



I N S T I T U T E F O R
Learning Innovation

***Amateur Astronomers as Informal Science
Ambassadors: Results of an Online Survey***

Astronomical Society of the Pacific

Prepared by:

Martin Storksdieck, Ph.D.

Lynn D. Dierking, Ph.D.

Melissa Wadman, M.A.

Mika Cohen Jones, M.S.

May 2002

Institute for Learning Innovation • 166 West St., Annapolis, MD 21401
(410) 268-5149 • Fax (410) 268-2179 • <http://www.ilinet.org>

Table of Contents

Introduction.....	4
Methods.....	5
Results	5
<i>Description of the sample</i>	<i>5</i>
Gender & Age Distribution.....	6
Occupation	6
Training in Astronomy.....	7
Participation in Astronomy-Related Activities	8
Interest in Astronomy.....	8
Participation in Astronomy Clubs.....	10
<i>Findings from Amateur Astronomers Currently Engaged in Outreach Activities.....</i>	<i>11</i>
Frequency of Amateur Astronomers' Participation in Outreach Activities	11
What Initiated Participation in Outreach Activities	11
Relationships with Schools and Other Formal/Informal Institutions	12
Types of Educational Outreach.....	14
Organization of Outreach Activities	15
Audiences for Educational Outreach.....	16
Topics Presented in Educational Outreach Activities	18
Type of Presentation Materials Used in Educational Outreach.....	20
Perceived support needs of Amateur Astronomers	23
Materials and resource needs of amateur astronomers.....	27
Workshops: Training in Skills	29
Additional Comments Shared by Amateur Astronomers Currently Engaged in Outreach Activities.....	33
<i>Findings from Amateur Astronomers Currently Not Engaged in Outreach Activities.....</i>	<i>38</i>
Relationship between Engagement and Interest in Public Education	39
Impediments to Engaging in Educational Outreach Activities	40
Supports To Encourage Participation in Educational Outreach Activities.....	40
Primary Audiences You Would Like to Serve.....	41
Recommendations	43

List of Tables

Table 1: Age distribution	6
Table 2: Age by gender	6
Table 3: Current occupation of respondents	7
Table 4: Respondents training in astronomy, physics, astrophysics, or related scientific fields	7
Table 5: Formal and informal training in astronomy-related subjects	8
Table 6: Participation in astronomy-related activities	8
Table 7: How long (in years) have you been interested in astronomy?	8
Table 8: Areas of astronomy interest.....	9
Table 9: Level of public interest in selected policy issues (1990–99)	10
Table 10: Approximate years of membership.....	10
Table 11: How often do you participate in outreach activities?.....	11
Table 12: What initiated your participation in educational outreach?	11
Table 13: Formal or informal association or cooperation with local schools	13
Table 14: Cooperation with local observatory, planetarium, research institutes or professionals	14
Table 15: Types of educational outreach activities.....	14
Table 16: Type of educational outreach activities (collapsed scale).....	15
Table 17: How engage in educational outreach	16
Table 18: Initiation & scheduling of educational outreach efforts	16
Table 19: Audiences for educational outreach.....	16
Table 20: Community groups served by amateur astronomers.....	17
Table 21: Formal sector served by amateur astronomers	18
Table 22: Topics presented in educational outreach activities.....	19
Table 23: Interest in folklore, mythology and story telling by gender.....	19
Table 24: Presentation materials used by amateur astronomers in educational and public outreach?.....	20
Table 25: Source of slides used by amateur astronomers	21
Table 26: Use of computers.....	21
Table 27: Types of presentation materials used as a function of availability and cost	21
Table 28: What sources of information do you use to prepare your educational outreach?	22
Table 29: Please specify astronomy magazines and journals	22
Table 30: Cross-tabulation of astronomy magazines and journals used by amateur astronomers	23
Table 31: What would help facilitate more/improve educational outreach?	24
Table 32: Obstacles to responding to requests?.....	26
Table 33: Kinds of resources which would help you in your outreach efforts	27
Table 34: Format of resources	29
Table 35: Preferred locations for workshops.....	29
Table 36: Preference for where workshops held.....	30
Table 37: Preference for workshop time.....	30
Table 38: Preference for workshop length.....	30
Table 39: Attendance at a workshop at a regional or national amateur astronomer conference/star party	31
Table 40: What kind of training would you seek in a workshop?	31
Table 41: What kind of technical skills would you like to have covered in a workshop?	32
Table 42: Most important thing which would help in my educational outreach efforts	33
Table 43: Interest in educational outreach amongst those NOT currently engaged in educational outreach	39
Table 44: Interest in public education and educational outreach.....	39
Table 45: Cross-tabulation between interest in outreach and current outreach practice.....	40
Table 46: Impediments to engaging in educational outreach.....	40
Table 47: Primary audience you would like to serve.....	41
Table 48: Community groups and other audiences you would like to serve	42
Table 49: Grades you would prefer to serve	42
Table 50: Kinds of support that would encourage you to engage in educational outreach.....	42

Amateur Astronomers as Informal Science Ambassadors: Results of an Online Survey

Astronomical Society of the Pacific

Prepared by:

Martin Storksdieck, Ph.D.
Lynn D. Dierking, Ph.D.
Melissa Wadman, M.A.
Mika Cohen Jones, M.S.

May 2002

Introduction

In order to gauge amateur astronomers' potential role and significance as informal science educators, the Astronomical Society of the Pacific (ASP), in partnership with the Astronomical League (AL), *Sky and Telescope Magazine*, and the Institute for Learning Innovation (the Institute), initiated a large-scale, web-based survey of amateur astronomers' current educational outreach practice and their perceived needs for conducting more and/or improved educational outreach. The effort also gathered feedback about potential products and/or services that might assist amateur astronomers in providing additional and higher quality educational/public outreach. The Institute for Learning Innovation, an Annapolis, MD-based not-for-profit research and development organization, assisted in this effort by designing the online questionnaire, advising on its administration, and the analysis and interpretation of findings.

Specifically, the study investigated the following aspects of amateur astronomers' participation in educational outreach activities:

1. Amateur astronomers' participation in current educational outreach along with their level of engagement, interests within astronomy, reason for doing outreach, etc.);
2. Target audiences served by amateur astronomers engaged in educational outreach;
3. Topics presented by amateur astronomers;
4. Use of media and other resources/equipment for this educational outreach;
5. Partnerships that amateur astronomers engage in for the purpose of educational outreach;
6. The way amateur astronomers organize their educational outreach efforts;
7. Current educational outreach demand not fulfilled by amateur astronomers;
8. Perceived main barriers to providing high quality outreach;
9. Potential products and/or services that would assist amateur astronomers in doing more and higher quality educational/public outreach;

In addition, amateur astronomers not currently engaged in educational outreach were asked:

1. Why they do not engage in educational outreach currently;
2. Whether they would like to engage in such outreach, and if so, under what circumstances;
3. Resources and other support they need to engage in educational outreach;
4. Target audiences they would like to reach, and topics they would like to cover in future educational outreach efforts.

The sample included amateur astronomers who as members of amateur astronomy clubs/societies or on their own initiative, already engaged in some outreach, including making class visits to schools and talks to local youth or community organizations, sponsoring star parties and participating in local festivals. In addition, the sample included those contemplating/interested in doing such outreach.

Methods

In close collaboration with ASP staff, Institute researchers developed a list of potential questions and pilot-tested them in semi-structured telephone interviews with a random sample of 15 active amateur astronomers whose contact information was derived from publicly accessible sources (websites). Based on the feedback received from this group, ASP staff and Institute researchers refined the survey questionnaire. The completed questionnaire was modified into a web-based survey, hosted on the Institute server (see Appendix A). ASP and the AL provided a link to the Institute web survey site and amateur astronomers who visited the ASP and AL websites were encouraged to complete the survey.

The survey was posted and advertised in mid-January on the ASP and ASP-associated websites, on the AL and AL-associated websites, as well as on the website of *Sky & Telescope* and *Reflector*. The survey was further promoted through postings on various listserves known to be highly frequented by amateur astronomers. In addition, a letter to the editor in the February edition of *Sky & Telescope* and notes in *Mercury* and *Reflector* announced the survey. The survey was also promoted through email announcements to ASP and AL members. Survey data was collected through late March.

Since the survey was solely administered on the web, we have no knowledge of the response rate or any bias that may be inherent in such a self-selected sample. However, since the vast majority of amateur astronomers are believed to have Internet access, and since the products that would be created as a result of feedback from this project, would most likely be distributed through ASP's website, we believe that the sample is a representative sample of amateur astronomers who are likely to engage in educational/public outreach efforts. Once the survey data was collected, a frequency analysis was conducted and chi-squares were calculated to determine whether there were significant differences between responses.

Results

Description of the sample

One thousand, one hundred and forty (1,142) amateur astronomers started responding to the survey. The initial question established that 63% (n=717) of those responding were engaged in educational outreach and 37% (n=425) were not. The survey was designed so that the 719 astronomers currently engaged in educational outreach were guided in a linear manner through the entire questionnaire (more than 80% of those involved in outreach continued the survey). If an astronomer was not involved in outreach they were directed to a subset of questions (53%; n=224, responded to these questions). To maximize overall response rate the survey was also designed so that amateur astronomers only saw one question at a time, and those responding were encouraged to skip questions with which they felt uncomfortable. Also as amateur astronomers worked their way through the survey, there was some attrition, particularly on the final personal background questions (depending upon the question in this section only about 500 responded). However, attrition was less than 20% for substantive questions asked of amateur astronomers currently engaged in outreach. For all these reasons, sample sizes vary for individual questions. Appendix B includes a chart tracking responses for each individual question.

Gender & Age Distribution

Eighty-three percent (83%) of the amateur astronomers responding were male and more than half were between 31 and 50 years of age. Another 30% were 51 to 65 years of age. Thus, the typical amateur astronomer responding to the survey was a male between 31 and 65. Table 1 shows the age distribution of the sample.

Table 1: Age distribution of sample

Age group	Percent (n=488)
Under 20	4%
20-30	8%
31-50	52%
51-65	31%
Over 65	5%

A cross-tabulation between age and gender revealed significant differences in the age distribution of male and female astronomers responding to the survey, with relatively more females in the younger age brackets of 30 and under than males, and—conversely—more older males (see Table 2). This could be mean that women are more interested in amateur astronomy when they are younger or that recent efforts to engage females in science is proving successful at least for younger women. It is likely that the gap between the number of male and female amateur astronomers will decrease over time.

Table 2: Age by gender

Age group	Gender ₁	
	Male (n=407)	Female (n=81)
Under 20	3%	14%
20-30	7%	14%
31-50	52%	52%
51-65	33%	19%
Over 65	5%	2% ₂

Note: ¹ Difference in age-distribution between genders is statistically significant for $p < 0.01$ (Chi-Square test). ² Totals may exceed 100% due to rounding errors.

Occupation

The occupations of amateur astronomers varied greatly, including teachers, professors, research scientists and medical professionals, as well as white collar and blue collar workers (see Table 3).

