

# Astronomical Society of the Pacific Space Rocks Kit Evaluation Memo Report

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## Introduction

The Astronomical Society of the Pacific (ASP) is a non-profit organization that supports astronomy education and public outreach through the design and delivery of programs, toolkits, conferences, and publications. These activities support the mission of the ASP to, “inspire youth and adults across the economic spectrum – in support of their success as science, technology and academic leaders”. As partners on the Asteroids project with the National Center for Interactive Learning, Space Science Institute, the ASP developed *Space Rocks*. This toolkit was designed to support amateur astronomers and out-of-school educators as they communicate with youth and public audiences about comets, asteroids, and meteors. The activities and materials in the toolkit were developed to complement the topics featured in the traveling exhibition *Great Balls of Fire! Comets, Asteroids, and Meteors*—the centerpiece of the Asteroids project.

*Space Rocks* was designed and developed through an established, iterative process that included two phases of implementation, feedback, and revision (e.g. alpha and beta testing phases). Once completed, the toolkit was distributed through the ASP’s Night Sky Network—an online community of practice with approximately 900 members. *Space Rocks* was released in November 2010. The toolkit included a range of hands on activities focused on asteroids, comets, and meteors; the dynamics of the asteroid belt; the origins and movement of comets; the past impacts on Earth of our rocky neighbors, and the risk, probability, and implications of future Earth impacts. In addition, kits also included CDs and DVDs that provided information and resources as well as demonstrations of how to conduct the activities. Members of the Night Sky Network were eligible to receive the *Space Rocks* toolkits based on their delivery of education and public outreach activities as measured through an event-log system. Once members have logged the required number of events new kits are shipped to those members.

Informed by research and evaluation conducted with this community of amateur astronomers<sup>1</sup>, the ASP designed *Space Rocks* to align with typical patterns of implementation and to encourage engagement

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<sup>1</sup> Yocco, V., Jones, E. C., Storksdieck, M. (2012) Factors Contributing to Amateur Astronomers’ Involvement in Education and Public Outreach. *Astronomy Education Review*. 2012, AER, 11, 010109-1, 10.3847/AER2011040

Storksdieck, M., & Berendsen, M. (2007). “Attributes and Practices of Amateur Astronomers Who Engage in Education and Public Outreach,” in *Science Educators Under the Stars: Amateur Astronomers Engaged in Education and Public Outreach*, eds. M. G. Gibbs, M. Berendsen, and M. Storksdieck, San Francisco: Astronomical Society of the Pacific, 30.

Storksdieck, M., Dierking, L. D., Wadman, M., and Cohen Jones, M. (2002). *Amateur Astronomers as Informal Science Ambassadors: Results of an Online Survey*, Annapolis, MD: Institute for Learning Innovation.

and public outreach with this toolkit. For example, program coordinators typically utilize activities and materials from a range of kits. As a result, all activities are modular and can easily be used to complement materials and topics found in a range of kits. This study provides insight into the demographics of those who have utilized and experienced the *Space Rocks* kit, the types of events where activities from this toolkit are typically used, and the response that this kit has generated among amateur astronomers and members of their audience. In addition to exploring these descriptive characteristics, analysis was also conducted to explore whether the utilization of *Space Rocks* by members of the Night Sky Network had remained constant or whether patterns of implementation had changed over time.

## Methods

The data for this study was accessed from a log file system created by ASP's Night Sky Network. Members of this online community who use the toolkits log into the website to document their activities and events. Those who log their events are rewarded with the ability to "unlock" new kits to expand their education and public outreach resources. Log file analysis of outreach events were divided into two time ranges for comparison of patterns of kit utilization. Analysis explored the initial four months after the kit was released and that same time period a year later. Only the events logged that utilized the *Space Rocks* kit were included in the analysis. The study used both a quantitative and qualitative approach to analyze the data provided in the log files.

## Results

### Quantitative Analysis

#### Event Implementation & Participation

There were a total of 123 events logged that used the *Space Rocks* kit between December 1, 2010 and March 31, 2011. There was a median of 26 participants per event. The number of visitors per event varied widely based on the activity type. The largest event, a community Science Expo, hosted 4,500 participants, and the smallest event, hosted by a family had one participant. Event logs also indicated a range of participant types. Adults were present at 93% of the events that featured the *Space Rocks* kits, children were present at 81%, and teens were present at 54% of these events. Minority populations were represented at 75% of the events suggesting that a large percentage were reaching diverse audiences. The populations who were least often reported as participating in events that featured the *Space Rocks* toolkit activities were teachers and students from high school and college. These groups were reported as attending less than 10% of the logged events.

