

Hands-On Science Activities Developed for Girl Scouts of Tanasi Council, Inc.

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Introduction

Outreach activities have been implemented to interest girls in careers in science and engineering, with emphasis on the physical and biological sciences. A patch program called “The Microscopic World” was designed for Girl Scouts in grades 1-12, sponsored by Tanasi Girl Scout Council. This program has been successful in providing hands-on science activities for girls in traditional Girl Scout troops, in large-group programs, in non-traditional Outreach groups, and at summer camp at Camp Tanasi. Over 900 girls have completed this patch program in the past four years.

Girl Scouts – Where Girls Grow Strong

Program Goals

The Girl Scout program has four goals for girls that it serves:¹

1. To develop to her full individual potential.
2. To relate to others with increasing understanding, skill and respect.
3. To develop values to guide her actions and to provide the foundation for sound decision making.
4. To contribute to the improvement of society through the use of her abilities and leadership skills, working in cooperation with others.

Goals 1 and 4 include learning new skills through education, such as science and math, to develop future career interests. Thus, Girl Scout councils are good collaborators for offering science outreach programs to girls. These councils typically serve thousands of girls through their existing members and programs.

Program Levels and Delivery Systems

Girl Scouting serves girls from Kindergarten through grade 12, with five different levels of programs for girls. Daisy Girl Scouts are in Kindergarten or grade 1. Brownies are in grades 1, 2 and 3. Juniors are in grades 3, 4, 5 and 6. Cadettes are in grades 6, 7, 8 and 9. Seniors are in grades 9, 10, 11 and 12. Programs offer various educational and/or recreational activities for girls, which allow girls to earn recognitions in the form of patches, badges, or pins. Some program activities are developed by the national organization, Girl Scouts of the U.S.A., and others are developed by individual Girl Scout councils.

Girl Scout councils provide their programs to girls through several delivery systems, including traditional troops led by adult volunteers, non-traditional or Outreach groups led by adult staff members, summer resident camps, and individually registered girls. Adult volunteers leading traditional troops are organized into larger groups known as service units, where multiple troops can organize and participate in activities or events together to earn recognitions. Adult

volunteers can lead their traditional troops in earning recognitions. Adult staff members lead girls in earning recognitions through the Outreach groups and at summer resident camp programs. Individually registered girls can earn recognitions by working with their parents or by attending events organized by their local service unit or council.

Girl Scouts of Tanasi Council, Inc.

Tanasi Council includes 18 counties in east Tennessee, and many of these counties lie in rural areas of Appalachia where children are bused long distances to school. Tanasi Council created the Outreach Girl Scouting program to serve girls where traditional troops were not feasible due to issues such as remote geography, lack of transportation, lack of parental involvement and volunteer leadership, and poor socioeconomic conditions.¹ In the 2001-02 year, 2339 girls were served through the Outreach program and 6339 girls were served through traditional troops. Within the Outreach program, 75% of the groups are set up as in-school programs in rural schools and 25% are set up in after-school programs at Boys & Girls clubs, recreation centers, YMCA's, YWCA's, churches, or schools.

The Outreach Girl Scouting program is supported financially through the United Way and other grants. Expenses include personnel to administer and lead the program activities, transportation for specific activities, resources and activity books, equipment, expendable materials and supplies, membership fees for the girls, uniform items for the girls (i.e. membership pins, tabs, and sometimes sashes), and earned recognitions for the girls (patches, badges, and pins). Girls participating in the Outreach program do not pay fees to cover any of these expenses.

The Microscopic World Patch Program

The Microscopic World patch program was developed to provide Tanasi Council with a science-based patch program for girls in grades 1 to 12. The council preferred to have one patch

program for multiple age levels, rather than different patches for each age level. The purpose of this patch program was to show girls how fascinating it is to look at familiar objects with microscopes and hand lenses, and to teach girls the difference between the worlds of Biological Science and Physical Science. Older girls are taught about career options in those scientific fields that use microscopes. A colorful, attractive cloth patch (see Figure 1) was designed as the earned recognition, so that girls would want to complete the program and wear the patch on their uniforms.



Figure 1. The Microscopic World patch is earned by Girl Scouts.

The patch program consists of 13 activities (see Table 1) that can be completed, with different requirements for each program or age level. Younger girls (Brownies) complete 4 activities, while older girls (Juniors, Cadettes or Seniors) complete 6 activities, with the complexity of

Table 1. Activities for the Microscopic World patch program. Brownies complete 4 of the following activities to earn this patch. Juniors complete 6 of the following activities, including the ones with a star (*). Cadettes & Senior Girl Scouts complete 6 of the following activities, including the ones with double stars (**).