Table 3: Current occupation of respondents

	Count
<i>Total science professionals</i>	40
Research (scientists)	13
Medical professionals	16
Professionals in astronomy (other than education)	11
<i>Total non-science professionals</i>	107
Business/management/entrepreneurs	26
(White collar) Professionals	81
<i>Total Computers/engineering</i>	119
Engineers	50
Computer specialists/web designers	32
Software engineers/programmers	37
<i>Total “education”</i>	45
Teacher	20
Professor	10
“Museum” educator	10
Other education	5
<i>Total other (technicians, mechanics, service, etc.)</i>	41
<i>Total non-employed</i>	102
Retired or semi-retired	69
Student	28
Not employed	5
<i>Total respondents</i>	454

Training in Astronomy

Forty-three percent (43%; n=214) of the amateur astronomers indicated they had some formal training in astronomy, astrophysics, physics, or other related science field, and 69% (n=335) had some form of informal training in those areas (Table 4).

Table 4: Respondents’ training in astronomy, physics, astrophysics, or related scientific fields

Formal training in astronomy, physics, astrophysics, or related scientific fields		Informal training in astronomy, physics, astrophysics, or related scientific fields	
	Percent (n=493)		Percent (n=488)
Yes	43%	Yes	69%
No	57%	No	31%

In fact, three-quarters of those responding had either formal or informal training specifically in astronomy-related subjects (see Table 5). Cross-tabulations also suggest that male amateur astronomers self report a higher level of formal and informal training in astronomy-related subjects than female amateur astronomers, though the results were not significant on a Chi-Square test for $p < 5\%$.

Table 5: Formal and informal training in astronomy-related subjects

Formal training in astronomy, physics, astrophysics, or related scientific fields	Informal training in astronomy, physics, astrophysics, or related scientific fields	
	Yes	No
Yes	39%	5%
No	30%	26%

Participation in Astronomy-Related Activities

Most of the amateur astronomers responding spend less than six hours per week engaging in astronomy-related activities (83%; n=467). A small sub-sample of amateur astronomers (7%; n=37) spend more than 10 hours per week engaging in astronomy-related activities (Table 6).

Table 6: Participation in astronomy-related activities

	Percentage (n=563)
0-3 hours per week	64%
4-5 hours per week	19%
6-10 hours per week	11%
10-19 hours per week	2%
20+ hours per week	5%

Interest in Astronomy

The majority of amateur astronomers who responded to the survey have been interested in the subject of astronomy for more than 20 years (56%; n=283). In fact, the average length of time was 29 years and one person indicated that they had been interested in astronomy for 65 years. There were relatively few who were new to the field of amateur astronomy: 4% (n=18) had been interested in astronomy for two years or less, and another 11% (n=57) had been interested for three to five years. Table 7 presents these findings.

Table 7: Duration of interest in astronomy?

	Percentage (n=502)
0 to 1 years	2%
2 years	2%
3-5 years	11%
6-10 years	12%
11-15 years	8%
16-20 years	9%
> 20 years (max=65)	56%

We asked amateur astronomers to rate their interest in 16 areas of astronomy on a three-item scale (not interested; somewhat interested; highly interested). Table 8 presents the results. Traditional observation of objects in the night sky was the most frequent specific interest (90% of the amateur astronomers responding indicated this choice). Almost four-fifths expressed high interest in general astronomy and current events in astronomy. The “other” category allowed those responding to specify other topics. Only one new

subject, historic and religious aspects of astronomy, was mentioned, however it was mentioned by ten astronomers. Those interested in history (five mentions) referred to the history of astronomy and discoveries; while those interested in the religious aspects of astronomy were interested in astronomy-related stories in the Bible and the Koran (e.g. Star of Bethlehem).

Table 8: Areas of astronomy interest

	Not interested	Somewhat interested	Highly interested	Totals 100%	Mean
Observing objects in the night sky: moon, stars and star systems, galaxies, etc.	1%	9%	90%	488	2.88
General astronomy/astrophysics/cosmology	3%	18%	80%	485	2.77
Current events in astronomy: solar eclipse, visible comets, meteor showers, etc.	1%	22%	77%	478	2.76
The solar system	2%	34%	65%	482	2.63
Stellar evolution, novas, supernovas, etc.	2%	35%	63%	472	2.61
Public education/teaching, sidewalk astronomy	5%	30%	65%	476	2.60
Astronomical instruments: telescopes, CCD cameras; telescope making	5%	31%	64%	482	2.59
General science	4%	44%	52%	459	2.49
Methods in astronomy	4%	46%	50%	472	2.46
Space exploration, satellites, International Space Station	6%	48%	47%	477	2.41
Search for extra-solar planets, planetary astronomy, astrobiology	8%	46%	46%	473	2.38
Origin of comets and meteors, their impact on earth	8%	49%	43%	475	2.35
Environmental topics: light pollution, greenhouse effect, solar power	13%	51%	37%	473	2.24
Astrophotography	19%	40%	41%	472	2.22
History of astronomy, biographies of astronomers	9%	64%	27%	473	2.19
Folklore and mythology, story-telling	29%	49%	22%	466	1.93
Average across all 16 Categories	8%	38%	55%	492	2.47

Note: Totals may differ from 100% due to rounding errors.

Researchers were also interested in comparing astronomers' interests in astronomy with those of the public. Table 9 presents the results of one question on a National Science Foundation Division of Science Resource Studies (NSF/SRS) survey of public attitudes and understanding of science and technology topics between 1990 and 1999. These data show the level of public interest in selected policy issues and the percentages of those responding "very interested" to a particular subject. These data show that people's interest in space exploration (the closest proxy to astronomy) was the topic consistently ranked the lowest over the 5-year period, with the most interest expressed being in 1997 when a little less than a third of the sample (32%, n=640) indicated high interest. Although they were asked to indicate their interest in these topics as policy issues which could have influenced their responses (by contrast, 68-70% of people surveyed consistently reported very high levels of interest in medical discoveries, a subject that perhaps has more relevance to people's day-to-day lives, thus rates higher as a policy topic), this is still data worthy of note.

Table 9: Level of public interest in selected policy issues (1990–99)

Issue	Percentages of respondents who reported to be “very interested” in the subject				
	1990	1992	1995	1997	1999
New medical discoveries	68	66	69	70	68
Environmental pollution	64	59	53	52	51
Issues about new scientific discoveries	39	36	44	49	45
Use of new inventions and technologies	39	37	43	47	41
Space exploration (proxy for astronomy)	26	22	25	32	28
Sample size	2,033	2,001	2,006	2,000	1,882

SOURCES: National Science Foundation, Division of Science Resource Studies (NSF/SRS), NSF Survey of Public Attitudes Toward and Understanding of Science and Technology, 1999 (and earlier years).

Participation in Astronomy Clubs

More than two-thirds of those responding (69%; n=349) are members of a local astronomy club, association, or society; 37% are officers in the organization. Interestingly, 57% (n=183) have been a member of an astronomy organization for 5 years or less (Table 10). Although on average, amateur astronomers had been interested in astronomy for 29 years, the average time they had been members of an astronomy-oriented club or society was only 14 years. The disparity between interest and participation in an affiliated group suggests that it may take time for an amateur astronomer to act upon his/her specific interest or that amateur astronomers are individually-minded people who take their time before joining more formal organizations of like-minded people.

Table 10: Approximate years of club membership

	Percentage (n=323)
0 to 2 years inclusive	24%
Above 2 to include 5 years	33%
Above 5 to include 10 years	16%
Above 10 to include 15 years	11%
Above 15 to include 20 years	7%
Above 20 to include 25 years	9%

Some of the astronomers responding to the survey identified the specific organization to which they belonged (342 did so), and these data showed that responses came from all across the United States (national astronomy organizations in the US; local and regional organizations in Arizona, California, Colorado, Delaware, Florida, Texas, New York, New Jersey, North Carolina, Ohio, Idaho, Indiana, Illinois, Minnesota, Nebraska, Nevada, New Hampshire Pennsylvania, Kansas, Maryland, District of Columbia, Massachusetts, Michigan, Montana, Utah, Vermont, Virginia & Washington). In addition, a small number of international amateur astronomers responded to the survey (countries represented included Austria, Canada, the Caribbean, France, Germany, Great Britain, India, Iran, & Luxembourg).

Findings from Amateur Astronomers Currently Engaged in Outreach Activities

Frequency of Amateur Astronomers' Participation in Outreach Activities

As discussed earlier, 63% of the sample consisted of amateur astronomers currently engaged in educational outreach activities. In terms of the frequency in which they engage in outreach activities, almost two-thirds of those responding that they do engage in educational outreach (64%; n=400) do so occasionally or monthly. Another 20% (n=125) engage in activities between two and three times per month, and the remaining 16% (n=104) are active almost every week or more often. Table 12 presents these results.

Table 11: Frequency of outreach activities

	Percentage (n=629)
1-7 per year ("occasionally")	30%
8-19 per year ("monthly")	34%
20-39 per year ("bimonthly")	20%
40-52 per year ("weekly")	17%

Note: Totals may differ from 100% due to rounding errors.

What Initiated Participation in Outreach Activities

We were interested to know what initiated an amateur astronomers' participation in educational outreach and the questionnaire allowed for only one response (see Table 12). No single reason emerged as the major factor influencing amateur astronomers' participation in science education, though at least a third (n=210) seemed to have been encouraged through their membership in an astronomy club or society.

Table 12: Reasons for starting educational and public outreach

	Percentage (n=588)
Through membership in astronomy club/society	26%
"I have always loved showing people the sky and do whatever I can to enhance their experience"	20%
Educational outreach is a major activity of my astronomy club/society	10%
Asked by a school teacher to give a presentation/do an activity in school	9%
Asked/encouraged by someone else to engage in public outreach	5%
Public or club Star Parties	5%
Through volunteer or part-time work at a planetarium, science center, or similar type institution	5%
Through full-time work at a planetarium, science center, or similar type institution	4%
Through some other kind of volunteer work	2%
Don't know anymore	1%
Project ASTRO	.3%
The first 6 reasons apply somewhat equally.	.3%
Other	12%

Note: Totals may differ from 100% due to rounding errors.

Twelve percent (n=73) selected "other" as their choice and their description indicated that several of the reasons applied to them. It was also apparent that there were a high percentage of teachers and people

affiliated with scouting. Project ASTRO was also specifically mentioned at least four times in the “other” category (it was also one of the “forced” choices).

Examples from the “other” category included:

Being a teacher/instructor at a school or college (14 replies)

- Adjunct astronomy instructor at local community college
- By being a teacher of astronomy since 1961 at elementary, middle school and university levels.
- Full time science teacher and also sharing through my local astronomy association which has a strong outreach/education component.
- I am a college teacher. I started doing it for my math classes.
- I am a retired professor of physics/astronomy and have been involved in public outreach most of my life.
- I decided to do so and propose a curriculum to the school.
- I teach Astronomy as part of our 8th grade science program.
- Wanted to share my love of astronomy with my middle school students.
- I am a middle school science teacher.
- As a high school science teacher and then as member of an amateur astronomy club.
- Bought a small telescope and started bringing it to Earth Science lab.

