

The following is an excerpt from the dissertation of Lawrence Krumenaker, prepared especially for participants at the NSTA Boston meeting. If you refer to it, please cite it as Krumenaker, L., (2008). *The Status and Makeup of the U.S. High School Course in Astronomy in the Era of No Child Left Behind*. Unpublished doctoral dissertation., University of Georgia, Athens.

Note that quotes have not been corrected for spelling or grammar flaws.

### Defending the Course

**If you should have to defend or justify the course at some future date, what arguments would you use? Why?**

Even though a previous question indicated that quite a few teachers have managed to avoid being on the NCLB radar, there are documented cases within this study of courses being cancelled. These have been because of the need for school-wide remediation or other reasons ostensibly due to this Act or related state reactions to it. Some teachers have defended the course successfully.

There are a grand total of 428 responses in the survey. This works out to be an average of 1.8 different responses per teacher. Some teachers, as one might imagine, contributed considerably more than one type of defense response/advice.

There are six primary themes in which answers fall. Table 58 lists them; percentages do not add up to 100 because of rounding.

Table 58  
*Themes Teachers Use to Defend the Course*

Theme Responses	Number	Percentage of
Defending with the nature of the course	137	32
Defending with effects on students	88	21
Defending with cultural linkages	78	19
Helps improves students, school, AYP	54	13
Defend with traits of science	24	6
Institutional benefits	22	5
Other	25	6

By far the largest group might be called “Defending with the nature of the course.” There are 137 responses, or 32% of the whole set of responses, in this one primary group. Found here are answers using aspects of what the course is, what the course does, and what these do for which groups of students. The largest single answer by count in this subgroup is the fact that this course is so interdisciplinary, involving math, other sciences, logic, history and more. “An integrated course” is given as all or part of a response 46 times, a full one-third of all the Nature of the Course responses.

The second group of the six, totaling 88 responses or 20.6%, might be called “Defending by current and past effects on students.” Here is the largest response by count, that students are interested in astronomy, often more than for any other science, so we should teach it. Forty-seven responses had this theme, fully 53% of the category.

The third largest group would be “Defending the course with its cultural linkages,” with 78 responses. This group contains historical, sociological and philosophical arguments and intangible connections that astronomy has with human thoughts and societies. A common defense here is that astronomy teaches students about their place in the universe and about the wonder of it all. The historical argument that

astronomy is the first science, the foundational science, appears here extensively. Other linkages are more tangible, such as astronomy is part of everyday life, for example, as cultural myths, origin of the calendar, and so on.

The next largest group would be “Astronomy helps improve students, school, and AYP measures”. Fifty-four responses (12.6% of the response pool) defend the course with arguments on how well it helps meet state standards, helps students pass state end-of-course and school graduation tests, and provides options for students who have troubles with the BCP science courses.

The last three groupings are all roughly equal in size.

“Defending the course with traits of the science” has 24 answers that include its accessibility to students, how it is perceived as less static than other sciences, and so on.

“The Institutional Defense’s” 22 responses promote the idea that astronomy courses help the school, its image and economics.

A final group includes 25 responses that do not fit any of the others, including a few negative comments, comments unrelated to the question or otherwise unintelligible, and a small number of unique defense strategies.

Each of the six primary groups will now be examined in detail.

### *Nature of the Course*

A number of critical and repeated themes make up this group of responses.

First of all, and highest in response count as noted before, is the justification that this science, unlike others--in the teachers’ opinions--is an integrated course. Involved in it are mathematics, literacy and language, the other sciences of chemistry, physics, various life sciences and even geosciences. While these others can incorporate

astronomy, if the teacher so desires, only astronomy seems to be the capstone that inherently incorporates them all or at least as many as the teacher wishes.

It is a solid college-level introductory course that provides students with a way to 'Integrate many facts, processes, and sciences together because of its broad, multi/interdisciplinary nature' --- Astronomy-only teacher at a very large 3.8K-students Illinois public school.

Requires mastery of all disciplines and integrates these like no other course can. My students learn more history than in some history classes. They use trig to rediscover Kepler's laws as well as analyze many articles about current research. --- Teacher in a minority, Needs Improvement, 1.7K students public high school in Georgia.