1.	Examine objects from the Biological World with magnifying glasses, hand lenses, loupes, etc. Suitable objects include your fingertips, leaves, plants, vegetables, pet fur, human hair, & wood.
2.	Examine objects from the Physical World with magnifying glasses, hand lenses, loupes, etc. Suitable objects include salt crystals, rocks, gems, metals, ceramics, plastics, fabrics, yarn, & stamps. Look at a fracture surface on a broken object (like a paper clip or a pencil).
3.*	Use a compound microscope to examine specimens in transmitted light (where light goes through the specimen). Use prepared slides or make your own specimens (#6). Use a range of magnifications (such as 50X, 100X, 200X) to examine specimens with the microscope.
4.	Use a compound microscope to examine specimens in reflected light (where light is reflected from the surface of specimens, but does not have to go through). If possible, use a range of magnifications (such as 10X, 20X, 50X) to examine specimens with the microscope. Look at crystals of table salt under both transmitted and reflected light microscopes (if available), and compare how differently the crystals appear.
5.	Tour a laboratory or other work site where microscopes are used. Observe a microscope in use. Look at an image through the microscope to see what it is used to do (at work).
6.*	Make your own specimens by attaching thin objects (such as salt crystals, lace, hair) to glass slides with clear nail polish.
7.*	Learn the names of the parts of a compound microscope. Learn how the image is formed.
8.*	Learn about the history of light microscopes. Who invented the first microscope? What was it used for?
9.**	Learn how to record what you observe through the microscope, either on film, with a drawing, or using a video camera.
10.**	Interview an adult who uses microscopes in their career. Ask questions about what microscopes are used to do. How did they learn to use a microscope? What kind(s) of microscope(s) do they use? Do they examine specimens from the Biological World or the Physical World? What careers involve the use of microscopes? Share what you learn with others.
11.**	Build your own simple microtome for making thin slices of soft specimens (vegetables, plastics). Prepare your own thin biological specimen from onion or another vegetable. Mount it on a glass slide. Stain your specimen before examining its structure.
12.**	Learn about microscopes which are not based on using light, such as electron microscopes, scanning tunneling microscopes, or atomic force microscopes. When were these invented?
13.	Make a thin specimen from a semicrystalline thermoplastic, by microtoming or by stretching molten plastic. Examine your specimen under polarized light.

activities increasing with age and skill level. Certain activities are required for older girls, depending on their program level, ensuring that they learn more about microscopes and explore career options in science or engineering.

Implementation in Traditional Girl Scout Troops and Large Groups

The patch program was created by an adult Girl Scout volunteer when her daughter was a Brownie. The program was originally intended for use by traditional troops. The activities were first tested within the Brownie troop (5-10 girls). Then a large-group program was organized with 35-40 Junior Girl Scouts participating, divided into two sessions (2 hours each). Each session included a tour of the UT Electron Microscopy Facility. Then girls were divided into small groups that rotated through stations to complete five additional activities. This program was very successful – both the girls and their adult leaders were extremely satisfied with the activities.

The patch program also gives older Girl Scout troops an opportunity to provide leadership to younger troops by running program



Figure 2. Older Girl Scouts ran a microscope event for Brownies.

events where the younger girls can earn this patch. The patch creator's daughter is now a Cadette, and her troop recently organized an event for Brownie troops based on this patch program (see Figure 2). Fourteen Brownies participated, including 1st, 2nd and 3rd graders. This event provided significant science outreach opportunities to girls of different ages, including the Brownies from grades 1-3 (see Figure 3) as well as the Juniors and Cadettes from grades 6-7. The younger girls particularly enjoyed learning about science from older girls – perhaps more so than learning from adults.

Development of the Microscopic World Kit

One constraint on successful implementation of this patch program was the need for microscope equipment that was readily available to troops – i.e. was inexpensive and easy to use by adult volunteers (non-professionals) and young girls. A kit was assembled, containing all the necessary equipment for Brownies and Juniors to complete their required activities. This kit was donated to Tanasi Council so that adult volunteers could borrow it for use with their troops. The kit contained magnifying glasses, small hand-held transmitted light microscopes, small hand-held reflected light microscopes, prepared slides, plain glass slides, clear nail polish (as an adhesive for mounting specimens on slides), specimens (including table salt, rocks, fabrics, coal, and feathers), books on microscopy, and a poster illustrating parts of the microscope.

Later an additional large-screen microscope was donated to the council, primarily for use by young Brownies. This microscope is suitable for use by small groups (see Figure 4), so that

several girls can see the magnified object on the screen at once. It also works well for younger girls because they do not have to focus the microscope themselves or to focus their eyes through a small eyepiece lens to see the magnified image.

Training of Adult Volunteers

The Microscopic World patch program and kit were introduced to adult volunteers throughout Tanasi Council at an annual Leaders College, or adult training event. A training session on “Fun Science for Girls” was offered for troop leaders. This topic was so popular that two sessions had to be held – training over 40 adult volunteers. The microscope equipment in the kit was demonstrated to adult volunteers, who rotated through activity stations just as their girls would in earning the patch. Thus, these adults were trained and prepared to lead the microscope activities with their traditional troops. Verbal feedback from these adult volunteers was very positive – they looked forward to helping their troops complete the patch program. Regrettably, no records

have been kept on how many girls in traditional troops have earned this patch over the previous four to five years.