Working with scouts (4)

- Am a Boy Scout counselor for the astronomy merit badge
- As a Scout leader, it was a logical extension

Started as a student (2)

- Started when I was managing a student observatory and continued as I've been working in space-based astronomy
- Student job at a campus observatory

A combination of reasons

- Combination of club star parties and volunteering at a planetarium

Other

- Decided to do a talk/star party at a church camp
- First presented "Astronomy 101" slide show at our club's annual star party, and requests began coming in to present it to scouts, etc. Have been doing it for 10 years.
- I monitor events (meteor shower, eclipse), and promote among friends.
- I started giving star parties when [comet] Hale-Bopp was visible. In a town of 14,000 it's impressive to have 25 people waiting for you to get set up at 4:00 A.M.
- I volunteered at my local school.
- Several years ago, I saw a void in our area and began writing my "Stargazer" newspaper column and teaching non-credit, short courses; then responding to requests for presentations
- Through my Astronomy Education business

Relationships with Schools and Other Formal/Informal Institutions

We were also interested in whether amateur astronomers' activities were integrated into local schools and other formal and informal learning institutions and if so, the level of involvement and the variety of ways this integration occurred. Multiple responses were allowed and the results are presented in Table 13. About a third of amateur astronomers (32%; n=186) were not associated with any school or school-like

organization. Fifty-five percent (55%; n=323) have an informal or formal association with a school, college or school board or district, and 22% (n=131) with a local Recreation or Parks department.

Table 13: Formal or informal association or cooperation with local schools

	Percentage (n=586)	
No	32%	
Yes, with a school	44%	} 55%
Yes, with a (community) college	17%	
Yes, with the city or county school board or school district	12%	
Yes, with local Recreation and Parks Department	22%	
Total other	19%	

Note: Totals may differ from 100% due to rounding errors.

Seventy-eight percent (78%; n=201) of the 257 astronomers who answered which type of school they were associated with indicated some relationship with elementary schools, 65% (n=166) were involved with middle schools and 45% (n=122) were associated with high schools. Multiple responses were accepted. A cross-tabulation analyzed the degree to which amateur astronomers focused their efforts on specific school types and the findings indicated that most astronomers did not limit their efforts to one level of school but instead offered outreach to all levels: elementary, middle, and high schools.

Since those responding did not know that a later question would explore their association with planetariums, observatories, and other professional astronomy organizations, an unusually high percentage of respondents chose the “other” category:

- Planetarium/observatory 16
- Science Center/museums 15
- Scouts 10
- Nature centers/envirom organizations 8
- Libraries 6
- Teacher associations 3
- Project ASTRO¹ 3
- Church 2
- Homeschoolers 2

Responses to the specific question about relationships with local observatories, planetariums, research institutes or professionals are presented in Table 14. Multiple answers were allowed. Seventy-two percent (n=422) of the sample indicated that they worked with a local planetarium and/or observatory and/or a local science/technology/nature center or natural history museum.

¹ Project ASTRO: Nation-wide ASP project to improve astronomy education in the classroom, funded by the National Science Foundation.

Table 14: Cooperation with local observatory, planetarium, research institutes or professionals

	Percentage (n=589)
No	34%
Yes, with a local planetarium and/or observatory	45%
Yes, with research institutes or individual professionals in the field of astronomy/astrophysics	25%
Yes, with a local science/technology/nature center, natural history museum, etc.	27%
Total other	11%

Note: Multiple answers possible; totals exceed 100%.

Examples of the most frequently stated “other,” included (not all who indicated “other” provided an example), 12 who indicated local astronomy club and its resources (non-professional observatory), 11 who indicated that the astronomer is a professional at a school, college, or planetarium/observatory and 2 who indicated cooperating with state and national parks.

Types of Educational Outreach

We also asked amateur astronomers in what types of educational outreach they were engaged (see Table 15). Again, multiple responses were allowed. Sixty percent engage in star parties for school groups (n=387) and 73% (n=469) host parties for the general public. In addition to star parties for schools, other school-related outreach activities includes visiting classrooms (45%; n=291), teaching a class themselves (33%; n=210), or providing professional development for teachers (12%; n=80). Fifty-five percent conduct public presentations and 18% organize workshops (most who organize workshops also give presentations). Twenty-two percent (n=138) engage in astronomy-related volunteer work for museums, science centers and planetariums and 13% (n=84) serve as judges for science or astronomy fairs. More than a quarter (n=171) identified internal training for astronomy club members as their educational outreach, and another 21% (n=136) organize guest speakers for club events. These categories were further collapsed and those findings are presented in Table 16. Multiple responses were allowed.

Table 15: Types of educational outreach activities

	Percentage (n=642)
Star parties for the general public or groups other than schools	73%
Star parties for school groups	60%
Presentations/talks/public lectures	55%
Visiting classrooms (school or college)	45%
Astronomy class at a school, community college, adult learning center, etc.	33%
Conduct internal training for club members	27%
Work as a volunteer for planetariums, science centers, etc.	22%
Recruit guest speaker for club meeting	21%
Workshops	18%
Judge astronomy or science fairs	13%
Professional development for teachers	12%
Other	19%

Note: Multiple answers possible; totals exceed 100%.

The “other” category allowed those responding to specify their answers and these responses included some outreach activities that were not included in the closed-answer choices. For example, fourteen of those responding indicated that their outreach activities include disseminating astronomy-related information via email, or maintaining a website with astronomy-related material. Twelve specifically referred to scout merit badges, with most helping a boy or girl scout earn a badge in astronomy, and ten indicated that they write astronomy-related columns or articles for local newspapers or publish newsletters. Sidewalk astronomy was mentioned eight times, and telescope making/teaching and one-on-one instruction was identified six times respectively.

- Email or web-based activities14
- Merit badges for kids12
- Publications in local newspapers/newsletters10
- Sidewalk astronomy8
- (Teaching) telescope making6
- One-on-one instruction6
- Project ASTRO2

Table 16: Type of educational outreach activities (collapsed scale)

	Percentage (n=642)
Star parties	82%
School-related activities (formal education)	81%
Presentations/workshops	58%
Conduct or organize internal training for club members	35%
Volunteer work for "museums" etc.	29%
Other	19%
Replies	n/a

Note: Multiple answers possible; totals exceed 100%.

Researchers also asked amateur astronomers to specify the subjects or topics which they covered in their outreach activities. Their responses correlated highly with their particular astronomy interests. Although not surprising, it does suggest a potential conflict if the interests of amateur astronomers do not overlap well with the astronomy interests of the general public.

Organization of Outreach Activities

Researchers were also interested in the organization of outreach activities. For instance, amateur astronomers were asked whether their educational outreach activities were an individual effort, or conducted as part of a team, or both (refer to Table 17). About a third of those responding (n=192) engage in educational outreach individually, a quarter (n=156) engage primarily as part of a team, and 44% engage in educational outreach activities both individually, and as part of a team or organization.

Table 17: Teaming up or individual outreach

	Percentage (n=620)
Mostly as an individual	31%
Mostly as part of a team effort	25%
Both	44%

Researchers also were interested in how educational outreach activities were initiated and scheduled. These findings are presented in Table 18.

Table 18: Initiation & scheduling of educational outreach efforts

	Percentage (n=617)
An event initiated by the astronomer or another individual	65%
An event initiated, organized, and/or sponsored by the local astronomy club or organization	62%
An event initiated, organized, and sponsored by a local organization (e.g. planetarium, science center, community group, etc.)	44%
An event initiated, organized, and/or sponsored by the local school/school liaison	52%
An event organized and scheduled through a club's speakers bureau	8%
Others	11%

Note: Multiple answers possible; totals exceed 100%.

Audiences for Educational Outreach

Amateur astronomers generally perceive that they are serving a broad representative set of audiences (see Table 19; multiple responses were allowed). Three-quarters of those currently involved in educational outreach (n=507) target the general public, and 70% (n=471) target school groups. Approximately half of all amateur astronomers responding to the survey indicated that they reach families with children, adults, teenagers and/or children, or community groups respectively. When families, adults, and teenagers are collapsed into the “general public” category, 91% (n=609) of those responding target the general public. If community groups are also collapsed into the “general public” category, 92% (n=615) of those responding reach the general public. While not offered as a category in the closed-ended questions, throughout the questionnaire internal training of new club members and/or interested individuals who visit club meetings, was also identified as an important, though oftentimes overlooked, audience for educational outreach.

Table 19: Audiences for educational outreach

	Percentage (n=617)
General public	76%
School groups	70%
Adults	55%
Teenagers and/or children	54%
Families with children	50%
Community groups and other audiences	48%
Other	19%

Note: Multiple answers possible; totals exceed 100%.

Most responses in the “other” category were specifications of existing categories rather than new ones:

- Scouts30
- Other amateur Astronomers14
- College level10
- Park visitors6
- Teachers6
- Church groups5
- Seniors4
- Project ASTRO2
- Home schooled children2
- 4-H groups2

Those responding were also asked what type of community groups they serve (Table 20; multiple responses were possible). The great majority of amateur astronomers who target community groups serve youth groups (86%; n=267), but “adult groups” were also targeted by more than two-thirds of those responding (69%; n=214) suggesting that amateur astronomers target a broad community, offering their educational activities wherever, whenever and to whomever expresses an interest or need.

Table 20: Community groups served by amateur astronomers

	Percentage (n=310)
Youth groups (like boy or girl scouts)	86%
Adult groups	69%
Family groups	55%
Camps	44%
Church groups	40%
Other	20%

Note: Multiple answers possible; totals exceed 100%.

A fifth of those responding checked the “other” category, and as was the case with previous questions, used this category to specify their answers without creating new audiences per se. The most frequent categories included:

- Astronomy groups (including own)8
- Park visitors7
- Mosque/church5
- Science centers/planetariums/libraries5
- Nature/environment groups4
- Business3
- Seniors3

Four hundred and sixty-six of those responding indicated that they target their efforts to schools. Again, multiple responses were accepted, and results suggested that as observed earlier, many amateur astronomers who specifically target schools work with many different grade levels. However, the percentages decline markedly as one progressed from the elementary school level to community college/university level (Table 21). Eighty-two percent (82%) target elementary schools, however only 55% target high schools and 32% focus on community college or university. This likely suggests two trends: astronomy is a more prevalent part of the elementary and middle school curriculum, at that level

there are more field trips, and more flexibility to include a specialized subject such as astronomy. Second, many amateur astronomers may not feel comfortable teaching upper grades, since astronomy is taught in more mathematical ways at those levels.

Table 21: Formal sector served by amateur astronomers

	Percentage (n=466)
Elementary school	82%
Middle school	74%
High school	55%
Community college/university	32%

Note: Multiple answers possible; totals exceed 100%.

