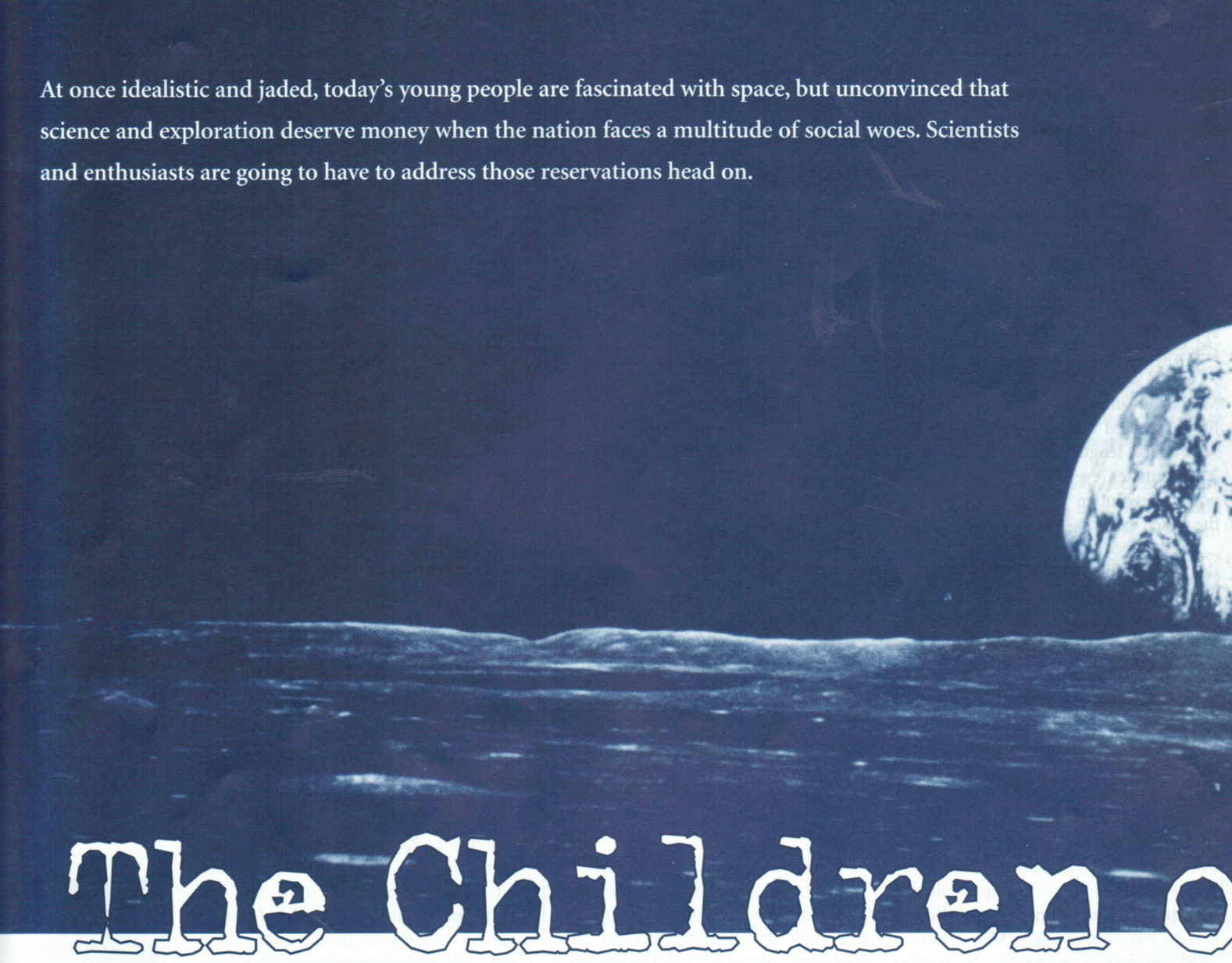
At once idealistic and jaded, today's young people are fascinated with space, but unconvinced that science and exploration deserve money when the nation faces a multitude of social woes. Scientists and enthusiasts are going to have to address those reservations head on.