Astronomy is truly a multi-disciplinary course in which the different sciences may be blended, but also one in which students may see direct application of other course content as well. For example, math is obviously required, but government policy/legislation with respect to aerospace expenditures, aerospace spinoffs that help solve Earth-bound problems, ELA communication of important findings and discoveries to the general public, understanding the environment by working to create closed ecosystems for colonization, etc., etc., etc. Beyond all this, it is a wonderful venue for teaching problem-solving skills because space exploration is still in its infancy. --- First year teacher of astronomy in a large 2.8K public high school in Texas.

Astronomy at the high school level should now integrate many other areas of science and mathematics. We can now do comparative geologies, meteorologies, and possibly some day comparative biologies to better understand our Earth's systems. --- Teacher in a 500-student Wisconsin public school.

Further listings of these cross-curricular and multidisciplinary aspects include:

- “Astronomy is one of the few courses where the math, science, social science, and writing demands can be applied and proven through the period of a semester.”
- “It integrates aspects of physical science, Earth Science, and Chemistry.”
- “emphasizes a tie between science and language, ...”
- “Practice using math, mythology, communication, computer skills, social sciences in real applications...”
- “really synthesizes all the other sciences. If students have time for one more course, Astronomy brings in Physics and Earth Science.”
- “\*It integrates modern science with basic knowledge\*Its history component makes it interdisciplinary\*”

- “As stated earlier, astronomy is the ultimate in culminating science courses, as it combines history, math, technology/engineering, chemistry, physics, acoustics, quantum theory and much more into a single unit. Students are forced to think across disciplines and approach science in a new way: astronomy often isn't a science done in a lab.”
- “The course integrates a lot of valuable reading and math skills.”
- “Two, Astronomy is an interdisciplinary science that examines our place in the universe and provides a context to the real world, history, and the future.”
- “Extends students experiences in physical sciences -- adds breadth to standard physics and chemistry courses.”

Not only can the course be taught in its interdisciplinary way, it also reinforces prior learning.

- “it utilizes concepts and processes that were previously taught in our science curriculum.”
- “The Astronomy course reinforces math and other science disciplines (e.g., Physics and Chemistry)”
- “The course reinforces solid science thinking, ...”
- “Provides a strong opportunity for students to apply the basic science skills acquired in physics, chemistry, and earth science courses.”

It can even substitute in some states for these other courses...

- “Content - teaches almost as much physics as our physics class.”

our district does not teach Earth Science at the high school level. Astronomy is as close to satisfying some of the Earth Sci. standards as we get. --- Teacher in a Wyoming public high school.

Knowing that what we know about the universe has changed rapidly over the years, and that elementary and middle schools may not be teaching astronomy with up-to-date knowledge or textbooks, the high school course may be the last chance to correct

students' knowledge bases. It is also content, in some states, that isn't taught anywhere else in their curricula at all.

Much of the information students learned about astronomy in elementary and middle schools is now out of date. --- Former teacher from a 500 student Wisconsin public high school.

There are many misconceptions about astronomy - many adults cannot easily distinguish astronomy from astrology - more and more students (and adults) are doubting we even went to the moon!! Schools should provide a course which sets the facts straight and provides some concrete knowledge of what they are seeing in the night sky. --- Astronomy-only teacher in a 1.7K-students public school in Pennsylvania.

This course also incorporates, or teaches, many skills.

Getting students engaged in the work is the first step to making them hypothesize, research, make inferences, and draw conclusions. These scientific methods are applicable in all areas of life. --- Optimistic teacher in 2.5K student public high school in Texas, even though course was no longer being offered.

We don't just memorize facts in class, we model, calculate, debate, and discuss the evolving nature of the science of Astronomy. All of these practices are meant to mold students into better critical thinkers-- one of the high goals of science as a discipline. --- Teacher at a 1.5K Wisconsin high school.

Promotes curiosity, creativity, awareness, cooperative learning and is a good forum for problem and project based learning. --- Teacher in a 1.5K, high minority public school in Indiana

The course then develops students' logical thinking. Many of today's data has to be analyzed and conclusions have to be drawn. Through this course, students can create their own projections and perhaps, become interested in an astronomy career. --- Teacher at a large 3.2K student New York public high school.