Topics Presented in Educational Outreach Activities

Amateur astronomers offer a variety of astronomy topics in their educational outreach (see Table 22; multiple responses were accepted). Most of the activities they engage in correlate highly with the interests in astronomy identified by amateurs presented earlier (Table 8). Traditional observation of objects in the night sky is the most frequent topic presented (91% of the amateur astronomers responding indicated this choice). Almost four-fifths expressed high interest in general astronomy, seasonal sky tours, introduction to the night sky and current events in astronomy.

Interestingly though, it is also important to compare what is presented by astronomers with the public's interests which were presented earlier in Table 9. Although not a very in-depth exploration of astronomy topics and asked within the context of these topics as policy issues, the least interesting of the topics presented to the public in the national surveys was space exploration (the closest proxy to astronomy), which was consistently ranked the lowest over the 5-year period assessed. For example in 1999, almost as many people stated that they were "not interested" in space exploration (25%), than indicated they were "very interested" (28%). Sharing these findings with amateur astronomers and perhaps probing the public's interest in a variety of astronomy topics in more depth as was done in this survey might be a useful way to better inform amateur astronomers of public interest. It is important that those engaged in educational outreach not overestimate the degree to which even the most interested part of the public is willing to learn about astronomy, at least as these survey findings indicate, astronomy viewed through the lens of space exploration.

Table 22: Topics presented in educational outreach activities

	Percentage (n=632)
Observable objects in the night sky: moon, stars and star systems, galaxies, nebula, planets, constellations	91%
General astronomy	82%
Seasonal sky, sky tour, common constellations	73%
Introduction on how to navigate the night sky	73%
Introduction to instruments: telescopes, binoculars, filters, CCD, etc.	72%
Current events in astronomy: solar eclipse, visible comets, meteor showers, shuttle launches, etc.	70%
Solar System	69%
Origin of comets and meteors, their impact on Earth	43%
Environmental topics: light pollution, greenhouse effect, solar power, etc.	41%
Folklore and mythology, story-telling	39%
Methods in astronomy, space exploration	29%
Cosmology	27%
Astrophysics	25%
Biographies of astronomers/astrophysicists	16%
Other	13%

Note: Multiple answers possible; totals exceed 100%.

There also may be disconnects between amateur astronomers' presentation styles and what the public desires. There is some evidence from the field of museums that visitors are interested in story telling, mythology and folklore and that exhibits and programs that integrate these approaches are highly effective. Likewise there is evidence that planetarium programs using this approach are enjoyed more, may be even more memorable, and thus more likely to influence long-term learning. However, findings presented earlier in Table 8 indicate that only 22% of the amateur astronomers responding to the survey claimed to be highly interested in these techniques, overall the lowest rated item on the questionnaire. A significant difference between male and female amateur astronomers' responses was observed on this item, with female amateur astronomers more interested in folklore, mythology, and story-telling than their male counterparts (Table 23) though no other factor, such as years of interest in astronomy, was significant. Should data actually reinforce that the general public does value these techniques more than amateur astronomers, at least the male ones, science-oriented presentations of astronomy-related subjects may not be as effective. Training efforts might need to include vignettes and stories about constellations, names of stars and planets, etc. that will captivate a novice audience more interested in "stories," than pure presentations of the science of astronomy. Female amateurs may also need encouragement that such approaches are valid and can still include accurate and timely astronomical information.

Table 23: Interest in folklore, mythology and story telling by gender

Interest level in folklore, mythology, story-telling	Gender ¹	
	Male (n=383)	Female (n=78)
Highly interested	18%	44%
Somewhat interested	52%	37%
Not interested	31%	19%

Note: ¹ Difference in interest between genders is statistically significant for $p < 0.01$ (Chi-Square test). Totals may differ from 100% due to rounding errors.

Type of Presentation Materials Used in Educational Outreach

We also asked those who responded about the type of presentation material they currently use to conduct their educational outreach (Table 24). The telescope is clearly the method of choice for most amateur astronomers, which would be expected since most of them are interested in observable objects in the night sky: 92% (n=580) of respondents use a telescope in educational and public outreach. However, 83% (n=524) also use visual aids of some kind, including videos, computers, slides or models. A little more than half of those responding (52%, n=324) prepare their own material for presentations, and two-thirds (66%; n=416) provide their audience with handouts. More surprisingly, half claim that they engage their audience in hands-on activities, though a closer analysis of the data suggests that this is probably closely connected to operating a telescope. When the two categories were collapsed only 18 additional counts resulted in the telescope category, suggesting that 298 astronomers had answered “telescope” and “hands-on activities.” Among amateur astronomers, working with the telescope is perceived as a hands-on activity: “When indoors, I have the telescope pointed toward several pic[ture]s of nighttime objects. This way the children can have “hands-on use” and images of the telescope instrument.” However, some amateur astronomers include other types of hands-on activities in their contingency plans for cloudy or rainy nights: “A few hands-on activities may be done on cloudy nights.” One person stated in the “other” category: “I wish I had more “hands-on stuff!”

The other category also included:

- Pictures from books and magazines.....12
- Star charts10
- Portable planetariums.....10
- Binoculars7
- PowerPoint presentations.....7
- Meteorites and other real objects5

Table 24: Presentation materials used by amateur astronomers in educational and public outreach

	Percentage (n=629)
Telescope	92%
Handouts	66%
Slides	52%
Hands-on activities	51%
Computers	42%
Posters	36%
Overheads/transparencies	36%
Videos/DVDs	33%
Multimedia presentations	28%
Models	23%
Other	16%

Note: Multiple answers possible; totals exceed 100%.

All 325 amateur astronomers who checked “slides” elaborated on the source of the slides they use in educational outreach (Table 25). Over three-quarters (78%; n=254) use purchased slide sets. However, many also use their own photographs (61%; n=199), or downloaded images from the Internet (52%; n=168).

Table 25: Source of slides used by amateur astronomers

	Percentage (325)
Purchased sets	78%
Own photographs	61%
Internet	52%
Other pictures	41%

Note: Multiple answers possible; totals exceed 100%.

Forty-two percent stated that they use computers in some capacity in their educational outreach (Table 26). Ninety-seven percent (97%; n=254) of those use astronomy software and/or the Internet in some way or another. Astronomy software alone was mentioned by 87% (n=229), the Internet by 74%, and PowerPoint presentations by 49%.

Table 26: Use of computers for educational and public outreach

	Percentage (n=262)
Astronomy software/simulations	87%
Websites/Internet	74%
PowerPoint presentations	49%
Other	10%

Note: Multiple answers possible; totals exceed 100%.

Table 27 presents the results of a cross-tabulation between the kinds of presentation materials amateur astronomers use and the ease of their availability and factors such as cost; multiple responses were accepted. While often not happy with the cost associated with various types of presentation materials, these astronomers are not negatively influenced by cost in terms of what they use. There is no relationship between the kinds of material used and whether people have easy access or not.

Table 27: Types of presentation materials used as a function of availability and cost

	Are materials you use for doing educational outreach easily available/accessible to you?			
	Yes 63% (n=394)	Yes, but expensive 26% (n=162)	No 6% (n=39)	Don't know/does not apply to me 5% (n=31)
Telescope	91%	94%	92%	97%
Visual aids	87%	89%	85%	65%
I prepare my own materials	53%	49%	54%	45%
Models/Computers	51%	58%	33%	39%
Hands-on activities	50%	59%	33%	42%
Other	15%	19%	18%	10%

Note: Totals may exceed 100% due to rounding errors

Table 28 also indicates that amateur astronomers frequently use astronomy magazines, websites, star charts, popular astronomy books, and astronomy software to prepare their educational outreach.

Interestingly, the Internet is ranked almost as high as the highest ranked source of information, astronomy magazines and journals. Hence, ensuring the scientific accuracy of information on the web seems to be particularly important. And since findings demonstrate that more than 80% of amateur astronomers already rely on the Internet for astronomy information, an interactive website would be a viable and useful tool for disseminating information and material to amateur astronomers.

Table 28: Sources of information used to prepare for educational and public outreach

	Percentage (n=622)
Astronomy magazines and journals	89%
Websites	82%
Star charts	77%
Popular books on astronomy	73%
Astronomy software	68%
Popular science books and textbooks	39%
Scholarly science books	32%
General science journals and magazines like Science, Nature, or Scientific American	32%
Other	14%

Note: Multiple answers possible; totals exceed 100%.

Other sources of information included:

- Advice from fellow club members, colleagues and other astronomers 14
- Project ASTRO/ASP (Universe at my Fingertips) 14
- Personal experience and observations..... 10
- NASA/JPL² 8

Astronomers were asked to specify the astronomy magazines and journals they read (Table 29). Ninety-nine percent read at least one of the three magazines “Sky & Telescope,” “Astronomy,” or “Mercury.”

Table 29: Astronomy magazines and journals used to prepare outreach efforts

	Percentage (n=550)
Sky & Telescope	97%
Astronomy	68%
Mercury	14%
Other	23%

Note: Multiple answers possible; totals exceed 100%.

Other journals and magazines purportedly used by amateur astronomers include:

- Amateur Astronomy.....13
- Scientific American13
- Astronomy Now9
- Planetary Report9

² NASA=National Aeronautic and Space Administration; JPL=Jet Propulsion Laboratory

- Sky News8
- Reflector.....6
- Sky & Space.....6
- Nature, Science6
- Science News6
- Internet Sources5
- Star Date (radio).....4
- Sterne und Weltraum (Ger: “Stars and Space”).....3

Table 30 presents the results of a cross-tabulation to determine any overlaps between readers of particular astronomy magazines and journals; multiple responses were accepted. One can see that there is very high overlap between *Astronomy* readers and those of *Sky & Telescope*. Almost all of the readers of *Astronomy* also read *Sky & Telescope*. The same is true for *Mercury*, with almost all of its readers also reading *Sky & Telescope*. In part, this is likely an artifact of the specific channels in which the survey was promoted and advertised (letter to the editor to *Sky & Telescope* Magazine alerting its readers to the survey).

Table 30: Cross-tabulation of astronomy magazines and journals used by amateur astronomers

	Sky & Telescope 97% (n=531)	Astronomy 68% (n=376)	Mercury 14% (n=77)	Other 23% (n=128)
Sky & Telescope	100%	96%	94%	93%
Astronomy	68%	100%	64%	73%
Mercury	14%	13%	100%	23%
Other	22%	25%	39%	100%

Note: Multiple answers possible; totals exceed 100%.

Perceived support needs of Amateur Astronomers

Researchers asked amateur astronomers who are currently engaged in educational outreach what - if anything - might assist them in doing more or improving their educational outreach efforts. Overall, the responses suggested that the amateur astronomer community is in search of assistance to support their outreach efforts. For example, they offered comments such as the following:

SOS! We really need help.

We need urgent help.

Nine categories emerged as potential areas where ASP could provide support for amateur astronomers: 1) presentation materials, 2) other resources, 3) access to equipment, 4) training in understanding audiences, 5) better access to experts, 6) training in presentation skills, 7) networking, 8) training in content areas, and 9) a mentoring structure (Table 31).