A year later, there were a total 236 events logged that used the *Space Rocks* kits between December 1, 2011 and March 31, 2012. This represented an impressive increase in total events that also translated into an increase in the average number of participants who engaged with material and activities included in the *Space Rocks* kits. There was a median of 46 participants per event, nearly a 50% increase compared to the initial four-month time period. Consistent with previous log file analysis, the number of visitors per event also varied widely during this time period. The largest event was conducted in conjunction with the 100<sup>th</sup> anniversary celebration of the Girl Scouts and recorded 3,488 participants while the smallest event was public star party that recorded only 1 participant. Event logs also provided demographic information about participants. Adults were present at 37% of the events that featured

the *Space Rocks* kits, children were present at 34%, and teens were present at 24% of these events. The shift in the distribution of attendance suggests that a larger number of the logged events may have been conducted for a specific target audiences (e.g. adult club members, school aged children, or scouts) as opposed to events for the general public that might be attended by more intergenerational groups. Minority populations were only participants in approximately 26% of the events a year after the initial release of the *Space Rocks* kits. Log file analysis does not provide insight into the reason for this decrease in the recorded diversity of participants. Consistent with the analysis of the initial time period, the populations who were least often reported as participating in events that featured the *Space Rocks* toolkit activities were teachers and students from high school and college. These groups were reported as attending less than 1% of the logged events.

Table 1: Summary of Participants at Events \*

Participant Types	Initial freq.	Initial %	1 year later freq.	1 year later %
Adults	114	93%	12,158	37%
Children	100	81%	11,170	34%
Minorities	91	74%	8,583	26%
Teens	67	54%	7,862	24%
K-8 Teachers	50	41%	801	2%
K-8 Students	32	26%	8,564	26%
High School Teachers	10	8%	10	<1%
High School Students	9	7%	80	<1%
College Students	12	10%	0	0%
College Instructors	6	4%	0	0%

\* All values are approximate due to correcting for missing data in log files

### Event Locations

Log file analysis also investigated where programs were being held that used the *Space Rocks* Kits. Across both measurement time periods, the *Space Rocks* kit has been used in a total of 34 states (see Table 2 for a complete summary). During the initial 4 months following the kit release, a total of 27 states hosted events that utilized this toolkit with a median of 3 events per state. The majority of events in this time frame were reported from California (22%, n=25), followed by Texas (9%, n=10), and New York (7%, n=8). In the remaining 24 states, log files indicated that there were 5 or fewer events that utilized the *Space Rocks* kits. Log file analysis conducted one year later indicated that the kits had been used in a total of 26 states with a median of 5 events per state. While the overall number of states decreased slightly, the distribution and frequency of events increased. Once again, California hosted the most events (23%, n=55). However, both Florida and Maryland hosted 10% of events (n=24), followed

by Georgia and Colorado who hosted 8% of events (n=20). In addition, one year following the initial kit release, only 15 states hosted five or fewer events.

Table 2: Locations where the *Space Rocks* kits were used during education and public outreach events

State	Initial freq.	Initial %	1 year later freq.	1 year later %
CA	25	22%	55	23%
TX	10	9%	12	5%
NY	8	7%	3	1%
AZ	5	4%	15	6%
FL	5	4%	24	10%
GA	5	4%	20	8%
MN	5	4%	n/a	n/a
NJ	5	4%	6	3%
WA	5	4%	3	1%
AR	4	4%	n/a	n/a
ME	4	4%	7	3%
OR	4	4%	5	2%
LA	3	3%	1	<1%
MI	3	3%	4	2%
NM	3	3%	2	1%
AL	2	2%	n/a	n/a
IL	2	2%	6	3%
MD	2	2%	24	10%
NC	2	2%	1	0%
TN	2	2%	0	0%
CO	1	1%	20	8%
IN	1	1%	1	<1%
MO	1	1%	n/a	n/a
NH	1	1%	n/a	n/a
OH	1	1%	13	6%
WI	1	1%	n/a	n/a
WY	1	1%	n/a	n/a
KS	n/a	n/a	5	2%
OK	n/a	n/a	2	1%
VA	n/a	n/a	2	1%
MA	n/a	n/a	1	<1%
MN	n/a	n/a	1	<1%
RI	n/a	n/a	1	<1%
PA	n/a	n/a	1	<1%

## Event Types

Of the 123 events where the *Space Rocks* kits were used during the initial log analysis, the most common event type were star parties representing 34%, n=42. These events were held at schools as well as being open to the public. Astronomy club meetings were the next most frequent kind of event accounting for 22%, n=27 of all the events logged. Classroom presentations accounted for 15%, n=18 where the *Space Rocks* kits were used. The log analysis conducted a year later revealed that star parties, and classroom presentations remained the most commonly logged events. However, of the 236 events logged, the most common event type were star parties accounting for 53% (n=125), followed by classroom presentations 21% (n=50), community events 8% (n=18) and astronomy club meetings, 6% (n=15). This shift in the types of events logged suggests that more club members may have been trained to use the materials and activities in the *Space Rocks* kits a year after the initial release and as a result were using them more frequently with members of the community.