Other skills mentioned include:

- “Skills for decision making as they employ the process of science;”
- “Foster student imagination and creativity--many more”
- “Development of critical thinking skills”

- “Practices deep/abstract thinking skills”
- “More than any other science course that our school offers, my Astronomy course forces students to use real life skills in gathering and reporting information.”
- “My approach to it also fosters the development of other skills such as writing and computer usage.”

In style, the course can be more hands-on than most...

Astronomy is basic to inquiry science. All aspects of astronomy lend itself to the inquiry method of science. --- Teacher of an all grades astronomy class in an AYP Failing, 800-student, minority Oregon school.

- “It is an excellent lab based science course that promotes critical thinking skills.”
- “not memorizing.”
- “We teach the course through inquiry learning and look at the changing nature of science through better instruments, data, and theory in astronomy through time, from Aristotle to today.”
- “Astronomy is a course built around discovery. It is a way to get students to think outside of the box and realize the potential of the future.”

Here is an argument for which there are two possibilities, more rigor or less rigor.

One apparently needs to choose the one that would work in your own situation:

Using the Investigating Astronomy course from TERC, which is inquiry-based, I am making astronomy a more rigorous course. ---Teacher at a 1.7K students, Needs Improvement, high minority public school in Arkansas.

it is a less rigorous option to chemistry, physics, and biology, which appeals to some students; --- Teacher at a 500 student passing, minority, public high school in Washington.

Note that the Washington state teacher was self-described as “somewhat optimistic” and the Arkansas one used the description “somewhat pessimistic.”

While the subject matter, unlike chemistry, physics or earth science, may be physically distant from the students, it is still with relevancy to their everyday lives.

As future voting members of our society, I believe it is crucial that the students have an understanding of the place of humanity in the Universe. Particularly critical right now is that students grasp how the Earth is not replaceable and we need the plants and animals to survive. To grasp that our survival depends on caring for Earth and to learn how to move to find other Earths is vitally important to the survival of life as we know it. --- Teacher at a 1000-student, high minority public high school in Texas.

- “Astronomy is today's science, make it relevant, see the papers, ...”
- “Understand news, current events, and earth's role in the Universe better”
- “Astronomy allows immediate access to the issues and situations that are at the cutting edge of Science.”
- “Everyone needs to be aware of what is going on and how the gov. is spending money or not to move the ability to discover new info.”
- “Astro students gain access to the roots of some of the major trends in modern society through the history of astronomy.”
- “Hopefully, this will allow them to make considered judgments about any activity that has an effect on our planet.”

Astronomy interest has no academic level restriction...

I also think it is a course that is great for students who struggle with science because it is a different kind of science and one that always seems to hold people captivated. --- Teacher of a future course at a private 500-student school in Pennsylvania.

This is a course that ANY student can be successful in because so many of the concepts can be understood at many different learning levels. --- Teacher at a 1.2K-students public school in Connecticut.

- “A lot of success with lots of upper level kids.”
- “(allows low students a way to succeed at something,...)”
- “This is a science class that is taken by students who do not always feel strong in science and math.”
- “It accommodates students with a variety of learning styles due to being in a planetarium.”
- “It is available to students regardless of their math skills, and ...”
- “Good for academic students AND students who are struggling. Good for traditional and non-traditional students”

Though the survey recorded many complaints about students placed in the classes without the proper preparation, some teachers noted that it can work with at-risk students, too.

It is more interesting for students especially those at risk or who have IEPs. --- Former teacher from a small 700-student Passing Arkansas public high school. The course was taught in an inner city school with students that had low math skills and generally were not science kids (not also enrolled in courses like AP chem or AP Physics), yet this course got them excited and enthusiastic about science. Kids joined the astronomy club and were INTERESTED! This is/was very uncommon for the school, and definitely encouraged many minority and minority female students to take a science class and join a science club. --- Former teacher from a high minority, Connecticut, 1.2K-student public high school.

Astronomy courses can be more than relevant, it can be tangibly beneficial. Some teachers have arranged it so that the students get transferable college credit.

- “they can get 5 University of Washington credits for taking the course (at a price of \$293) through the UW in the High School Program”
- “Astronomy is a popular freshman course in college and our students can be better prepared if that have had some exposure to it.”
- “Students often leave and take astronomy courses at local colleges and universities to fulfill their COLLEGE science credit and do well. They do well even though we did not cover all the content of a college course.”

