
15:00—16:30
(referenced in Educator's Guide step 9)
Starts with Dr. Fischer saying, "I'm Dr. Debra Fischer…" Ends with her saying "Instead, we actually exploit the laws of physics a bit."

What Goes Around Comes Around
16:31—19:35
(referenced in Educator's Guide step 10)
Starts with the blue title screen entitled, *The Laws of Physics*. Ends with Dr. Fischer saying, "…so that's what we're measuring."

Somewhere…Out There
2:51—4:12
(referenced in Educator's Guide step 11)
Starts with music and radio dish images. Ends with Mr. Shostak saying, "…we don't have the telescopes to find them yet."

What is Alien Life?
12:34—13:18
(referenced in Educator's Guide step 13)
Starts with Bill asking, "What if we found life on Mars?" Ends with McKay saying, "…we're searching for something that's different."

Science and Healthy Skepticism
19:35—20:16
(referenced in Educator's Guide step 14)
Starts with Dr. Fischer and Bill walking up stairs. Ends with Dr. Fischer saying, "…around other stars."

Procedure: Motivate Phase

1) Ask students if they have ever considered the possibility of life anywhere besides Earth. Most have, but ask them *why*. Suggest they are not the only ones who have difficulty responding to this question. It is sometimes hard to explain why knowing about our place in the world (or universe) is so important to us, but it has been this way for ages.

2) Play ***"An Age-Old Question,"*** and discuss the transition from our view of humankind at the center of the universe to what we know and accept today. Ask students if considering "our place" is easier now than it used to be.

Suggest that though we know much more, and our methods for obtaining data and information are much more sophisticated, it always seems the more we know the more we discover we *do not* know. We progress and we find it remains difficult—but essential.

Optional: *Encourage students to explore the discoveries that changed our "geocentric" views. Read about the progression of concepts through Aristotle, Archimedes, Eratosthenes, Hipparchus, Ptolemy, Copernicus, Brahe, Kepler, and Galileo Galilei.*

3) Some students may feel we know our place in the universe—raise the consideration of what it would be like had we always accepted that the earth was the "center," or that the earth was flat. Ask if, in the quest to learn, we uncover important understandings that affect everything we do and learn from that point forward. Explain that as our horizons expand, imagining our place becomes more and more mind-boggling—part of the reason many feel there *must* be life on other planets. Play ***"Chapter 1: Astrobiology Preview"*** (end at title frame). Restate the broad question posed, "Are we alone?"

4) Ask students to suggest what we need to know to answer that question. Many will involve life itself—what it is, where it came from, what it takes for life to thrive. Others will involve what we (scientists) do to "search for life" and what evidence we have found in the process. Help students categorize and combine suggestions, and devise two scientific and one social question that we can directly investigate (see possibilities below).

Potential scientific questions:

a) What are the requirements for life?

b) What evidence have we found, and what methods have we used, that indicate these requirements could possibly be met elsewhere?

Potential social questions:

c) What would it mean to us if we found this life?

Procedure: Assess Phase

5) Ask students to define "life"—emphasize the difficulty of such an undertaking by suggesting that *no one* really can honestly do that. Suggest we do know some things, however, that are required for life to exist—at least *as we know it*. Play ***"Just Add Water,"*** in which Bill demonstrates the reaction that occurs between an acid and base when water is added. Reiterate the notion that as we know it, we see water as a requirement for life because it is so on Earth, and what else would we expect on the "water planet?" Suggest, however, that our *assumption*, from which our searches, and claims of evidence, emerge, is not an inappropriate way to proceed. It is what science *does*, and it is simply proper to *recognize* it, not disregard it because it is only an assumption.

6) Introduce the concept of "extremophiles"—organisms that are able to live in environments with extreme conditions. Mention a few of the environments in which we have found them to thrive. Ask students why it is important to learn about extremophiles in our search for life "out there." Suggest that these questions greatly influence the research we do and the money we spend on that research.