The Children o

Elizabeth N. Waterhouse
Shaker High School

June 24, 1995. I sat on a sofa cushion in the small gym and listened to Don McCarthy of the University of Arizona speak about NASA's new mission to search for extrasolar planets and life. It was my first day at the university's Astronomy Camp, and I was immediately captured by both the passion that radiated from this man and the implications of the search if it were successful. McCarthy concluded with an image: that of Earth from space. He explained that children were being raised with this image, the view like a swirling blue, green, and white marble. He invited us to ponder how this new perspective could change society.

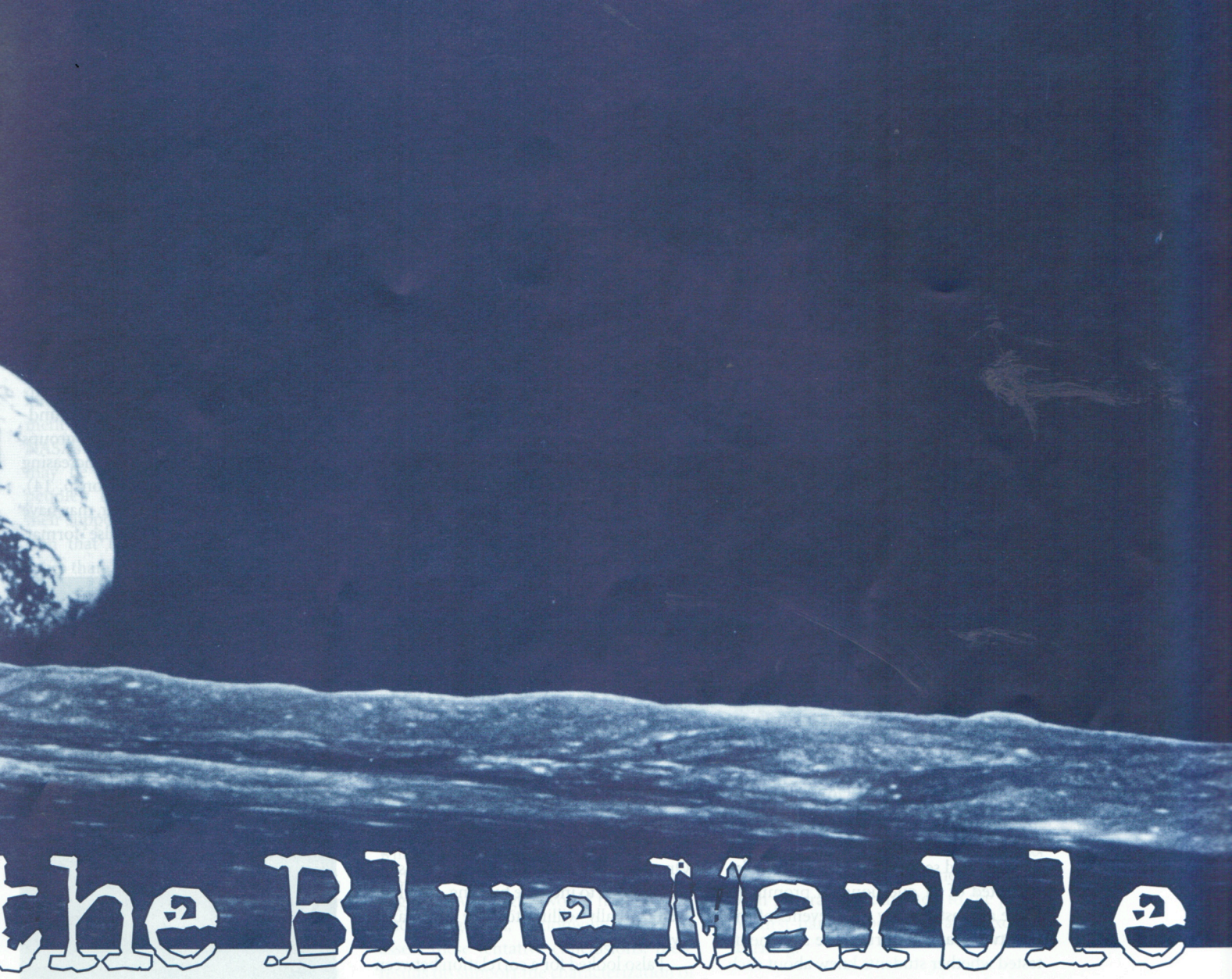
The image of Earth from space symbolizes how science has progressed and revolutionized our world. Children today are constantly being told that technology is the career path of the future. It is the age of the gigahertz, in which information flows rapidly and the world is united by cables, TVs, and computers. Technology has shaped work and leisure and provided new, higher standards of excellence. Being raised in this informational surge has taught us young people to take efficiency and scientific breakthroughs for granted. We cannot imagine a world without our precious modern advancements.