Table 31: Things that would help facilitate more/improve educational outreach

	Percentage (n=605)
Material	66%
Having more time/sharing task	59%
Content (training, mentors, contacts)	41%
Technical	36%
Soft skills	34%
Access to info and material	24%
Other	13%
Nothing, I am doing fine	10%

Note: Multiple answers possible; totals exceed 100%.

About two-thirds of those responding (66%; n=401) felt that material of some sort would be useful. Through an educational outreach web portal focused on amateur astronomers, ASP could provide a range of materials, from images to handouts, curricula, explanatory texts, packages of materials, etc. Astronomers offered multiple suggestions for the sort of material and resource support ASP could offer:

We need access to inexpensive copies of ASP slides without copyright infringement.

Discounts on HST slide sets w/ proof of outreach.

Easy methods to generate 35 mm slides from Internet or hardcopy.

Less expensive, "summary" topical slide sets. And we need up-dated slides.

Free slide sets, free posters, perhaps even PowerPoint presentations and videos.

15, 30, and 60 min prepackaged PowerPoint presentations with sound and video.

Access to more physical props.

I would like a video that shows real Moon and planetary motion, including retrograde motion.

People don't understand computer planetarium displays. They don't look real.

Starter materials "How to get started in Astronomy [outreach]." The public likes handouts - would love to get more posters.

I could use web resources of presentation ideas and materials.

A third felt that access to better presentation equipment would be helpful to them. While ASP cannot provide this service, it might be possible to create an exchange and communication section on the web portal that would facilitate local coordination of equipment; a feature that could also provide better access to professionals in the field locally (25% felt this would be helpful).

Surprisingly, "soft skills" (understanding the audience, better targeting, and presentation and facilitation skills) were identified by a third of those responding as being helpful. These same skills also emerged from the open-ended answers given in the "other" category. One person indicated the need for better publicity, public relations, or marketing skills. Specifically, many amateur astronomers feel the need to better communicate their willingness to do educational outreach to schools and the general public, and needed

assistance in better targeting their audience. The following comments illustrate amateur astronomers' perceived needs in the area of PR and marketing:

I would like a method for getting better publicity

I need help communicating myself as an available resource to the community.

It would be great to have better contacts and information on initiating contact with organizations. I feel like I am a resource that schools/teachers are not making use of.

Marketing help/opportunities would really help. I can't find enough opportunities to help.

It would be great if there were more schools and other groups knowing I do the outreach.

Several astronomers also specifically mentioned that training in better targeting their audience would be useful and would greatly support their ongoing outreach efforts. ASP could publish relevant material, but more so, could offer workshops of various kinds that address these issues:

I need to better my ability to "stratify" audience. It's always a mix of ages and knowledge levels.

It would be useful to have better material for younger age groups.

And amateur astronomers expressed a clear need to network more with other astronomers engaged in educational outreach:

I could use better organization skills for my local astronomers club.

It would be good to network with others to learn how they do it on a budget, in [the] shortest time.

Not surprisingly, many amateur astronomers (59%; n=354) felt that time was a major constraint limiting their ability to expand their outreach efforts. While ASP cannot address the issue of time, it can –perhaps through a web portal – connect amateur astronomers who are not currently working with others on the local level, allow for the exchange of ideas and materials, and generally create a community of like-minded individuals, including mentors and local experts.

In addition to not feeling that they always know best out to reach a particular audience or set of audiences, many amateur astronomers currently involved in some type of outreach activity reported that they are not able to fully serve all audiences who request educational outreach. A third of those responding (33%; n=196) felt that they were unable to respond to all requests (Table 32). For those who receive more requests for outreach than they fulfill, more than three-quarters (77%; n=150) reported that they lack the time to conduct all of the outreach activities they are requested to lead, and almost half (48%; n=93) lacked the resources or support to act on requests for educational outreach. Only 14% (n=28) believed that a lack of knowledge or expertise prevented them from responding to requests for educational outreach: "I lack the guts to go into the daytime classroom. I'm comfortable at the telescope."

Table 32: Obstacles to responding to requests for additional/more outreach

	Percentage (n=195)
Lack of time	77%
Lack of resources/support/"manpower"	48%
Lack of expertise/knowledge	14%
Lack of interest	6%
Total other	17%

Note: Multiple answers possible; totals exceed 100%.

Amateur astronomers responding provided a number of specific comments that illuminated their constraints. In many cases, these are constraints, like time, that consistently emerged from a variety of items on the questionnaire and are beyond the control of ASP:

LACK OF TIME!!!

Daytime presentations at schools - day job makes it impossible.

I'd love to spend all my time on astronomy education, but unfortunately I have to work for a living.

Other comments were travel or transportation-related:

There is the difficulty of travel.

Excessive travel requirements.

Actually only once, it was too far to go.

I cannot travel to all rural areas.

If I had an astronomy van to haul around my "stuff" I could do more.

Lack of transportation for equipment.

Many of the comments again illustrated the lack of an astronomers' network to maintain the manpower and active club needed to sustain outreach efforts. Amateur astronomers offered the following comments:

Like many club (120+ members), it's the same half dozen that do everything.

A small core group of my club does 90% of these - and we need to stay employed, happily married, etc.!

Mainly it is the lack of manpower. Once we start a program with say the scouts or a grade school class-then there is a flood of similar requests and we just run out of people and time!

Need to create a larger group of presenters for our astro group to meet with the public.

It usually takes, or needs, more than one person to do a good job.

The need for more resources and materials also served as a constraint for amateur astronomers:

There is a lack of duplicate presentation equipment for doing parallel events.

There is a lack of money to get the facilities.

Materials and resource needs of amateur astronomers

In addition to the general question of what would facilitate more activity and help to improve their educational outreach in which 66% indicated materials, we also asked amateur astronomers what kind of specific resources would help them in their educational outreach efforts (Table 33). Multiple responses were accepted. They were offered a choice of 10 categories which had been identified as key resource areas during the piloting of the survey. All of the offered categories were checked by at least a third of those responding, and six out of the ten were chosen by roughly half of the sample. The only choice that rose significantly above the others was the need for ready-made, targeted, hands-on activities for teaching chosen by 68% of the amateur astronomers who opted to answer the question. Beyond this “stand-out” resource, the rest of the nine categories emerged as viable needs. Interestingly, amateur astronomers seem to be as much in need of “pedagogical” material (hands-on activities, content-material/curricula, teaching tips, etc.; 89%) as imaging materials (posters, simulations, video clips, slides, overheads; 88%). Also surprising was the fact that slides without sample scripts were preferred to slides with sample scripts.

Table 33: Types of resources identified to help in outreach efforts

	Percentage (n=581)
Ready-made, targeted, hands-on activities for teaching (classroom or otherwise)	68%
Content-oriented material/curricula	54%
Posters and other images	53%
Teaching tips	51%
Software/simulations	48%
PowerPoint presentations	48%
Videos/video clips	48%
Slides	44%
Slides with sample scripts	39%
Overheads	35%
Other	10%

Note: Multiple answers possible; totals exceed 100%.

The “other” category allowed astronomers to specify and add to the list of resources that might help them in their outreach efforts. Specifically, astronomers provided the following comments:

Hardware

[As was said earlier, while ASP cannot supply amateur astronomers with “hardware,” it may be possible to link amateur astronomers and encourage exchange of resources]

- "Stuff"/Hardware: Lenses, simple optical equipment
- Eclipse glasses, planispheres
- Equipment; 2 (telescopes, ancillary equipment, computer projector, another laptop computer)
- Expensive hardware - LCD projectors (2), Starlab planetarium
- Modern observing equipment, e.g. video camera for telescope.
- Sources for inexpensive or donated telescope making materials

- Obtaining presentation equipment, particularly computer projectors is difficult so simple visual aids with more common and less expensive equipment would be best.

PR/publicity

- Announcements or something to send to schools to let them know we are available.
- Better PR - i.e. how to get the word out to the interested public
- Convince teachers to make the effort to schedule outside presentations.
- Letting people/groups know I do this gratis.
- PR management
- National organizations promoting participation through large market media

Handouts

- Descriptive handouts
- Handouts for public star parties
- Handouts, such as NASA posters
- Flashy handouts to energize kids the day after the event
- Handouts! Free things for all to bring home and mull over in their own time. Astronomy over-saturates most at first! They need soft exposure.
- More access to affordable examples of the above, easy to duplicate handout materials, material that takes advantage of the fact that most people can learn concepts easiest from analogies/mental images

Visualization

Props

- 3-D models of planets for kids
- 3-D Hands-on materials like scale models of planets or the moon's orbit
- Easily made visual props to represent concepts
- Objects that could be passed around the room. Models of planets, telescope parts, etc.

Presentation materials

- Astronomy DVDs
- Audio tape star guides
- Especially simulations -- the AAVSO observing simulation is a good example
- Access to illustrative graphics in electronic format

Sky maps/planispheres

- Maps of sky
- Planispheres
- Star charts for light-polluted areas

Participation material

- Participation activities for all age groups and all knowledge levels

Mixed answers

- This really depends on the audience. Children want posters, adults want content, all want visuals, some simulations of models/theory.
- If interested amateurs received the *Universe in the Classroom*, or subsets of it, that would be a good resource, in addition to multimedia devices, things like portable easels, screens and larger models for big audiences

Responses also suggested that resources should be flexible and adjustable to specific needs or activities (Table 34). Most astronomers (77%; n=447) indicated they would prefer modular, flexible resources that allow them to design their own outreach activities with the highest degree of freedom. Combined with results from the previous question this result suggests that hands-on activities are desired, but as a stand-alone to be used in a variety of situations and that can be adapted and combined with other activities.

Table 34: Preferred format of bundled resources

	Percentage (582)
Modular, flexible resources, where you can pick and choose and design your own specific activity/event	77%
Complete packages of content, media, and curriculum, where content, supplies and instructions are integrated into a ready-to-use set, but adaptable to the target audience	20%
Complete packages of content, media, and curriculum, where content, supplies and instructions are integrated into a ready-to-use set	4%

Note: Totals may exceed 100% due to rounding errors

Workshops: Training in Skills

Astronomers were asked whether workshops or training of some sort would be helpful to them in their educational outreach efforts. More than half of the 608 responding to the question felt that it depends upon the circumstances (55%), 36% felt that such training would be helpful, and 9% did not think so (multiple responses were accepted). Based on feedback from astronomers, workshops preferably should be local (Table 35), with the great majority of amateur astronomers (77%; n=450) preferring them to take place somewhere close by (less than a two-hour commute). Multiple responses were accepted.

Table 35: Preferred locations for workshops

	Percentage (n=587)
Local (less than 2 hours commute)	77%
Regional (2 to 6 hours commute)	30%
In-state	13%
National	4%
National as part of another conference or meeting	8%

Note: Multiple answers possible; totals exceed 100%.