7) Explain that Dr. Chris McKay at the NASA Ames Research Center has been exploring extremophiles here on Earth, and using what he finds to target his searches on other planets—first Mars. Play ***"Chapter 3: At the Limits of Life"*** (end after visit with McKay) and tell students to note what requirements of life even extremophiles exhibit, and also how these particular extremophiles could tell us how other life can come into existence as a result of their prosperity. Use the handout "Cyanobacteria and the Dawn of Life" to more fully explore the importance of the study of certain organisms in our quest for life.

8) Recall that even the cyanobacteria above required water, and that light seemed to also be important. Ask students to consider the following: If there is water, *is* there life? Further, is water present anywhere other than Earth? Explain this is a question being deeply explored even as we speak. Play ***"Red Rover, Red Rover,"*** and review what we think we are discovering about Mars that will at a minimum lead to continued search for water. Encourage students to access up-to-date information on Mars mission findings (see below). Remind students again of the assumptions on which we are basing our search —that water means life. Ask them to suggest other *kinds* of places that may meet the requirements of water, and light as well. Suggest that, as with Mars, other *planets* seem to be the logical place to look.

Claims suggest that we are accumulating an amazing amount of information that tells us a great deal about the possibility of life on Mars. Stay tuned to the latest findings from Mars rovers.

For more on the quest for Martian life, go to eyesofnye.org

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9) Play ***"Plying for Planets"*** in which conditions that suggest the viability of planets for supporting life are raised, and in which Dr. Debra Fischer, research astronomer at Berkeley, discusses discoveries of planets made since 1995. Ask students to recall how our techniques and capacities impact our search—narrow the request if needed to recalling what *types* of planets we are able to find and study. When searching outside our own solar system, constraints in our technology at this point allow us only to detect and study large gaseous planets. Ask if our paradigm of searching for water and other Earth-like characteristics is at odds with our use of methods that can only detect planets that are *not* Earthlike; given the obvious discrepancy, some students will suggest that we shouldn't bother. Further compound this doubt by asking them how *on Earth* we ever study something we can't touch. Follow, however, by reminding them of similar comments made centuries ago to early astronomers such as Brahe, Copernicus, and Galileo Galilei. Ask students if these individuals should have "not bothered," and where

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*See **The Eyes of Nye** Issue Support **Cyanobacteria and the Dawn of Life***

Encourage students to explore unique work.

*See **The Eyes of Nye** Issue Support **She Has Star Power***

we would be today if they hadn't. Recall as well that just as these early astronomers found ways to study what they could not touch, so have today's astronomers—by what Bill refers to near the end of the segment as the laws of physics.

10) Ask students to observe closely as Bill physically demonstrates and Dr. Fischer uses computer-generated data to illustrate the effects of planetary force and motion. Play ***"What Goes Around Comes Around,"*** and explain that by using some of the principles discovered many years ago along with a few new twists, we can learn a great deal about completely new things in our quest for knowledge.

Teacher Note: *The Doppler Effect (above) and the efforts to detect extraterrestrial signals in the form of radio waves (below) represent two types of past scientific efforts that continue to be employed on a regular basis. The former continues to inform multiple new endeavors. The use of radio waves, while debatable in terms of what it has provided in the search for extraterrestrial life, has proven immensely beneficial in studying distant galaxies and informing our growing understanding of the universe*
For more, go to eyesofnye.org.

Procedure: Propose Phase

11) Ask students to recall how even early mankind must have wondered about their place in the world, as small as it was for them, and how they must have fancied finding out what was "just over the horizon"—intelligent life as well as new food. Ask students to consider what difficulties they may have encountered once they finally decided to make that journey and find out for themselves. Suggest that "communication" probably was a problem—talking most likely, at that early stage of the game. Raise the notion that mostly sounds and signals were used, and ask them if it is this way for us today (yes). Play ***"Somewhere… Out There,"*** in which Dr. Seth Shostak at the Search for Extraterrestrial Intelligence Institute (SETI) describes the effort to detect radio waves from other planets, hopefully planets much like Earth.