I believe that my generation is one of transition, but to what? Students today are caught in a crescendoing battle between the benefits of technology and the dehumanization of our world. My generation craves money, cars, and cellphones along with picnics and evenings by the fireplace. We embrace the efficiency of the computer but grow restless from the dull glow of the screen. We delight in the practicality of answering machines but dislike the coldness of recorded telephone services. My generation is a group of goal-oriented romantics: hippies marred with a drive for fame and success. We are conglomeration of materialistic, frustrated dreamers.

Generations and Marbles

This contrast of our goals and desires extends to our view of the space program. Students today are the children of the blue marble. The view of Earth from space is ingrained in our minds, branding a reminder that space flight is possible. But as with technology, our appreciation for space exploration has dimmed with familiarity. My generation has been raised knowing that America reached the Moon; the *Challenger* accident is a dim or nonexistent memory. Unlike our parents, we see human space flight as ordinary, not miraculous.

At the same time, students today are frustrated by the debt left by older generations. This burden has conditioned us to



the Blue Marble

shun organizations apart from those that have produced tangible improvements to our lives or are considered politically correct. For most young people, NASA falls into neither category. Its benefits are often unrecognized. The medical, material, and other technological advancements, let alone the science, are overshadowed by negative impressions and financial worries.

And yet, though young people criticize NASA's funding and remain oblivious to its activities, we do possess a natural inquisitiveness and curiosity. As dreamers and visionaries, we are attracted to the elusive and the mysterious. Bookstores cater to our interest in pseudoscience, astrology, and mysticism with shelves dedicated to horoscopes, ESP, and miracle cures. Like the frontier in 19th-century America, space offers excitement and promise. Our interests in fantasy, combined with those in science and technology, naturally incline us to space.

But are these interests strong enough to overcome the reservations? Are we adequately informed when we make judgments of NASA programs? Indeed, are these generalizations about my generation even correct?

To probe these questions, I undertook a short survey of students at my school, Shaker High School, in the North Colonie Central School District near Albany, N.Y. English classes, selected randomly from the 11th- and 12th-grades, completed the questionnaire. Two hundred eighty-seven students participated in all. Their responses reflect the attitudes of young people in a predominantly white, urban community of about 33,000, where the average household income was $43,000 in 1990 (putting incomes in the second quartile nationally) and only 4 percent of citizens had incomes below the poverty level.

The Next Generation

The first section of the survey probed the students' raw interest in astronomy and space-related topics. As predicted, respondents stated that they were inclined to read science fiction and watch shows such as *The X Files*, *Sightings*, and *Star Trek*. Fifty-seven percent indicated that they read sci fi; 15 percent said it occupied half or more of their reading time. Two-thirds indicated that they watched space-focused shows. These local results agree with national, and indeed international, trends. *The X Files* is among the most popular shows on television; last year, Nielsen found that 17 percent of American viewers tuned in to the show during its old Friday-night time slot.

When it came to documentaries, these numbers decreased. A third of the respondents indicated that they watched programs such as *Cosmos* and *Nova*. The

Earthrise. Apollo 11 *captured this view of Earth on the lunar horizon. On that little ball is the totality of humanity and its works. Photo courtesy of NASA Headquarters.*

same fraction said they read newspaper articles, magazines, and books on astronomy. Additionally, 56 percent of the students agreed that they wished to learn more about astronomy and space in school. These results support my hypothesis that students today possess a genuine interest in space, and especially in the media that cater to space fantasy.