Nature of the course arguments that can be used to administrators include:

- “Increases science literacy;”
- “We are teaching our students science by doing real science ”
- “It is a college prep course that gives our students an idea of what they may expect from a college level introductory science course.”
- “This class is constantly evolving because we discover things every day that add to or alter our understanding of our solar system and our universe. It is current!”

## *Course Effects with Students*

Students should be able to gain the skills and thinking abilities they need to be successful in any context in a course that interests them. --- Teacher in a Needs Improvement, 800-student high school in Michigan.

Astronomy courses have some of the highest interest and appeal rating among students, these teachers find.

- “Students may not be excited about the number of neutrons in a carbon atom, but show them a picture of a galaxy and you get their attention.”
- “Many students are interested in Astronomy and it therefore is an excellent medium for teaching fundamental science principals (i.e., science inquiry, nature of science, etc.”
- “students are excited by astronomy topics in a way that they don't seem to be about other science topics, and ...”
- “Any time I have ever spoken of space in my classrooms, regardless of the age, students are always attentive. It is an intriguing subject...”

Because of this it attracts students that don't normally like science; it has been seen to change students attitudes, to bring students into science, even to cause them to become scientists.

I don't need to do this at all but my justification usually is that astronomy represents a course that is still very interesting to many of the kids who have been turned off to science and for that reason represents a 'foot in the door' possibility to teach a large segment of kids that would otherwise not take another science course. ---Teacher at a 700-student private high school in Florida.

Often times it sparks an appreciation for science in students who may not have enjoyed the subject up until now. --- Nearly full-time astronomy only teacher at a 1.2K Wisconsin public high school.

Besides the logistics and necessity for a low level semester course in our school, I would justify this course as an attempt to improve the affective attitudes of students to learn science. There has been a decrease in numbers of students pursuing the fields of science, mathematics, technology and engineering. Astronomy is a field of science that can be used to inspire the next generation of

explorers. --- First year as astronomy teacher at a Needs Improvement, 2.8K-students Pennsylvania school.

Additional comments include:

- “Students enjoy the course; it is sometimes the only advanced science course some students take;”
- “I feel that there is a need to offer elective science courses to meet the interests of our students, and to encourage them to take Science courses which are widely regarded as difficult and unnecessary.”

This “interest factor” is good material for a teacher to use...

I can take that interest and use it to teach astronomy, integrating physics and chemistry into an interesting course that considers one of the greatest philosophical questions faced by humankind throughout history - our place in the universe! --- Teacher at a 1K students public Wisconsin high school.

Students may be more motivated to succeed in astronomy because of this interest than in other science courses. It can improve students academically, and affectively.

The astro course at [school name deleted] is mainly taken by non-sci majors....It provides these students with an opportunity to excel at a science and develop a positive self image about their capacity to do science --- Teacher at a small Massachusetts private school.

A benefit for the teacher, the appeal and extant interest in astronomy ought to help keep (or get) a course going.

easiest to get enrollment, relevant --- Self-described pessimistic, former teacher of a 10-12<sup>th</sup> grade astronomy course in a 1.9K student, Arizona high school.

Students are naturally curious about the universe so what better class to get them excited about science. --- Teacher at a private 1000 student high school in Arizona.

Students can be a very strong source of support if a course is need of defending.

I would solicit comments from my former students to help justify the course to the Board of Directors. --- Teacher at a 1.2K private school in Minnesota.

I'd prpbably use former students comments and get them to state how important the class was for them. --- Teacher at a high minority, Passing, 1.8K-students public school in Texas.

Student surveys reveal substantial numbers of students who would not take another science course if this one was not offered. ---Full time astronomy teacher at a large 3.4K students, high minority, California Passing public high school.

I would present the success of my former students in their college studies, as that is perhaps the strongest argument I can offer. --- Teacher in a small 300 student public school in Ohio that is Passing.

The ultimate reason to use student attitudes as a defense justification may be that since they like it, they really want to take the class.

But mostly, it is a science class many students really want to take, rather than have to take. Even some who do not like science. --- Teacher at a 2.8K public high school in Texas.