12) Tell students to imagine that Dr. Shostak and his colleagues detected a signal—and we can understand it. Intelligent life. Ask students to write a paragraph describing how this might impact us technologically, scientifically, or socially. Ask students to volunteer their ideas and discuss some of these. Inform them that actually Dr. Shostak claimed elsewhere that we probably would not be able to understand the signals—we would be too primitive.

It's not an easy thing to be the ones charged with answering some of the types of questions we ask. From the perspective of Seth Shostak, look into the thoughts and potential risks a scientist takes when he or she steps into the unknown.
For more on exploring claims and claimants, go to eyesofnye.org.

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*See **The Eyes of Nye** Issue Support **Who Dares, Wins… Or Do They?***

13) Tell students to consider for a moment that we are the ones who are more advanced. Ask them if, then, there is anything we can learn. Play ***"What is Alien Life?"*** in which Dr. McKay points out that we are looking for whatever type of life we can find, and how much we could learn even from studying life with a completely different DNA than life forms here on Earth.

14) Ask students to consider if they believe there is life "out there," and if so, what they think it is like. Allow time—have them write this out if you wish—but emphasize afterward that though to quest is to dream, to be scientific in approach is to know there are limits to what we can infer. Play ***"Science and Healthy Skepticism."*** Dr. Fischer puts things nicely into perspective from a scientist's standpoint.

Final Teacher Note: *The importance of these scientists' views regarding the search for life, what we may find, and what it may mean to us cannot be overstated. In public circles, we often associate the search for life with bad science, and in so doing lose sight of the value of the quest. The scientists featured have real objectives and intent, and while they dream, as do we all, the skepticism and reserved manner of conjecturing what may be found demonstrates a scientific learning experience from which students can benefit.*

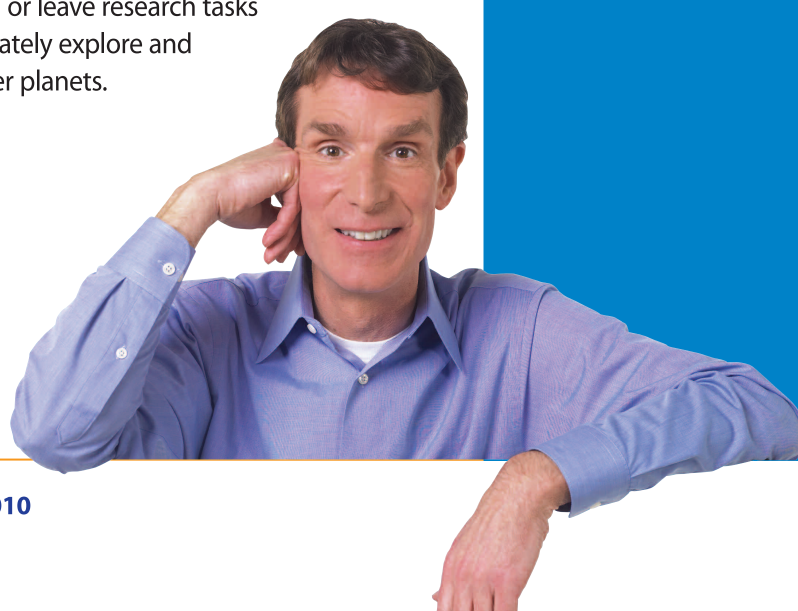
For more, go to eyesofnye.org.

Further Research

Investigating the Issue: Astrobiology

Making decisions or constructing lines of argumentation related to the question "Are we alone?" is a difficult task—thus, the timelessness of the question. Students can and should, however, hone their abilities to obtain and assess information related to the question, and explore the scientific aspects of the issue in light of accepted scientific norms (constitutive criteria such as accuracy, precision, and consistency), social biases notwithstanding. The social attitudes of many toward the search for extraterrestrial life become a unique springboard for exploring the impact of societal views on scientists themselves and on quests for knowledge beyond the purview of most.

In addition to the information and claims presented in *The Eyes of Nye - Astrobiology*, students may access a variety of informative sources related to ongoing research in the field as well as NASA mission-related findings that change and update on an almost weekly basis. Teachers may direct them to specific information or leave research tasks as open as they feel is necessary for students to adequately explore and assess information related to the search for life on other planets.