The second section of the survey consisted of seven multiple-choice questions on space-related science: day and night, seasons, phases of the Moon, relative sizes of the planets, stars, the Milky Way galaxy, comets. This information is taught in science classes at Shaker. The average score was 4.2 out of 7. Students had the most difficulty with the questions involving comets, the phases, and stars.

This level of knowledge is respectable considering that the respondents included students who both liked and disliked the subject matter. I fear, however, that if the questionnaire were administered nationally, the average score would be much lower. The average SAT score for Shaker seniors is almost 100 points above the national average, and 70 percent earn a New York State Regents Diploma, compared to 40 percent statewide.

The third section of the questionnaire consisted of 11 questions on prominent space and astronomy news events of the past two years. Ten true-false statements tested whether students knew about such topics as comet Hyakutake, the martian meteorite, *Galileo*, the fate of the Russian *Mars '96* spacecraft, and the discovery of new planets. The 11th question asked how many space-shuttle missions were completed in 1996. The students were not required to know the exact number, only that it was greater than seven. The average score for these current-events questions was 6.2 out of 11, higher than the 5.3 expected from pure chance.

Ante Up

The final section of the questionnaire focused on NASA's funding. Only a third indicated that the U.S. government spends just 1 percent of its budget on NASA. The other three choices were 10 percent, 25 percent, and 40 or more percent — all extremely inflated answers (see figure 1 on p. 14).

Only 29 percent of the students said they wished to increase NASA's funding. Thirty-four percent were willing to raise their taxes by $25 to support NASA, whereas 64 percent were not. When asked to prioritize funding for AIDS and cancer research, the military and national defense, poverty and homelessness, education, and NASA, the respondents ranked the space program last, with 46 percent agreeing that it should be the lowest priority.

Yet when asked simply for "support," rather than cash, the students delivered. Sixty-five percent supported NASA's new mission to search for life and Earth-like planets. These figures indicate that despite the students' profession of interest in space, they did not have the type of commitment that ultimately matters: financial.

The most interesting results of this survey, however, were the correlations among the various questions. Of the respondents who had the correct estimate of NASA's budget, 42 percent wished to increase it, while only 9 percent wanted to decrease it and 2 percent to drop funding altogether (see figure 2 on p. 14). Willingness to pay decreased dramatically with delusion over the size of the budget (see figure 3 on p. 14). This suggests that NASA might gain support by publicizing its budget more effectively. On the other hand, of those who said they wished to increase funding, only half were actually willing to raise their taxes by $25.

I also looked for a correlation between the students' knowledge and the priority they gave to NASA out of the five government functions. There was none. The priority did not vary significantly with the respondents' ability to answer either the space-science or the current-events questions correctly. This suggests that students apply a uniform set of principles when they rationalize the finances of government programs. They are commonly committed to solving other national problems before giving money to space exploration.

Nor was there much of a connection between space-science knowledge and opinions on NASA's funding. The supporters of an augmented budget were somewhat more numerous among those who got five or more of the seven questions right (the bars labeled "good" and "excellent" in figure 4 on p. 14). Interestingly, those with the least knowledge showed a similar degree of support. It was the groups in the middle — those who answered three or four questions correctly — which were the least supportive of increased funding to the space agency.

This correlation, however, was quite weak. So, too, was the correlation between space-science knowledge and willingness to contribute 25 tax dollars (see figure 7 on p. 14). The support for planet-hunting did increase with space-science knowledge (see figure 6 on p. 14).

The correlation between current-events knowledge and opinion on funding was even less pronounced; all groups were similarly inclined about increasing NASA's budget (see figure 5 on p. 14). Any correlations here, however, may have been hidden by the true-false format,

Suspended by a thread. A satellite took this picture after being released from its mother ship, the Challenger *orbiter. Photo courtesy of NASA Headquarters.*

which increased the likelihood that respondents could guess their way to a high score.

Extravagance

Although respondents tended to be more supportive of NASA when they were better informed about astronomy, those who wished to increase NASA's funding were all minorities within their knowledge group. The knowledge most likely to change their minds was not astronomical knowledge, but a more realistic assessment of the federal budget. Ironically, NASA's massive public-relations effort may be counterproductive, increasing people's knowledge but undermining their support by giving them the impression that the space agency spends far more than it does.