Not surprisingly, those who responded “maybe/depends” to the question of whether workshops would be useful are less likely to attend workshops that necessitate a longer commute than those who answered yes to the question (24% compared to 41%; see Table 36). While 61% of those indicating that workshops would be helpful would attend a workshop held regionally or in-state, among those indicating maybe/depends only 33% were willing to travel so far (multiple responses were accepted). However, no significant differences between these groups were found for national workshops, particularly if workshops were to take place as part of another national conference or meeting.

Table 36: Preference for where workshops should be held

Location workshops	Training or workshops helpful		
	Maybe/Depends (n=333)	Yes (n=215)	No (n=38)
Local (less than 2 hours commute)	78%	73%	84%
Regional (2 to 6 hours commute)	24%	41%	13%
In-state	9%	20%	5%
National	3%	7%	3%
National as part of another conference or meeting	8%	9%	3%

Note: Totals may exceed 100% due to rounding errors

The majority of amateur astronomers (56%; n=327) would prefer workshops to be conducted on weekends (Table 37). Another 30% would participate any time, suggesting that 86% of amateur astronomers would potentially be able to attend weekend workshops.

Table 37: Preference for workshop time

	Total (n=588)	Training or workshops helpful		
		Maybe/Depends (n=332)	Yes (n=216)	No (n=39)
Weekend	56%	57%	53%	54%
Any time	30%	28%	37%	15%
Weeknight	12%	12%	9%	23%
Weekday	2%	3%	1%	8%

Note: Totals may differ from 100% due to rounding errors. Total response is higher than sum of individual responses due to missing data.

When researchers asked amateur astronomers their preference for workshop length, we found that the great majority would prefer workshops of one day duration or less. A full-day workshop was preferred by 37% of those responding (n=215), followed by half day (28%; n=165) and a few hours (23%; n=135). Those responding that they felt that workshops would be helpful, preferred longer workshops than those for whom the usefulness of workshops depended on circumstances. Table 38 presents these results.

Table 38: Preference for workshop length

	Total (n=584)	Training or workshops helpful		
		Maybe/Depends (n=330)	Yes (n=215)	No (n=38)
Few hours	23%	27%	15%	37%
Half day	28%	29%	26%	29%
Full day	37%	35%	42%	24%
2 days	12%	9%	16%	11%

Note: Totals may differ from 100% due to rounding errors. Total response is higher than sum of individual responses due to missing data.

When researchers asked those responding whether they would be willing to attend a workshop during a regional or national amateur conference, there was a significant difference between those who found workshops helpful without restrictions and those for whom the usefulness depended on circumstances (Table 39). More than half of those who found workshops helpful (54%; n=115) would attend a regional or national amateur astronomer conference or star party (with almost all of the rest of the sample answering

maybe/depends; 45%; n=97), while just a third of those who indicated it would depend upon circumstances (32%; n=105) would attend, with almost two-thirds (63%; n=209) answering maybe/depends, and 5% saying no.

Table 39: Attendance at a workshop at a regional or national amateur astronomer conference/star party

	Total (n=602)	Training or workshops helpful		
		Maybe/Depends (n=332)	Yes (n=215)	No (n=54)
Yes	39%	32%	54%	28%
Maybe/Depends	55%	63%	45%	41%
No	6%	5%	1%	32%

Note: Totals may differ from 100% due to rounding errors. Total response is higher than sum of individual responses due to missing data.

Researchers asked amateur astronomers what kind of training they would seek in a workshop were they to attend one (Table 40). Almost three-quarters of those responding (73%, n=426) preferred content-oriented workshops which would update them on astronomy-related issues and facts. Fifty-six percent (56%; n=327) would also be interested in communication skills and teaching methods, specifically techniques for presenting astronomy to young and very young audiences, while 47% would like to improve their technical skills, including tips on how to create and use portable multimedia presentations, handouts, visual aids and supplemental information for participants to take home, as well as resource development/library science/Internet search skill development and translating current events in research astronomy to the general public. As seen in findings presented earlier, almost a third would like to learn about marketing, publicity and public relations. Many amateur astronomers seem to believe that they are currently unable to reach potential audiences with their offerings and would like to improve their skills for advertising educational outreach events.

Table 40: Type of training sought in a workshop

	Percentage (n=583)
Content	73%
Communication skills/teaching methods	56%
Technical skills	47%
Marketing, PR	30%
Total other	10%

Note: Multiple answers possible; totals exceed 100%.

The following comments provide a deeper understanding of the sorts of training amateur astronomers would be interested in receiving during workshops:

Networking/access to experts/exchange

- Interaction with other like-minded people.
- Interchange with other contributors.
- Access to an expert.
- Exchange ideas, see what others do, what the pros do.
- Sharing ideas with others, sharing experiences.
- Other successful programs already in place.
- Tried and tested ideas from others.

Materials

- Handouts that can be reproduced for my outreach activities.
- Lesson plans, hands-on activities.
- Material that can be copied for distribution, as well as slides.
- Materials - slides, overheads, etc., at some kind of discount.

Teaching methods

- Techniques to make adults more comfortable with learning about science. Many adults and children feel that basic astronomy is too complex and therefore shy away from it, thus missing the fun.
- New ways to present complexity simply.
- Optimization of available presentation tools.

Technical skills

- Creation of portable multimedia presentations.
- Preparing useful handouts, supplemental information for participants to take home.
- Preparing visual aids.
- Resource development/library science/Internet search skill development.
- Specifically techniques for presenting to young and very young audiences.
- Translating current events in research astronomy to general public.
- Use of visual materials.

Overview of available resources

- Survey of available materials.
- Sources for resource materials.
- Updated info and theory.

Marketing/PR

- News media, article writing, legislative/political action and inclusion (local & state).

Astronomers again used the “other” category to express more detail about the categories they selected. However, in analyzing these responses most only added detail to categorical responses selected; most “other” responses resonated with the idea of networking and exchanging ideas with like-minded people and experts and that amateur participants use workshops to access resources (or to find out about resources which are available).

We also asked those responding who checked “technical skills” to specify their needs in this area in more detail (Table 41). Multiple responses were accepted. More than two-thirds (69%; n=185) suggested training in optics and mechanics, most likely related to operating a telescope. But more than half (58%; n=156) also wanted to learn about the latest presentation technology and digital imaging.

Table 41: Type of technical skills that should be covered in a workshop

	Percentage (n=270)
Background knowledge on optics and mechanical aspects of astronomical equipment	69%
Latest presentation technologies	58%
New digital imaging	56%
Other	8%

Note: Multiple answers possible; totals exceed 100%.

Again, answers in the “other” category fleshed out rather than extended the categories:

Telescope

- I am self taught in the use of my telescope and have no ready access to other more knowledgeable amateurs or equipment specialist
- Likely problems with telescopes, and how to remedy
- Props for explaining concepts and increasing interest (Mr. Science), classroom experiments, simple field experiments
- Story telling skills
- Trouble shooting telescope problems, electronic telescope set up, mirror grinding and telescope making

Presentation technologies/digital imaging

- CCD work
- Computer skills in PowerPoint

Additional Comments Shared by Amateur Astronomers Currently Engaged in Outreach Activities

Most Important Thing Which Would Help in my Educational Outreach Efforts

Researchers asked those responding to an open-ended question what the one most important or useful thing would be to help them in their educational outreach efforts (Table 42). A total of 463 responded to the question. Almost a third felt that additional material resources were needed. Not surprisingly, more time was mentioned, but only by 16% as the most important aspect. Other important aspects included marketing and PR skills and assistance; networking and exchange opportunities to develop a broader community of amateur astronomers in educational outreach and to share tested and proven ideas for effective educational outreach; and, effective recruitment (since many felt that “manpower” is lacking); presentation skills (for better targeted and more inspiring interactions with the public). Only 5% felt that the one most important factor which would help them was improved content knowledge.

Table 42: Most important thing which would help in educational outreach efforts

Most important in helping with educational outreach efforts	Percentage (n=463)
Materials	31%
Time	16%
PR help	12%
Networking/exchange	8%
Effective recruitment/human resources	7%
Training on presentation skills	6%
Equipment and Technology	6%
More content learning	5%
Grants/financial resources	4%
Darker skies/better weather	3%
Other	3%

Note: Totals may differ from 100% due to rounding errors.

Again, open-ended comments provide a deeper understanding of the most pressing support needs amateur astronomers’ perceive:

Materials and Curriculum

- A good curriculum and visuals that I could use.
- Handouts and multi-media presentations.
- Simple flyers geared to the public on specific aspects of astronomy such as types of deep sky objects, various solar system objects, and stellar evolution.
- A scripted Power Point presentation on seasonal skies and observable objects.
- Access to a wide range of program materials (slides, videos, computer graphics, etc.) from which I could select to construct presentations. “Canned” presentations seldom apply, since schools and other groups have their own specific needs and desires. The resource materials for *Project ASTRO* have been handy; some similar items in AV format would be helpful.
- Prepared material.
- Inexpensive materials and images to accompany presentations at the telescope.

Time

- Having more time. My job and school just takes too much.
- Nothing at the moment. I am doing all that time permits.
- I’m a newsletter editor for two clubs, and a regular volunteer on weekends at Chabot Space and Science Center, plus I have a regular day job, so the thing I lack the most is time.

Public relations help

- Finding out how to get started communicating with schools and interested individuals.
- I work for a non-profit science center and publicity has always been a problem. Our budget does not allow for publicity expenses and free publicity is getting harder and harder to access.
- Better methods of advertising the events.
- I usually give a talk once, and that is it. If I knew of other astronomy clubs, high school physics or astronomy classes, or college astronomy classes that could benefit from my talks, I would love to give the talks again and get some mileage out of my efforts.
- Marketing! I don’t want advice. I want somebody to do it for me. I don’t need materials or curriculum, I love creating curriculum. It’s making the contacts, calling back over and over again; offering to help over and over again that is hard.

Networking/exchange

- A meeting place on the web for everyone who tried this in the amateur astronomy community would be most helpful! Somewhere to exchange curriculum and teaching materials, post questions, calendar of events, etc.
- A www site where astronomical educators could exchange ideas and presentation materials.
- I need someone who can answer my questions. That is the most important thing for me.
- Regular meetings with professionals that focus on teaching astronomy.
- Access to an expert on a particular topic that could answer questions, point me to resources, and maybe review my slides before a talk.

Effective recruitment

- We mainly need advice on training new members and maintaining interest in committed volunteers.
- Find ways to motivate others to help.
- More manpower.
- Interested and dedicated people who I could train.

Training on presentation skills

- *Project ASTRO* materials are useful for teaching the middle school kids, but we need materials on training ourselves to be more effective presenters.
- I guess more people comfortable and willing to do this talk to others would be a great solution. The local astronomy club is small and has few members who are comfortable talking in front of larger groups. I guess having workshops about presentation methods and training would be great.

Equipment

- Easy access to a computer/LCD projector.
- The availability of presentation equipment, direct feed video from telescope to monitor for groups to view planets.

Content learning

- Convincing me, that even as a really amateur astronomer, that I know enough to help others.
- More experience and knowledge of the content.

Financial resources

- I do this for free because I love it. It would be a big help to be compensated at least enough to cover basic costs of time and materials.
- A grant to aid in the further education of the average citizen would be much appreciated.