Exploring Astrobiology

NASA funds and sponsors the principal sources of information related to the search for extraterrestrial life. These resources are particularly helpful during the "assess" phase of the educator's guide as students investigate scientific evidence related to the issue of astrobiology. Once there, students can easily find the Search for Extraterrestrial Intelligence Institute (SETI) web site, the Astrobiology Institute, and the most recent information regarding the Mars rovers and findings that are updated on a regular basis.

Access at: http://www.nasa.gov

Exploring Astrobiology Claims and Claimants

Dr. Seth Shostak, Dr. Chris McKay, and Dr. Debra Fischer provided the principal information in *The Eyes of Nye - Astrobiology*. Teachers may encourage students to conduct open-ended searches for information related to these individuals and the institution at which they conduct their work.

Dr. Seth Shostak, senior astronomer	Search for Extraterrestrial Intelligence Institute (SETI)
Dr. Chris McKay, astrobiologist	NASA Ames Research Center
Dr. Debra Fischer, research astronomer	University of California, Berkeley

ISSUES SUPPORT MATERIAL

Astrobiology: Does Extraterrestrial Life Exist?

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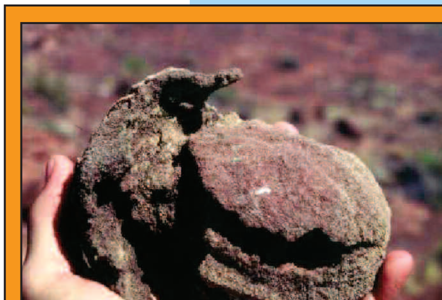
Cyanobacteria and the Dawn of Life

Talk about extreme environments! Imagine Earth in its earliest stages—devoid of life with temperatures and atmospheric conditions that could not support life. From 4.5 billion years ago—when scientists estimated the earth originated—to just over 2 billion years ago, we have no indications there was even any oxygen in the atmosphere. That would make life—as we know it—impossible. Enter cyanobacteria.

Frozen stromatolites found in Shark's Bay, Australia.

Ever seen what looks like green scum on the surface of sediments and soils? It is usually not algae, though for years it has typically been called blue-green algae. It is cyanobacteria. What does that have to do with the dawn of life? Even today we find cyanobacteria using light as energy, "breathing" carbon dioxide, and generating oxygen. They did not need oxygen—in fact, they didn't like it then, and they still don't. They avoid it. But, they produce it in quantity, and multicellular organisms need to grow, thrive, reproduce, evolve, and…create what we see today.



Stromatolite sample from the Grand Canyon National Park.

Scientists have what they consider good evidence from analyses of rock layers called stromatolites, and even the prevalence of oxidized iron mineral deposits containing rust and hematite dating from around the time oxygen began to be plentiful enough to support life. So where are the cyanobacteria today? Still in extreme environments! When they begin to appear in less extreme environments, other organisms (thriving in these environments they love) eat them—not something the cyanobacteria would prefer if they had a say. But, then again, 3.8 billion years ago when they first appeared, there just weren't many other organisms to eat them, now were there?

The perfect arrangement—resulting in life!

Images courtesy of Cyanosite, Department of Biological Sciences, Purdue University.
http://www-cyanosite.bio.purdue.edu/index.html

Disney Educational Productions (800) 295-5010

She Has Star Power

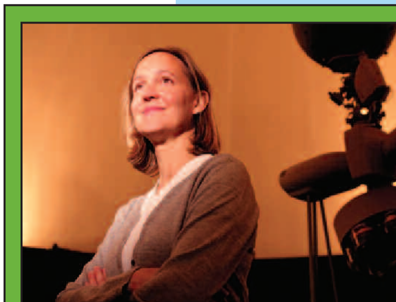
Planet Hunter Returns to Campus

Astronomer Debra Fischer knows a lot about velocity and has a surprising amount herself. If she's not at a blackboard drawing diagrams to explain planetary movement, she's offering a physics test to an unwitting visitor. "Okay," she says, jumping out of her chair, "if I have two identical balls on the edge of this table, and drop one off the edge, but launch the other at a velocity of 100 miles an hour, which one hits the ground first?"