In the comment box on the survey form, many respondents reiterated their concern for solving problems on Earth first. "I think NASA's program is very good, and I think that discovering new planets and life is important," wrote one. "But I also think that there are more important things that tax money should go to, like education and Cancer Research."

Another wrote, "Life here on Earth deserves our attention and our money much more than life light-years away, wouldn't you agree? The funding for NASA could feed countless poverty-stricken children in *this* world."

Other students used the comment box to criticize NASA's activities: "NASA doesn't affect our lives. They don't contribute really anything but facts about the solar system. I can learn that in school. I wouldn't give them any money." And: "I'd be more willing to give money to NASA if I heard more results and discoveries coming from them."

One student wrote, "NASA doesn't affect our lives. They don't contribute really anything but facts about the solar system. I can learn that in school."

These comments again exemplify how NASA must improve its effort to reach people with its missions and research. Overall, the survey indicated that young people do have an interest in space exploration, but are critical about the size of NASA's budget. They are somewhat more willing to support the agency, morally and materially, when they are knowledgeable. Although I would have to conduct a rigorous, nationwide survey to assess these tentative conclusions, these results do support the characterization of my generation as materialistic visionaries. NASA, and science in general, could capitalize on their raw interest.

Although I believe that education is the key to dissolving my generation's financial skepticism into support, a better-informed public could also end up disapproving of NASA. We need insightful opinions to both promote and reform the space program. As with democracy, the health of the nation is best preserved when voters are knowledgeable.

Learning opportunities both inside and outside the classroom should be made available to cater to students' demonstrated affinity for the unknown. Although a national space curriculum would surely help, individuals can take strides to spread their own passion for astronomy to others.

There are many ways to get involved at all levels of commitment. The most dedicated people, such as McCarthy, have established camps to provide students with a taste of professional astronomy. Securely financed institutions, such as the Dudley Observatory in upstate New York, the U.S. Space and Rocket Center in Huntsville, Ala., and the University of Arizona Alumni Association, provide scholarships to programs such as Astronomy Camp and the U.S. Space Camp, which encourage students already interested in space to seriously consider careers in science. As a former camper in both programs, I can attest to the power of first-hand experience and exciting learning.

If You Tell Two People...

Yet for most people, classroom teaching is the most efficient and practical means to spread scientific knowledge. For someone who is well-educated in astronomy, workshops take minimal time to prepare and are generally well received by students. I have personally found that a focus on elementary students is especially rewarding (see box on p. 15). The interest and energy that these young students emanate amazes me, as an only child immersed in high school.

The challenge with any presentation is to make it active and fun. Colored transparencies, photos, and student participation are assets when you are attempting to stimulate supple minds. The enjoyable presentations are the ones that children remember. For individuals with telescopes, observing sessions at local schools are fabulous introductions to astronomy. Organizing these events

What the...? Shaker High School sophomores Timothy Mosca (left) and Kundandeep Nagi (right) work on an engineering project in their Honors physics class. Photo courtesy of Elizabeth N. Waterhouse.

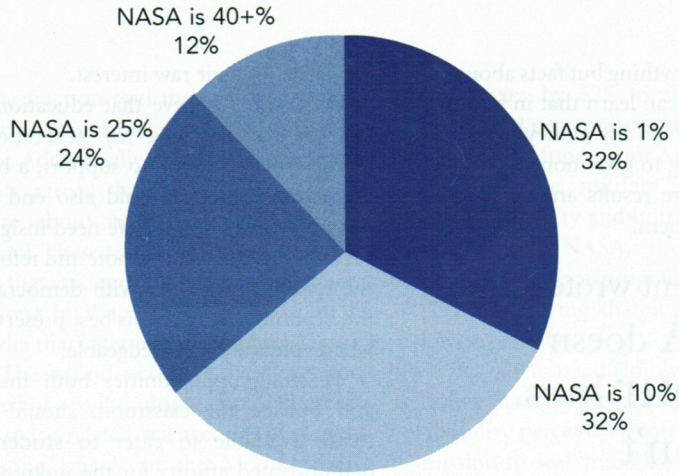


Figure 1. Responses to the question, "About what percent is NASA's government budget compared to the government's total spending?" Only a third of the respondents got it right: about 1 percent. If you use this graph to draw conclusions about students in general, the sampling error is ±3 percent. This and subsequent data courtesy of Elizabeth N. Waterhouse.