Skies/Weather

- More emphasis on the importance of dark sky legislation.
- Better light pollution controls, so people could see more without having to drive so far.
- Better control over the weather. More seriously, better alternatives to offer when the weather doesn't cooperate and allow decent viewing.

Those responding also were provided another opportunity to provide suggestions for types of support that might prove useful to amateur astronomers. Astronomers offered the following comments:

Reaching an audience and understanding audience

- Getting publicity is sometimes difficult. Handout materials and multimedia would be great, so would an extra telescope or 2.
- If national astronomy organizations (ASP?) can find a way to use mass media (as "sports" does) to keep amateur/*participatory* astronomy constantly in the mind of the public, then the positive results would be far greater than current outreach efforts could ever achieve. The public needs to be encouraged to participate from a non-local source. Constant mention of something from a geographically distant organization gives the public the impression of both greater importance, and wide spread acceptance of the activity. The public has been conditioned to think that if something is important, it will be frequently mentioned by the mass media (primarily television). If not frequently mentioned, it's not worth thinking about.
- ...I'm comfortable working with adults at all levels, but not accustomed to dealing with the elementary school groups I sometimes visit or host at the observatory. Having materials and some guidelines on how to interest younger kids in astronomy would be helpful.

Networking/sharing information

- Finally, it is important to partner amateur organizations with professional organizations in any nation educational outreach effort. For example, Flagstaff is home to Lowell Observatory, the U.S. Naval Observatory and the U.S. Geological Survey. The Coconino Astronomical Society partners with these organizations as part of its public outreach efforts. Other local clubs should do the same by approaching the local university, for example.
- I would love to know if there are any groups in my area with similar interests in astronomy, that I could contact.
- Additional resources and networking between amateur presenters like myself would be incredibly helpful!!!!
- Information about *Project ASTRO* needs more dissemination to school administrators. Many astronomy teachers or enthusiasts know about it but people who schedule or extend invitations [to speakers] need to know that there is such an excellent program.
- I think it would be nice to post an outreach volunteer program per location based on this survey.
- The local source for information on astronomy is excellent - the CfA³/Harvard-Smithsonian Center in Cambridge. They have recently expanded their public outreach offerings considerably, but I think they could do more with additional funding. Things that would be helpful include more public lectures on astronomy, training in some of the new methods of teaching and communicating science (which they are developing there, as well as in other places), and more frequent access to small amateur telescopes through either their center or the Museum of Science. Because the local Museum of Science in Boston is expensive, I think it discourages many families with children, and the viewing is too late for many kids (8 p.m. on a Friday night). The free viewing at CfA is even later (although free, which is quite a plus).
- There are more than just schools and local amateur astronomy societies that can facilitate astronomical outreach - try environmental organizations, adult education, town parks & recreation, professional education organizations/learning societies. With additional guidance and possibly funds or materials, these organizations can exponentially affect public interest and knowledge in astronomy.
- There are a large number of great outreach programs such as SETI-VTT, RBSE/TLRBSE, TERC, etc. It would be nice if all the national and state science programs could be listed and reviewed with comments regarding their content and target recipients by one "clearinghouse" such as ASP, NSF, or NSTA.⁴

Resources and materials

- I think the best thing would be to create materials electronically (i.e., PowerPoint or similar) and distribute them via the WWW. I would love to see a whole library of PowerPoints on the AL website!
- It would be extremely beneficial if there was a 'repository' of supplies/resources were available on a check-out basis.
- I do teach an astronomy class at a local community college and my previous comments about the need to teach basic concepts stem from my experiences there. I would use the ASP teaching materials more but they are expensive to buy out of my own pocket. Computers are good tools for presentations but projectors are expensive and most likely not available for a general presentation. I believe that what is lacking in astronomy education are good three- dimensional models or at least good animations or videos to demonstrate three-dimensional concepts. For example, if [there was] a good computer program or scale model showing the Moon's orbit around the Earth with everything to scale (I know - difficult) and adjustable for the Moon's inclination to the ecliptic, etc., it would be immensely easier to grasp such concepts [such] as why there is not an eclipse every month, the saros cycle, why it is so difficult to go to the moon, why solar eclipses are only visible in certain places on the Earth but lunar eclipses are visible from an entire hemisphere, etc.

³ CfA = Center for Astrophysics (Harvard University).

⁴ NSF = National Science Foundation; NSTA = National Science Teacher Association.

- ...Are there reviews of college texts available? I am having trouble finding one that fits my needs that does not have lots of errors.
- A source of materials for demonstrations and teaching are the most needed and I believe the most beneficial.
- Handouts and hands-on activities are a much needed item. It is also important to stay on the education level of your students.
- I'm not happy with the selection of "lesson plans" that are generally provided for classroom talks and school star parties. They are usually cheaply made, teach very little, require too much organization and too much time for an audience with very short attention spans, and cater to only small groups at a time (requiring a lot of manpower). We don't like bringing crayons and scissors to outdoor activities. Half-baked leaflets do nothing but kill trees.... we need props that are "phat!", especially on cloudy nights. Telescopes are hands-on, so don't need much more in that category.
- At the very minimum, slide sets should be made available to clubs or individuals highly active [in outreach]. Their labor, gas, astro equipment, etc is all free. Should we have to spend money on materials as well? Now the real way to do the materials is via digital images and an LCD projector. Our club really needs to do a grant proposal for one, but somehow between running star parties, doing school talks, etc, etc, I just haven't got around to it.
- A good magazine without much hi tech words for the beginning astronomer. Sky & Telescope and Astronomy magazine are two very great mags, but there is no magazine for the younger (ages 12 to 15) astronomers.

Assistance with content

- My biggest suggestion would be to teach content oriented curricula (such as what we do through *Project ASTRO*) at regional star parties to amateur astronomers.
- Also, any national effort should emphasize [the importance of] accuracy in the information being presented. Amateur astronomers often talk about "an alarming level" of scientific illiteracy among the general public. However, these same amateurs often convey poor or simply wrong science in their public outreach efforts. It is important that accurate science be communicated as part of a national effort to improve science literacy.
- I am always looking for ways to expand my knowledge and any suggestions would be greatly appreciated.

Training in Skills

- I think it would be great if the ASP offered training in astronomical presentation skills. You could [use] our observatory to conduct such training.
- We have a large club but there seems to be a dedicated core of members who do the bulk of the "work". Organizational management advice would be helpful. How do you best organize for outreach activities? Team members, position descriptions, allocation of responsibilities, rotation of duties, etc.? How does this differ depending on the size of the club? How do you prevent burnout among the core participants? I think that addressing organizational management issues is ultimately more important than providing content (slide sets and handout materials). I have not seen this kind of management expertise available in the astronomical community. Organizations are the key. Through my club activities I reach hundreds more people each year than I did as an individual amateur astronomer. We gladly donate our time and equipment. Any form of external support would be appreciated.

Other

- Evaluation is an essential component which is often ignored by astronomy clubs doing public outreach. Any national effort to expand and grown the level of public outreach in this field should include a strong evaluation component. Otherwise, we will have no way of determining the efficacy of the effort.

Although most comments were extremely positive and supportive, a few astronomers felt negatively about different aspects of public outreach including the social dynamics of many clubs, frustrations with the mind sets of teachers and even the actual need for support, as expressed in these comments:

- Too many local Astronomy Clubs are closed cliques that are highly socially stratified (Fossilized Pecking-Order), and not "user-friendly" to outsiders, especially neophyte stargazers! I have had MANY parents tell me that they felt humiliated in front of their kids by the Know-it-all "Old-Farts" who were way too anxious to show off their fancy high-end instruments and their inflated egos. I have found that too many amateurs are more than willing to try and impress the public with their obtuse "lingo" and their "insider" knowledge. This may impress the purveyors of said "attitude," but it alienates far too many of the "rejects" that end up at my presentations. It is hard enough to counter the pervasive anti-science attitudes of certain groups today, without having to try and salvage something from the debris of the crossfire of "Amateur" and "Professional" egos. I work very hard to convince people that you do not need multi-thousand dollar instruments (Yes, I know I am a heretic!), nor a Ph.D. to fully appreciate astronomy. It would be nice if I did not have to try and repair the damage these two self-absorbed groups inflict on decent people who just want to know about their universe.
- Many amateur astronomers use public presentations as a way to build their ego by presenting the latest theories to their students. This may be good if your students are cosmology majors at a major university. Do not bore the public with theories, they don't care and will be turned off by your instruction. Keep it simple!!
- It is my opinion that teachers are not favorably inclined towards educational outreach programs, either because of time constraints or an unwillingness to exert themselves. The problem of such programs for schools is not the lack of speakers, materials, knowledge, or enthusiasm on the part of presenters; it is lack of interest on the part of teachers.
- Generally, teachers request that we repeat lesson plans they have already covered in hopes that we can provide different perspectives on the same concepts so their class will pass a myriad of standardized test. We also discover some teachers (admittedly) are not qualified to teach the topics, and subsequently request our help. We also need to learn how to get into the psyche of the school board, and the science teachers, who have, on occasion, told a student "No, Virginia, you cannot do a science fair project on astronomy"!!!
- If a club or individual wants information about putting on public star parties they can easily get the information on the net by asking for it. We have given out information about public star parties, school star parties, etc. for years on Sci.Astro.Amateur, and other lists. There is no need for the NSF to hand out money (tax dollars) to the ASP or other group to promote public star parties. We don't need the ASP. Just leave us alone. We don't need the government spending tax dollars on this project.

Findings from Amateur Astronomers Currently Not Engaged in Outreach Activities

As mentioned earlier, 37% (n=423) of those responding to the initial survey question indicated that they currently are NOT involved in educational outreach activities. This sub-sample was immediately redirected to the question of whether they were interested in doing so in the future. Forty-six percent of the 224 who answered the question (46%; n=103) were not sure, 45% said yes and only 9% (n=20) stated that they would not want to do so (Table 43). Unfortunately almost half of the sample (47%; n=199) did not continue responding to the survey and this needs to be taken into consideration when interpreting the following results since those astronomers probably were expressing their lack of interest in engaging in outreach activities by not continuing the survey.

Table 43: Interest in educational outreach amongst those NOT currently engaged in educational outreach

Interested in doing educational outreach in the future?	Percentage (n=224)
Yes	45%
Maybe/Depends	46%
No	9%

Relationship between Engagement and Interest in Public Education

Those not currently engaged in educational outreach who expressed a “high interest” in doing so are likely candidates for future engagement in educational outreach. A cross-tabulation with “interest in educating the public” not surprisingly showed that 72% of the sub-sample that claims high interest in public education is also interested in engaging in educational outreach in the future, and 26% say that they *may* be interested in engaging in outreach in the future (Table 44). Interestingly also, more than two-fifths of the “somewhat interested in public education” sub-sample (90%; n=62) also expressed interest in engaging in educational outreach.