Figure 3. A Brownie Girl Scout learns about microscopes.

Implementation in Outreach Groups

In 1999-2000, Tanasi Council began using science kits for activities in the non-traditional Outreach groups. Paid staff leads these groups instead of adult volunteers, and the girls come from minority groups or from low-income families, often in rural communities. These groups meet either during school hours or in after-school programs. Over 500 girls have earned the Microscopic World patch through the Outreach groups between 1999 and 2002. These girls are primarily Brownies (50%) and Juniors (40%), with some Cadettes (5%) and Daisies (5%) but few Senior Girl Scouts. The Outreach Girl Scouting program has been an excellent delivery system for science outreach to girls, as it reaches large numbers of girls through cooperation with a non-profit organization (Girl Scouts of Tanasi Council, Inc.) designed to serve girls.

Implementation at Summer Resident Camp

In the summer of 2001, a second Microscopic World kit was assembled and donated to the Girl Scout camp (Camp Tanasi) for summer resident camp activities. Training was provided to the counselors that summer, and then returning counselors trained staff the following year. The Microscopic World patch activities were included in the Nature Quest program for Brownies and Juniors at resident camp. Girls were able to collect specimens from the environment, such as lake water, plants, bugs, rocks, and fossils, and then examine these specimens with microscopes. About 400 girls earned the patch during summer camp programs in 2001 and 2002, and the

program will continue to be offered in future years. Summer resident camp is another very good delivery system for science outreach that reaches large numbers of girls every year.

Advantages of this Hands-On Science Program

Science programs such as “The Microscopic World” make science fun and interesting, and provide girls with hands-on learning opportunities that allow them to envision positive futures for themselves. Career fields that women have not traditionally pursued, such as science, engineering, and math, show girls how their interests and abilities in these subjects can provide economic and professional opportunities while reinforcing the message that education is a critical life tool. One girl from an Outreach troop in a rural community stated that she wanted to be a biologist after completing this patch program, because she enjoyed the activities.

One advantage specific to microscope activities is the visual aspect of this scientific tool. People are very interested in visual sensory information, and learning is often directly related to what is seen. Often a person will say, “I see” when they mean, “I understand.” Girls are fascinated by looking at familiar, common objects under the microscope – and this makes science “fun.” Science activities that are “fun” are most likely to have a long-term impact on girls’ career choices, as they grow older, since many girls lose interest in science during middle school.

Another advantage of this program is that it is progressive – girls can earn the patch multiple times as they grow up through the levels in Girl Scouting, and do new, more advanced activities



Figure 4. An older Girl Scout teaches Brownies how to use a large-screen microscope.

each time. Depending on the equipment available, girls can change the activities just by using different models of microscopes. They can also examine many different types of specimens, so that activities are rarely ever perceived as boring. Older girls can teach the program to younger girls (see Figure 4), developing leadership skills and interest in science in the older girls. Young girls particularly enjoy doing activities with older girls, who are closer to their age than adults.

The equipment required for the hands-on activities is readily available at reasonable cost, and this is a definite advantage for volunteers and non-profit organizations. Magnifying glasses are easy to obtain and provide fun activities for young girls. Children’s microscopes can be purchased at most major toy stores with decent resolution (magnifications of 30X – 400X) at prices between \$15 and \$50 each. Many children’s microscopes are packaged with prepared slides as well as plain glass slides, cover slips, and stains for biological specimens. Some microscope kits include a microslicer, or small microtome, suitable for making thin sections of celery, carrots, or other plant tissue. This microslicer is ideal for completing activity #11 (in Table 1), instead of trying to build a microtome (as described in the book by Oxlade and Stockley).¹¹

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Microscopes are used in many different engineering and scientific careers, so this program exposes girls to many possible career choices. Thus, the program is more flexible for non-technical adult volunteers leading the activities for older girls, since activity #10 (in Table 1) requires interviewing “an adult who uses microscopes in their career.” Such careers include biomedical engineers, chemical engineers, civil engineers, electronics engineers, materials engineers, mechanical engineers, biologists, chemists, physicists, medical professionals, and veterinarians.

Summary

The Microscopic World patch program has been very effective as a hands-on science outreach program for girls in grades 1 – 12. By setting up this patch program through the Girl Scouts of Tanasi Council, Inc., opportunities became available to reach hundreds or potentially thousands of girls through the work of adult volunteers and Girl Scout staff. Over 900 girls have participated in the past four years. The program is now on-going, and requires little support from the creator (Monica A. Schmidt, Ph.D.). Through the Outreach Girl Scouting program, the patch activities are offered to about 200 girls each year that are at-risk due to poor socioeconomic conditions and/or living in rural areas of Appalachia. These girls are encouraged and motivated to advance their educations and pursue career opportunities that would not ordinarily be considered as possibilities. Summer resident camp programs at Camp Tanasi allow 200 girls per year to participate in hands-on science activities. The patch program is also implemented through traditional Girl Scout troops and large group events.

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