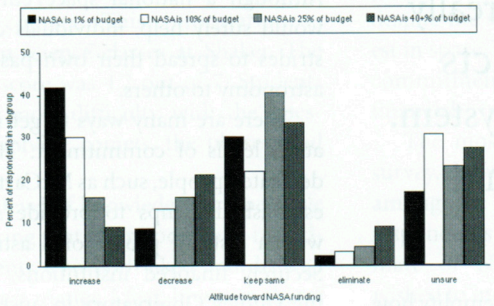


Figure 2. Correlation between perception of NASA's funding and support for increased funding. Those who correctly estimated NASA's budget were more likely to endorse a budget increase than those who overestimated the budget. A chi-squared test performed by the ASP confirms this correlation.

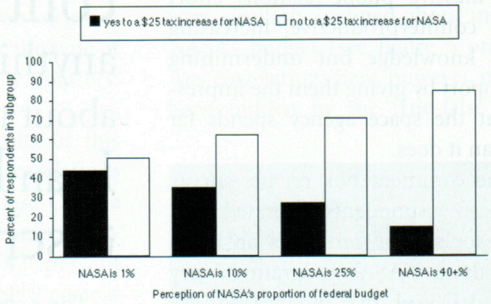


Figure 3. Correlation between willingness to raise taxes by $25 for NASA and perception of the agency's funding. Respondents were more likely to open their wallets if they knew what NASA's current budget is. A chi-squared test confirms this correlation (p = 0.006).

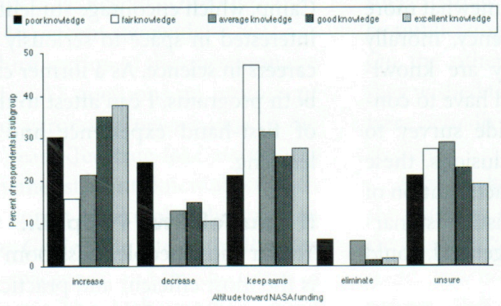


Figure 4. Correlation between astronomical knowledge and support for increased NASA funding. Knowledgeable respondents were more likely to want to give more money to the space program, but the correlation is much weaker than in figure 3. A chi-squared test confirms this marginal correlation (p = 0.084).

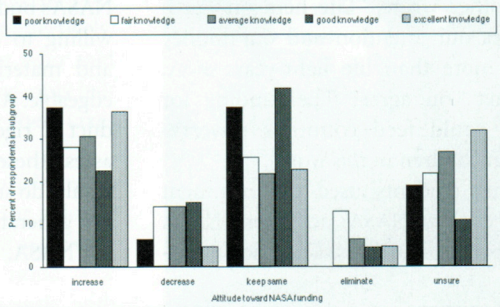


Figure 5. Correlation between awareness of current events and support fo increased NASA funding. No trend emerges. A chi-squared test confirms this lack of correlation (p = 0.149).

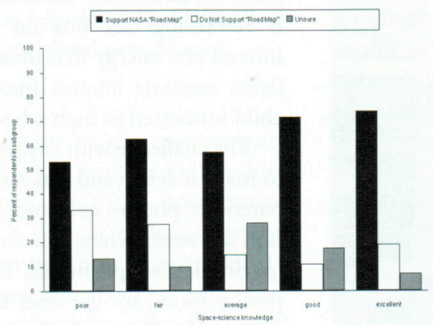


Figure 6. Correlation between support for extrasolar planet searches and astronomical knowledge. People who knew more astronomy were more likely to want to look for Earth-like planets elsewhere. A chi-squared test confirms this correlation (p = 0.0059).