For the last seven years, the San Francisco State University (SFSU) alumna has been working with the California and Carnegie Planet Search Project, the successful planet-hunting team credited with discovering most of the 110 known planets outside our solar system.

While earning her master's in physics, Fischer worked with astronomer Geoff Marcy, who co-founded the project at SFSU in 1983.

Although they still conduct research together, the original members of the SFSU project dispersed to other institutions; Marcy and Fischer relocated to UC Berkeley in 1999, and Paul Butler *(B.A., '85, B.S., '86, M.S., '89)* now works for the Carnegie Institution in Washington, D.C.



Dr. Debra Fischer, research astronomer

Fischer came back to SFSU as an assistant professor in the Physics and Astronomy Department, drawn by the opportunity to combine research and teaching. "One of the things I want to bring to SFSU is research," she says, " to make the things [students] learn meaningful and real. It makes such a difference in their lives to actually go to the telescope and collect data."

The hunt for planets intensified after the first extra-solar planet was discovered by a Swiss astronomy team in 1995. Marcy and his SFSU team caused a flurry of international excitement when they confirmed the existence of three more planets the following year, including the first multi-planet system.

In 1997, Fischer rejoined Marcy at SFSU as a post-doctoral planet-hunter. Over the next two years, she would be credited with discovering three planets herself.

But even while fielding questions from CNN and being filmed for documentaries in the late '90s, Fischer was focused on her scientific goals. "I thought of all the media exposure as educational outreach," she says. "What I found really exciting was cracking open this new area of science and getting more pieces of the puzzle."

Fischer and her team use an observation technique that measures the metal content of stars to find planets. Stars richer in metals are more likely candidates.

Using telescopes at the University of California's Lick Observatory, Fischer and her colleagues look for "wobble," the fluctuations in a star's velocity that signal the presence of a planet. But even when a potential planet is identified, it must be monitored for a full orbital cycle which, depending on its distance from the star, could be a few days or a few years.

"These discoveries are new chapters in basic astronomy books," Fischer says.

"Before, the search for extraterrestrial intelligence was taken less seriously. But when planets were discovered orbiting nearby stars, it shifted the entire focus of NASA. It put them on the road to finding Earth-like planets."

In 2010, NASA will launch a new satellite telescope into solar orbit taking advantage of data from Fischer's team and others to find planets in zones scientists think are likely to support life. This mission will search for smaller planets that are more likely to be terrestrial, or Earth-like, rather than gaseous, like Jupiter. If found in the inhabitable zone, the surface of a terrestrial planet would allow water to collect in a way that might support life.

Fischer cites her early research work as the inspiration for her career. "I became an astronomer because I had the opportunity to work with Professor Marcy and do research," she says. It's this same interest she hopes to excite in her own students. "The students at SFSU span an incredible range. When you give them a challenge, they rise to the occasion."

In addition to planet-hunting, Fischer is spearheading efforts to bring a $6.5 million robotic telescope to Lick Observatory. This "automated planet finder" will be the world's first telescope completely dedicated to finding new planets. Fischer's team and their students will use the telescope 365 nights a year to track selected stars that may host smaller, terrestrial planets.

Fischer doesn't attribute her team's success to high-tech telescopes.
"Teamwork," she says. "We work well together because we all give this project everything we've got."

Still up in the air on those balls Fischer mentioned at the beginning of the story? They both hit at the same time!

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"Someday, humans may venture into interstellar space and drop anchor on one of Dr. Fischer's planetary harbors."

*- **Astronomer Geoff Marcy**, adjunct professor, physics and astronomy*

Source: Reprinted with permission of San Francisco State University.
Roolf, J. (2003). She has star power. SFSU Magazine Online, Fall/Winter 2003, Volume 1, Number 4.
http://www.sfsu.edu/~sfsumag/archive/fall_winter_03/starpower.html

Who Dares, Wins…Or Do They?

by Seth Shostak, Senior Astronomer, SETI Institute

The recent brouhaha over whether there's compelling evidence for life on Mars offers a stark lesson about research life: a major scientific discovery is a temptress as beguiling, and as dangerous, as the Sirens that beckoned Ulysses.