Classes that interest students keeps them motivated. School should not be all about the three R's. --- Teacher in a Needs Improvement, minority 1.8K-students public high Washington school.

Finally, national studies again and again when surveying students discover that students normally list space science and dinosaurs as their favorite areas of science. Is it any wonder that students get turned off by science when they can't study what they enjoy about it? Astronomy can be used to gather interest in the subject and introduce more difficult aspects of science in general under the guise of astronomy and help create a love of science that can entice students to go into more difficult aspects of science. --- Teacher at a 1600-students public high school in West Virginia.

And this one is hard to argue against...

For some, it could be life changing. How many courses can offer that? --- California teacher in a 1.9K student, minority public high school.

## *Cultural Linkages*

We all do it. We all look up at some time or another. Unlike other sciences, this science can be done all one's life, at home, with your family.

- “It promotes wonder.”
- “What child has not wondered about their place in the universe? Who has not wondered if there might be life elsewhere? Who will live their entire life indoors?”
- “an appreciation of both the wonder of the universe and the ingenuity of scientists.”
- “It is stimulating to appreciate what men did so long ago without what we think is necessary today.”
- “Adds to students knowledge of self and relation to universe. Helps teens look at things differently.”

Astronomy is also the ‘first science’, the oldest, the mother of all sciences, the grandmother of all sciences, and other similar phrases. How compelling that argument is with administrators isn't made clear, though the argument is commonly expressed by the survey teachers.

Astronomy is the most fundamental science of them all. From the time of the earliest humans we have been looking to the night sky with curiosity. Now that we have the technology to answer many of the questions our ancestors asked, it would be a shame to stop wondering. At its heart, Astronomy is about who we are, how we came to be, and where our place in the universe lies. The sense of wonder it engenders is one of a kind. --- Teacher at a private 500 student school in Connecticut.

The history of astronomy as a pursuit of understanding offers like no other course can an understanding of how we have evolved intellectually, including the complex roles that societal politics, culture, and religion play in the pursuit of understanding our place in the grand scheme, giving us a glimpse of what is to come as well. --- Teacher in a minority, 1.9K students, California public school

Paradoxically, it is considered both advanced, the frontier, the future, and also the least developed...

- “Astronomy is perhaps the most primitive (sic) science and in many cases is the most reproducible under those original conditions.”
- “Astronomy is probably the beginnings of modern human thought.”
- “Astronomy and space exploration may be the future of mankind.”

Astronomy is a part of every culture, not just Western...

- “Man has been looking at the stars since the dawn of the human race. It is something that crosses cultural boundaries.”
- “Close connections to astronomy in culture and history.”
- “It has direct ties to ancient cultures”

Knowing astronomy, to some even today, is still the same hallmark of being educated that it was prior to the time of the Committee of Ten:

I thought it was so amazing last year when some students really didn't understand that the moon rotates around the Earth creating phases or that the constellations appear to move across the sky through the seasons. I feel that these are very basic concepts that all people, no matter the age should know!! Not only the discussion of stars and planets should be taken into account but the whole discussion of the calendar and time. You would think that such basic principles would be known but so many students haven't had Astronomy since 3rd grade. --- A teacher at a 2K-students, Needs Improvement Georgia school.

Most will never be scientists but all should be science literate citizens. --- Astronomy only teacher in a 1000-student Pennsylvania public high school with a planetarium

It also seems to be considered valuable in a philosophical way...

In learning about space, we learn about ourselves. --- First year teacher at a 300-student Illinois public school.

- “Finally, it helps students put life in perspective when we see what our role on Earth is, what role Earth has in the solar system, what role our solar system has in the galaxy, and what role our galaxy has in the universe.”
- “It is important to develop a Cosmological perspective in our students.”
- “Students need to have an understanding of Astronomy. There is an interesting 'world' out there that is just being”
- “Important for student to have a cosmic perspective on science and their 'place in space.'”
- “Big picture needed for human perspective.”
- “It is ultimately a search to understand ourselves and our world better.”
- “makes them aware of our place in the universe.”
- “It offers our students a chance to expand their minds and wonder about the origins of their universe.”
- “This course offers perspective and understanding like no other course can. ... Even a basic understanding of Astronomy offers those who do a deep sense of connection to something grand and far greater than themselves, and yet at the same time makes clear how precious and amazing we are as a human race.”
- “Understanding the universe helps to put our world in perspective.”
- “It helps people to understand what they see about them.”
- “A student who takes Astronomy and truly understands what was taught will never look at the night sky or themselves the same way again.”
- “The answers to our existence (sic) and where we came from can only be answered by studies in astronomy. The future is in the stars.”