Table 3: Summary of the most common types of events where the *Space Rocks* kit was utilized

Event Type	Initial freq.	Initial %	1 year later freq.	1 year later %
Star Party	44	36%	125	53%
Club Meeting	29	24%	50	21%
Classroom Presentation	18	15%	15	6%
Public event	12	10%	8	3%
Youth Group Event/Meeting	9	8%	12	5%
Community event / celebration	6	5%	18	8%
Other organization's meeting/conference	5	4%	8	3%

## Topics Featured at Events

The most common topic covered at events that used the *Space Rocks* kits during the initial log analysis were asteroids and meteors—reported at 70% of events. The moon was the next most popular topic, featured in 57% of the events. Telescopes, comets, and size/scale concepts were all included in at least 40% of the logged events. Interestingly, during the time period of the second log analysis the most popular topics covered at events that used the *Space Rocks* kits were not asteroids and meteors. Instead, the most frequently covered topics were the solar system—covered at 84% of the events and the moon—addressed at 80% of events. Asteroids and meteors were included in 72% of the events, followed by size and scale activities featured in 65% of the events logged. Comets were only covered in 37% of the events that used the *Space Rocks* kits. One possible explanation for the increased attention on asteroids and meteors in comparison to comets across both log file analysis time periods might be the popularity of the meteor – right / meteor-wrong activity. Each event used at least one toolkit and some events used materials from up to 10 toolkits. Most events used bits and pieces from multiple tool kits with an average of 2 kits used per event. In addition to toolkits, the Night Sky Network has resources available online. Approximately a third of the events reported using other Night Sky Network resources in coordination with their use of toolkit materials during events. This pattern of activity provided further evidence that amateur astronomers consistently used a wide range of resources to deliver customized education and public outreach experiences.

## Qualitative Analysis

Out of a total of 123 events included in the initial log analysis, 117 (95%) provided comments or anecdotes as a part of the file. During the second log file analysis there were a total of 236 events reviewed and only 157 (67%) provided a comment. This open-ended feedback was coded for emergent themes that would capture the overall response to the *Space Rocks* kits. Table 4 summarizes the most common themes that were identified in the logged comments and provides examples of the kinds of responses that were included in each category.

Table 4: Examples of Coded Comments & Feedback

Comment Code	Description	Example(s)
Description: Activity	Description of activity	Stargaze for students, parents and faculty during the school's annual "Family Math & Science Night". All enjoyed telescopic views of Jupiter, Full Moon and Orion Nebula. (Star Party)
<i>Space Rocks</i>	Specific mention of the <i>Space Rocks</i> kit	Taught about the differences between the words asteroid, meteoroid, meteor; Completed meteor-right and meteor-wrong. Talked about how asteroids and meteorites gave clues to beginning of the solar system. Showed them different types of meteorites and some of the characteristics. (Classroom Presentation)
Evaluative	Comments about the usability of the kit activities or reflections on the experiences of the participants.	We cooked up several comets and it was the first opportunity that I used the <i>Space Rocks</i> tool kit! The tool kit was a great success! I really like this tool kit. (Boy Scout Troop)
Weather Conditions	Comment related to the weather or observation conditions	The last program for the year so I tried to make it special and wouldn't you know it was cloudy with snow flurries. (Star Party)
Description: Training	Description of the activity that included the mention of giving a training or overview	An introduction to the NSN Toolkits and how they can be used to engage students in space science. The interactive workshop includes activities from several of the available Toolkits. (Teacher Workshop)

Analysis revealed that a mutually exclusive coding scheme could not be applied to the comment field. Many of the comments offered were detailed and included multiple kinds of reflections. As a result, when appropriate, more than one coding category was applied to the text in the comment section. During the initial analysis, the majority of comments were descriptions about the overall event, 88%, n=103. These descriptions often included details about the kinds of science practices that participants engaged in (e.g. observations, predictions) as well as the content of what they observed (e.g. moon, planets, particular constellations, transits of the International Space Station). Evaluative comments accounted for 26%, n=29 of the coded responses. This suggested that many of the amateur astronomers who used the *Space Rocks* kits were engaged in reflective practice and motivated to share their feedback on their education and public outreach experiences. Specific references to the *Space Rocks* kit,

were made in 24%, n=28 of the responses, with the “Meteor-right and Meteor-wrong” activity and passing around the samples of meteorites being most frequently mentioned. During the second log analysis descriptive comments remained the most popular and accounted for 58%, n=136 of the comments logged. Evaluative comments were the next most frequent representing 39% (n=93) of the responses followed by comments about weather conditions that influenced observations 24%, n=56. Specific references to the *Space Rocks* kits were found in 18%, n=43 of the comments.

Table 5: Summary of descriptive codes that emerged from logged comments

Comment Code	Initial freq.	Initial %	1 year later freq.	1 year later %
Description: Activity	103	88%	136	58%
Evaluative	29	26%	93	39%
<i>Space Rocks</i>	28	24%	43	18%
Weather Conditions	14	12%	56	24%
Description: Training	10	9%	17	7%

## Conclusions

The *Space Rocks* toolkit was designed to support amateur astronomers and out-of-school educators as they conduct education and public outreach programs with youth and public audiences about comets, asteroids, and meteors. The log file analysis described implementation patterns including: participation in events that featured the *Space Rocks* kit, the types of events where activities from this toolkit were typically used, and the response that this kit generated among amateur astronomers and members of their audience. Analysis also revealed that the popularity and utilization of the *Space Rocks* kit by members of the Night Sky Network significantly increased over time.