Table 44: Interest in public education and educational outreach

NOT doing educational outreach, but interested in doing so in the future?	Interest in public education/teaching, sidewalk astronomy ¹		
	Highly interested (n=65)	Somewhat interested (n=69)	Not interested (n=18)
Yes	72%	42%	28%
Maybe/Depends	26%	48%	39%
No	2%	10%	33%

Note: ¹ Difference in interest to do outreach in the future by general interest in public education and sidewalk astronomy is statistically significant for $p < 0.01$ (Chi-Square test). Totals may differ from 100% due to rounding errors.

As Table 44 shows, about two-thirds of those responding to the survey (72%; n=47) indicated high interest in public education, teaching, and/or sidewalk astronomy. When we cross-tabulated this item with whether they were *currently engaged* in educational outreach, we found – not surprisingly – a significant correlation between the two items. Those astronomers currently engaged in educational outreach are also more interested in public education. Three-fourths of the amateur astronomers currently engaged in educational outreach (76%; n=245) expressed a high interest in educating the public (Table 45). This group is most likely a stable cohort of amateur astronomers who can be depended upon to engage in public outreach. However, a quarter of the amateur astronomers currently engaged in educational outreach (25%; n=79) claim to be “not interested” or “somewhat interested” in public education. This group may be less dependable and may abandon their educational outreach efforts at some point in the future if they do not receive support and encouragement.

Table 45: Cross-tabulation between interest in outreach and current outreach practice

Interest in public education / teaching, sidewalk astronomy	Are you currently doing any educational outreach in astronomy-related subjects? ¹		
	Total (n=476)	Yes 63% (n=324)	No 37% (n=152)
Highly interested	65%	76%	43%
Somewhat interested	30%	23%	45%
Not interested	5%	2%	12%

Note: ¹ Difference in by general interest in public education and sidewalk astronomy by current outreach activities is statistically significant for $p < 0.01$ (Chi-Square test). Totals may differ from 100% due to rounding errors.

Impediments to Engaging in Educational Outreach Activities

Table 46 presents the impediments that astronomers expressed to currently engaging in educational outreach. Multiple responses were accepted. No significant differences were found between those who said they definitely had an interest in doing so in the future and those who said “maybe/depends.” Half of them (n=87) experience time constraints. Almost half (46%; n=80) believe they lack sufficient expertise or expert knowledge. Two-fifths (40%; n=70) feel they need materials and equipment, another third (31%; n=55) financial support. Another third (31%; n=55) lacked group support and encouragement. In total, 60%; n=105) stated that personal issues (lack of expertise, encouragement) prevented them from doing educational outreach, and almost half (48%; n=84) felt that lack of materials and/or funding were impediments. A third (33%; n=58) indicated that a lack of demand for their services might prevent them from doing educational outreach.

Table 46: Impediments to engaging in educational outreach

	Percentage (n=175)
<i>Personal issue (expertise, encouragement)</i>	60%
• Lack of expertise/specialized knowledge	46%
• Lack of group support/encouragement	31%
<i>Lack of time</i>	50%
<i>Materials and funding</i>	48%
• Lack of materials and equipment	40%
• Lack of funding/cost of materials/equipment	31%
<i>Demand</i>	33%
• Disinterest/lack of awareness by the local schools	22%
• Lack of effective PR/marketing	12%
• Lack of public interest	12%
<i>Unsuitable weather conditions</i>	11%
<i>Lack of space</i>	6%
<i>Other</i>	14%

Note: Multiple answers possible; totals exceed 100%.

Supports To Encourage Participation in Educational Outreach Activities

Researchers asked amateur astronomers participating in the survey what kind of support would potentially encourage them to engage in educational outreach. Seventy-eight percent (78%) would need some form of

personal support, either training in content and/or teaching skills or teaming/mentoring. Two-thirds would need materials and/or funding. Astronomers offered a number of comments that more deeply illustrate the factors that prevent some amateur astronomers from becoming involved in outreach activities:

Lack of ideas

- Don't know what to do at the moment.
- I'm a college student without any idea [about] how to get started.

Lack of expertise/specialized knowledge

- Entry level of Celestial Knowledge.
- I am new.
- I'm a novice - just completed an astronomy lab course.
- I've just joined an astronomy club and am now gaining interest and support.
- I am just learning myself.

Lack of support for youth outreach

- No one wants to hear a 16 year old kid much.

Travel and transportation

- Traveling distances.

Lack of local network

- Unaware of others in my area involved in amateur astronomy.

Primary Audiences You Would Like to Serve

Ninety-four percent of those responding (n=149) indicated they would like to serve the non-school public, and 55% (n=88) would also like to serve schools (see Table 47; multiple responses were allowed). More than half (54%; n=85) specified that they would like to focus on teenagers and children, and about a third (35%; n=55) specified families with children and adults.

Table 47: Target audience for potential outreach

	Percentage (n=159)
General public	61%
School groups	55%
Community groups and other audiences	43%
Teenagers and children	54%
Families with children	35%
Adults	30%
Other	7%

Note: Multiple answers possible; totals exceed 100%.

Astronomers were also asked more specific questions about the community groups and other audiences they might choose to serve as well, as the level of schools they would choose to serve (Table 48 & Table 49). Community groups included adult and children groups (79% & 77% respectively), with slightly fewer wanting to specifically target family groups (62%; n=41). Camps and church groups were mentioned by about half of the astronomers (52% & 49% respectively). Those who indicated that they *would like to serve* schools – in contrast to those who *currently* target schools – would choose middle school first (72%;

n=110), then elementary school (64%; n=97), and then high school (57%; n=87). Community College/University was only mentioned by 28% of the sample (n=42).

Table 48: Community groups and other audiences likely served by future outreach

	Percentage (n=66)
Adult groups	79%
Youth groups (like boy or girl scouts)	77%
Family groups	62%
Camps	52%
Church groups	49%

Note: Multiple answers possible; totals exceed 100%.

Table 49: Target (school) grades for potential outreach

	Percentage (n=152)
Middle school	72%
Elementary school	64%
High school	57%
Community College/University	28%

Note: Multiple answers possible; totals exceed 100%.

Amateur astronomers who reported not being currently involved with educational outreach activities were also asked to describe the kind of support they would need to begin to engage in such activities (Table 50). Both material and personal support emerged as important areas within which ASP could facilitate these astronomers and encourage them to engage in outreach efforts.

Table 50: Type of support that would encourage educational outreach for those currently not engaged in it

	Percentage (n=162)
<i>Personal support</i>	78%
• Teaming up with someone else, group support	62%
• Training in content-related areas	40%
• Training in teaching methods/communication	28%
• Mentoring	25%
<i>Material and funding</i>	66%
• Materials, supplies, equipment	44%
• Targeted, ready-to-use material for classroom, lectures, or workshops	35%
• Funding	33%
• Infrastructure already in place to support outreach	26%
<i>I simply don't have the time currently to do educational outreach</i>	14%
<i>Other</i>	4%

Note: Multiple answers possible; totals exceed 100%.

Recommendations

The following four general findings emerged from the specific comments made by amateur astronomers. Based on these results, specific recommendations for the types and format of resources likely to support amateur astronomers in their current and future educational outreach efforts emerged.

Finding #1: Amateur astronomers need material and resource support in formats that fit their specific needs.

More than any other form of support, amateur astronomers reported a need for improved access to materials and resources which could enhance their outreach efforts. However, they want materials and resources that are flexible and adaptable to a variety of situations. Three specific recommendations emerged from the analysis:

- a. Develop inexpensive props, curricula, handouts and posters or develop a portal that refers amateur astronomers to such material available elsewhere (NASA, JPL, etc.).
- b. Develop a set of brief video clips of animations that explain the basic celestial motions, solar system, seasons and so on. Ideally amateur astronomers would be able to preview lower-resolution versions of video clips/animation online and choose their own package from the available resources (download larger clips in various formats like Quicktime or MPEG, or order custom-made video tapes, CD-ROMS, or DVDs). As with the still images, scripts and explanations should be supplied.
- c. Provide a slide chooser website, where people can pick and choose individual slides in a searchable data base that contains lower-resolution thumbnail images of all available images. The slides can be connected to text/explanations with a suggestion for a short presentation, including a referral for other, similar, and complementary/supplementary slides. The images could be made available for download (for instance by clicking on the thumbnails), emailed to free subscribers as jpg-files (with or without text), or ASP might offer to print the slides and mail them at a fair and reasonable cost (fee should remain below \$2 per slide).

Finding #2: Amateur astronomers need assistance and training in how to identify, reach and understand the needs of current and potential audiences.

The need for support in identifying, reaching, and understanding current and potential audiences continually emerged from the analysis. In some cases, the theme emerged in the form of “PR support,” or amateur astronomers simply mentioned a difficulty in reaching the audiences they wish to serve. The following recommendations emerged:

- a. Create a website that could function as a clearinghouse between schools/colleges and amateur astronomers who are willing to do in-class or field trip education in/for the formal sector.
- b. Develop a primer for amateur astronomers about how to engage in educational outreach activities. This primer could include information about why, who, and how to target audiences, what the public wants, comprehension levels, tips from experienced and seasoned amateurs and professionals, marketing, public relations, organizational tips for your club about engaging in outreach, etc.

- c. Develop a series of brief workshops that address presentation skills. These workshops could focus on the following themes: (1) publicity/marketing/public relations, (2) how to address schools and school system needs, (3) targeting audiences, and (4) planning and organizing your club or your public outreach event.

Finding #3: Amateur astronomers are very interested in being networked to one another and to experts.

Findings suggested that amateur astronomers perceive they would benefit from being better connected with one another and with other experts. A variety of specific ways in which ASP could facilitate the development of beneficial informal relationships among and between amateur astronomers and professionals emerged from these data:

- a. Create an expert referral system (local professional astronomers and/or astronomy educators could join a system that allows amateur astronomers to ask questions and refers them to the appropriate expert on a case-by-case basis that would need to be determined. In order to minimize abuse, a free registration/sign-in system would be required.
- b. Create an Internet portal for amateur astronomers who are involved in educational outreach or would like to be. The portal could offer ASP's resources, but also provide discussion rooms, referrals (For example, who near Baltimore has a video projector I could borrow for a presentation at the local scout meeting? Can anybody lend me a meteorite for two days?), exchange of ideas, curricula, scripts, or props; posting presentation scripts, PowerPoint presentations, and software.

Finding #4: Amateur astronomers would like to strengthen their presentation and technical skills.

Amateur astronomers self defined a number of areas within public astronomy in which they could use additional training. One potentially effective mechanism for offering such support could be a series of local or regional workshops. The workshops could be short (2 hours), added to the agendas of existing conferences, or be stand-alone half or full day events. They could potentially be franchised to state astronomy associations. These specific recommendations emerged:

- a. Develop a series of brief workshops that address the presentation skills required for public outreach, including teaching pedagogy and public speaking, rhetoric.
- b. Develop a series of brief workshops that address technical skills, including: (1) how to develop and write handouts, (2) how to address the curricular needs of teachers, after-school programs, etc., and (3) how to make effective PowerPoint presentations.