It has direct relevancy to modern society...

Technology that comes out of the space program has benefited (sic) the country. Students need to be informed of this. They will be voting for these things in the future. --- Teacher in a 1.4K students public school in Wisconsin.

Space age technology has been around for over 50 years and has an effect on our lives. Astronomy and its physical principles are part of that technology. --- Teacher in a large 3K students, high minority, Texas high school.

As one of the oldest sciences, astronomy has influenced our lives through use of calendars, vocabulary, and the scientific thought process. Most recently, the 'demotion' (sic) of Pluto to a dwarf planet has engendered much discussion about how science changes as improved technology brings new information to us. --- Teacher in a 1K students public school in Massachusetts.

- “The things that they learn one day may not hold true in 3 years due to the imagination, thinking, and discovery of people. The technology component reminds students of where we are and also where we have come from.”

- “Space is just now opening up to us and you will see all kinds of jobs in the near future dealing with space.”
- “...as well as the discussions regarding ethical use of space and of the public's impact on the space program.”

Three interesting arguments for the course, two modern, one ancient...

The only program that created more advancements for society that didn't come from war was the Apollo and Mercury astronaut programs. Any progress to society not gained via war is a subject that everyone should explore. --- Soon to be astronomy teacher at a Needs Improvement school in New Jersey.

Students want it, it's in the state standards, and this nation has a commitment to space exploration. Any school board wanna-be would be gone if they disagreed with those 3 reasons. --- Teacher at a planetarium equipped, Needs Improvement school in Indiana.

Astronomy compels the soul to look upwards and leads off from this world to another. Plato. I couldn't say it better! --- Former teacher from a 1.9K student Texas public high school.

### *Helping with AYP Issues*

With science soon to be a factor in determining AYP status, schools seem to be seeking more options. Teachers have noted that.

Astronomy as an elective provides an interesting and exciting 4th year of science. Students will opt out of science if it isn't something they are interested in. --- Teacher at a AYP Passing tiny 150-student Arizona public high school.

These students would fail for the year and get no credit instead of possibly .5 credit. These students would cause behavioral issues if they remained in Earth Science. Some of these students turn themselves around the following year because they were given a chance to change their work ethic and attitude --- Teacher of a freshmen level astronomy course in a 1.8K students, high minority public high school in Virginia.

My particular school needs general science classes for non science majors. This class provides a classic education in all of the sciences, the history of science, and astronomy and space sciences as well. --- Teacher in a private, 200 student Maryland high minority school.

Also, in the last 2-3 years, our district has mandated that students graduating from high school have 3 years of science. Offering Astronomy will provide another year. --- Teacher in a 2K students public high school in Colorado

- “It is something different, unlike Bio and Chem, it's a good alternative to Physics for seniors ...”
- “it gives students a non-AP option for their fourth science course (only required if they are getting an advanced diploma),”
- “Need for an additional non-math oriented science”
- “Non-science oriented students need this course to fulfill a science graduation requirement.”
- “not all kids can handle chemistry and physics”

An astronomy course, designed appropriately, will meet a variety of states’ standards and national ones as well.

An astronomy course can cover a wide number of benchmarks and standards (i.e. chemistry, physics, biology standards) due to its interdisciplinary nature. Astronomy is well suited to long term science projects. --- Teacher at a Maine 1.2K students public high school.

Honors Astronomy involves all of the important skills that virtually all state and national teaching standards emphasize: critical thinking, application of math and computer skills, project-based learning, development of presentation skills. --- Grades 10-12 astronomy course teacher at a high minority, 1.8K students Passing California public school.

We use a variety of technology (telescopes, CCD imagers, computers) and software (Hands-On-Universe, Adobe Photoshop, TheSky, Starry Night Pro) to aid the state mandate to make sure all students are technologically literate. --- Teacher at a Failing school in West Virginia.