To learn something both important and new not only guarantees a scientist steady employment and a wall-full of awards; it can permanently fix his name in the big book of human achievement. It's immortality, of a sort.

On the other hand, a claim that turns out to be mistaken is often an indelible black mark, leading to criticism, ridicule, and a brisk ride to oblivion.

Many people outside the scientific establishment have a Hollywood view of research. For them, discovery consists of a "eureka" moment when a scientist – impelled by brilliant insight or too much French roast – will suddenly cover blackboards with fresh mathematica or throw a knife switch in the lab, and moments later step back to confront some new, profound truth.

In fact, much discovery is tentative. The data suggest something, but they are seldom thoroughly unambiguous except, perhaps, in retrospect.

So a researcher has to make a choice of whether to "interpret" the data and gamble on discovery, or keep quiet, continue the slog, and risk being trumped by a competitor. In other words, there's a fine balance between discreetly jumping the gun and being out of the race.

The right choice is seldom dead obvious. In 1989, chemists Stanley Pons and Martin Fleishman claimed they had provoked cold fusion in their lab. What they actually provoked was cold rebuke from their peers. In contrast, Edwin Hubble pored over his plot of galaxy spectra in 1929, and decided that the universe was expanding linearly. If you look at that data yourself, you'll appreciate the degree of inspiration (or imagination) required to dare that conclusion. More than a decade before Hubble, astronomer Vesto Slipher had already measured the recession velocities of a fistful of galaxies, and found that most of them were receding. If he had been a bit more audacious, NASA might be debating the merits of a Slipher Service Mission to save our premier space telescope.

When the first planets were found around other suns a decade ago, there were serious people in the astronomical community who believed the claimants had merely observed double stars, not planetary systems. The discoverers held fast, however, and were eventually guaranteed ink in every Astronomy 101 textbook from now until the Sun goes nova. They did this despite a sobering precedent: in the 1960s and 1970s astronomer Peter van de Kamp had gone public with the news that two nearby stellar systems, including Barnard's star, danced back and forth on the sky, proving they hosted planets. Unfortunately for van de Kamp, the dancing was caused by periodic maintenance of his telescope, not by distant worlds. Sic transit gloria mundi.

There's also the problem of interpreting data based on preconceived notions. Facts are, research often proceeds in an attempt to prove what you think is true. In polite parlance, this is admired as "proceeding on a hunch." Of course, when your hunch is hogwash, the results are rubbish. Columbus departed this world still believing his ships had landed in the Indies, because that's where he *thought* he'd land. Had his notions been more open, we'd be calling it the United States of Columbia.

It's hard to imagine a discovery more grand than finding intelligent life in space. However, SETI scientists have assured both themselves and anyone who asks that they will meticulously check any candidate signals picked up by their telescopes, making sure they are truly extraterrestrial and truly technological. They take to heart the lesson of the pulsars: signals that, at first, seemed to be the handiwork of Little Green Men – but turned out to be a previously undiscovered creature in Nature's celestial bestiary. They remember CTA-102, a variable, cosmic radio source that Russian researchers thought might be the noisy broadcast of an advanced society. CTA-102 was a quasar.

Nonetheless, good intentions are easy, and deciding on the data is hard. So when SETI researchers find an interesting signal, they don't immediately flush with adrenaline and shout from the shingles. They know that any signal will need extensive confirmation to rule out such mundane origins as a telecommunication satellite, local interference or squirrelly software.

But at some point there will be a need to decide which way this teeter-totter is coming down. A wrong call could simply make you grist for Jay Leno's monologue. But a delay might mean that your ticket to Stockholm will be given to someone else.

It will, no doubt, be a tough call.

Source: Reprinted with permission of the Search for Extraterrestrial Life Institute (SETI)
Shostak, S. (2005). Who dares, wins… or do they?
http://www.seti.org/site/apps/nl/content2.asp?c=ktJ2J9MMIsE&b=194993&ct=567827