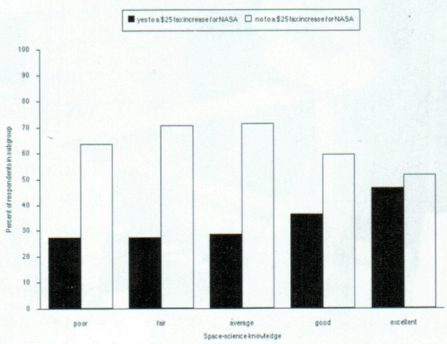


Figure 7. Correlation between willingness to raise taxes by $25 for NASA and astronomical knowledge. At first glance, there appears to be a trend, but a chi-squared test reveals that there is none (p = 0.147). The illusion of a trend is due to the differing number of responses in the various categories.

through science classes ensures students' participation. Many students uninterested in science will find they are pleasantly surprised with their first telescope experience.

One especially important topic for teaching is the actual work of the space program. As demonstrated by my survey, many students are unaware of the expenditures, research, and practical applications of NASA. At my elementary-school teaching session last October, I grasped the opportunity to introduce students to the government budget and its relationship with NASA.

The children were confused when I sat them down to write a proposal for an imaginary, $1 million grant — they had just spent an hour and a half talking about life in outer space and did not see a connection. I promised them that I would link the two topics before the close of our session.

After 20 minutes of group discussion, I brought the kids together in a large circle and they presented their proposals. Students explained their first priority for funding and the reason they selected it. I concluded the program by explaining that, with increasingly tight government budgets, it was becoming the individual's responsibility to campaign for causes that he or she valued.

Although I said I respected that NASA was not everyone's first priority, I emphasized that the space program was especially precarious and in need of public support. I told the children that this was why I was there teaching: to enlarge the cadre of educated space enthusiasts. The intent faces indicated to me that I had made an impression. It was a both a self-

Education might dissolve financial skepticism into support, but a better informed public could also end up disapproving of NASA.

ish and charitable act. I had given the children a piece of my passion and asked them to be accountable for it.

Sadly, I believe that the beauty of Earth from space, the view of the blue marble, is growing stale with familiarity. But there is now another image that I hope my generation will learn to associate with. It is of a shuttle, viewed from space (see photo on p. 12).

What strikes me about this photo is the fragility of the flight. The orbiter resembles a white bird in the midst of blackness. The stark contrast of the vessel with the black space and brilliant blue oceans below is both abhorrent and thrillingly beautiful. The shuttle's mechanical crudeness seems to symbolize that we were not meant to fly; yet we do. We have succeeded in moving against our very nature, escaping the gravity which binds us to this Earth.

As *Challenger*, the shuttle in this image, later found out, space flight has not been a path lined solely with rewards. Humanity has struggled to reach the level of mobility it possesses today. I hope my generation, the dreamers, will appreciate the hope and beauty of space as well as feel a humanistic pride in our ability to study it. I hope that society incorporates the view of Earth, looking inward, with that of *Challenger*, looking outward to the heavens. ***m***

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For more information on Astronomy Camp, read her article, "I Hope That I Could Come," July/August 1996, p. 23.

Students Teaching Students

Elizabeth N. Waterhouse Shaker High School

I believe that high-school students are ideal teachers for elementary students. Young children both respect and relate to students in high school. This relationship allows for an excellent exchange of ideas.

Here are some practical guidelines for students interested in teaching:

1. Call your old elementary school. Your former teachers will probably be more than happy to have you return.
2. Plan ahead. Make your lesson plan longer than needed so that you do not run out of ideas.
3. Make activities short but linked. Children have very short attention spans and do not want to listen to long lectures. Alternating discussion with hands-on activities can be highly successful.
4. Bring visuals. Remember, most kids probably have not seen the neat photos from the *Hubble Space Telescope*.
5. Speak on their level. Define new terms in simple language.
6. Be animated. In case you forgot, kids like being entertained.
7. Bring name tags for the children. Name tags allow you to call on students personally and reign them into the topics. If you have time in the beginning of class (and a good memory), learn everyone's names. The students will love the personalized attention.
8. Have the kids call you by your first name.
9. Dress up. Although a first-name basis is good, jeans are not. The authority of clothes can be an asset if you lose control of the class (although the teacher should always be there to handle discipline). It also demonstrates to the teachers that you respect your responsibility.
10. Make a packet for the children to keep when you leave. Additional information will be welcomed by the kids who were inspired by your presentation. Others will use it in school projects. Parents might also have the opportunity to read the material and discuss it with their children.
11. Have fun! They aren't going to enjoy it unless you do.