- “The way it is taught focuses on the standards of NSTA, especially inquiry and science as a human endeavor”
- “It's a course that offers practical understanding of the universe that 'increases awareness/literacy of how science works and improves attitudes towards science.' ” (uses quote from Benchmarks of Science)
- “It also reteaches some of the PSSA standards for Earth/Space Science.”
- “I have correlated it with the existing science frameworks that are published by the Arkansas Department of Education.”
- “The WI state standards have astronomical topics included and not all are taught elsewhere.”

- “Also, there are several space science state standards required and only 1 chapter on space taught to only the 10th grade students who take physical science.”

It also can be more valuable than an administrator may think towards helping students pass state end-of-course tests or graduation exams. Note that no state was indicated that had an astronomy end-of-course test but many astronomy concepts do appear to be in other courses’ tests.

Kentucky's Core Content has a subsection based on astronomy. According to KSTA, the lowest scores in the state deal with the universe's formation. Since our state's test is one the engines that drives this train here at [deleted school name] this fact will always make a good case for my astronomy class. --- Teacher at a 1.4K students Passing public high school.

- “with the science PSSA's coming out, it is the only Earth science that students have a chance to experience before the test if they take it in their Junior year”
- “There are Earth Science and Astronomy questions on the WASL.”
- “gain knowledge for the scientific method part of the state science test. ”
- “There are objectives on the ACT that this course covers.”
- “CLEP test prep.”
- “The course does cover Ohio Graduation Test objectives in earth and space science which are not covered in other classes.”

Since AYP status depends on language arts, astronomy can play a role in that...

- “The students are required to produce research papers and other analytic essays. ”

### *Institutional Benefits*

Sometimes it is good to be in the newspapers for a positive reason...

[When the Oregon Department of Education said schools ranked an “F” for astronomy in the state,] Our Superintendent immediately told the press/ public about our thriving Astronomy courses and his commitment to continue to teach this relevant and stimulating course. --- Teacher at an Oregon public high school.

A very common response in one particular group of teachers – those with planetariums—is not to waste such an expensive resource!

At our school, there has always been a strong showing of interest by both faculty and students in the astronomy program. A multi million dollar observatory complex would be a shame to waste: It is routinely used by programs all year long on each clear night, and not only from within our school. Interschool collaborations and other projects from high schools and universities have used the facilities. --- Teacher at a private 1K students private school in New Hampshire, teacher teaches only astronomy, with a portable planetarium and an observatory.

- “You spent how much on the planetarium???”
- “WE HAVE A PLANETARIUM. It would be stupid for us not to use a million dollar facility.”

Teachers note other things that would (or are) going to waste:

- “(cancelling the course will mean the school) does not utilize (telescopes, nature center for observing, local planetarium, etc.).“
- “We have the texts and equipment being wasted in storage.”
- “have one of the largest video and library collections and materials for the course.”

Teachers are resources, too.

I would definitely argue that it is my specialty and that the school should use me for what I'm good at .--- Soon-to-teach first astronomy course teacher at a 500-student Pennsylvania private school.

- “I have a passion for teaching it, and am more than capable.”
- “Do you want me to continue to be a teacher here?”

It also makes school-shopping parents consider your school more closely.

As a selling point to prospective students/parents. Few other schools are doing astro. --- A Georgia 400-student private school teacher.

Upper-level courses such as astronomy are essential in competing (that's what we really are doing!) with private schools (they often cannot offer a specialty course

such as astronomy) --- Teacher at a large 2.4K students public school in Ohio with a planetarium.

A pair of teachers present a possibly typical scenario...

I'll explain the course's value to our students and society, but the administration will politely tell me that students, parents and citizens don't care anymore. --- Self-described somewhat pessimistic teacher at a large, 2.2K students public high school with a planetarium in Wisconsin.

... and solution.

The course is a very effective way to counter the anti-science and general apathy rampant in the public today. --- Self-described optimistic teacher at a similar school in Tennessee, 1.6K students, with planetarium, teaching in first year of course.

Another scenario 'pairing'...

Unfortunately, money wins and I doubt this course will be offered again in the future (its been two years now since the last offering). --- Self-described pessimistic former teacher from an AYP Passing, 400-student Wisconsin public school.

...and a possible solution, too.

...students from surrounding schools enroll into our course. Because they do not attend our school, we can count their presence and receive partial state aid. Economics are always a good argument. --- A teacher at a 1.8K students public school with a planetarium in Michigan.

### *The Science Itself*

content is vast and it allows student creativity and imagination to expand. --- A first year, and only time teaching astronomy, Georgia, 1.6K students public high school teacher.

I would say that astronomy is not a niche science, it's the foundation science from which all other sciences emerge and no other science class can better prepare students to see the interconnectedness of the different science disciplines & the connectedness of themselves to the world that we live in. --- Teacher in a Needs Improvement, high minority, 2K students New Mexico high school.

Additionally...

- “It offers richness to the student's knowledge base and ...”
- “Students learn about the nature of science and inquiry as well as astronomy content which allows them to better understand the world around them.”

The science is more accessible to student minds than some other ones...

Also its one of the few courses that you can learn something that day and use that knowlege that night. --- Teacher at a 1000-student, Minnesota public high school.

One of the few courses that students actually take away skills and information that they can use and remember (directly) for the rest of their lives, especially if they spend any amount of time in the out of doors. --- Planetarian/teacher at a 1.3K student, Passing, Wisconsin public high school.

- “Astronomy is relevant to students because all students have access to the night sky.”
- “Students can experience original discovery by repeating acts from thousands of years ago.”
- “I teach physics and physical science, as well, but these disciplines seem 'static'.”

Astronomy is the rare science where amateurs do make significant, valid, and valuable contributions, and this can be a real jumpstart to a college career. Students can actually contribute original research – some have discovered new asteroids, for example -  
- to astronomy and high school students can feel an ownership of the material.

This course gives students an opportunity to contribute to the school and astronomy research. Many of my students are non-athletes who really love astronomy. They are involved in several reseach programs through NASA and get their observations publicized frequently. They have the same pride in

contributing to astronomy as athletes do in sports. ---Teacher at a small, 400-student Kansas public high school, with a portable planetarium and an observatory.

We've contributed to the body of scientific knowledge by discovering 3 supernovae, over 20 asteroids, and by providing followup measurements on nearly a hundred Near Earth Objects. --- Teacher at a public North Carolina, 2.5K-students high school with no observatory.

We involve our students in real research with astronomers. For example, we are currently one of 14 classrooms involved in a joint study between GAVRT and the Spitzer Infrared Space Telescope studying AGN of various masses to see if there is a correlation between the radio frequencies and infrared data collected. We are collecting real time data and archived data using both instruments. --- Full-time astronomy teacher in an 2.2K students Oklahoma public school.

### *Some Strategies*

The sky will be there for a long time...your entire lifetime...and you will know it better by taking this course. --- A Georgia teacher at a large 2.8K students, minority school, with a portable planetarium.

I'd give my class evaluations, which are generally very positive. I'd state how we don't really have any expenses to keep the course running, besides of course my salary. (I teach 5 mathematics and this 1 science class). And, perhaps most importantly, I'd reiterate the justifications I gave when first proposing this course: that its subject matter is intrinsically interesting, that it provides a great way to review and use much of the science and mathematics that was previously taught, etc. --- Teacher at a 600-student private school in Ohio.

I would talk about this integrated science brings physics, chemistry, earth science and mathematics into the student's repertoire and that this helps us meet the state goals in science. --- Teacher at a small 300-student Illinois public high school.

Some strategies are just unique.

Three, we have an Apollo astronaut [name deleted] who graduated from our school. --- Teacher at a Michigan public school.

I teach this course to many students who are interested in science through science fiction. Many of these students may not go to a traditional 4 year university. Many will go to a 2 year technical college. This course prepares them for the

critical thinking needed in the course work at those institutions. Many students are turned off by science in general, but are extremely interested in astronomy and space science. Students who enter in the freshmen year comment that they learn much chemistry and physics in the class that it makes it easier for them to take these classes as upper level students. --- Teacher at a 1600 students public high school in West Virginia.

Results should count!

Continued strong student demand and support for the course speaks for itself. --- Teacher in a 1.1K-students private New Mexico school.  
Plus...

- “Several past students have become astronomers.”
- “Some wonderful research projects have been done over the years, several students have taken projects all the way to the California State Science Fair.”
- “We have high science scores relative to the rest of the school.”

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