


Chapter 5

Enriching the Lives of High School Teenagers With Science Cafés

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ABSTRACT

This chapter provides a roadmap for any who are inspired to start a teen science café program as a member of the teen science café network. These out-of-school programs are a free, fun way for teens to explore the advances in science and technology affecting their lives. Teens and scientists engage in lively conversations and activities to explore a topic deeply. Teens get increased understanding of the nature of science and develop a realistic perception of scientists, science careers, and the lives they lead. Scientists gain skills in communicating science to the public and inspire youth to STEM careers. Adult leaders serve as guides for the teen leaders and are the linchpin of the program. Evaluation shows programs positively influenced teens understanding of science issues in the news, the ability to use facts to support scientific points of view and considering multiple sides of an issue before making a decision.

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Enriching the Lives of High School Teenagers With Science Cafés

INTRODUCTION

In centuries past, people of all walks of life would gather in public places to discuss and debate the changes in their world to come to deeper understandings of what the future might **bring**. Books were not prevalent and most people received their news by word of mouth. Sitting in a pub or café, people would discuss changes in law, politics, philosophy, science, art, the future of medicine, and much more. Over time, these public gatherings diminished.

In 1992, the French philosopher Marc Sautet revived the idea of ordinary people engaging in rich philosophical discussions and founded the Café Philosophique in Paris, France. A mostly forgotten process of engaging in public discussions was reborn across Europe. Six years later, Duncan Dallas, an English scientist with a passion for communicating scientific ideas with the public, envisioned a “Café Scientifique” (Dallas, 2006; Café Scientifique, 2012) in which people come together in a social setting to explore the latest ideas and discoveries in science.

The model is popular with teens for the same reason that adult Cafés are popular; the blend of a collegial social setting where participants can interact with each other and satisfy their curiosity about a science-based topic through lively interaction with a scientist (Farmelo, 2004). Teen cafés differ only in the leadership and the addition of hands-on activities that correspond with the topic. The Café movement coincided with the growing importance in academia of the study of and practice of communicating scientific ideas. Thus, the science café model spread rapidly across every continent.

BACKGROUND

The teen science café model was constructed on programmatic answers to a series of key questions, then validated via rigorous evaluation.

The following questions guided the development of the teen science café program:

- How to make science engaging and accessible to more youth?
- How to help them see science and technology research and discoveries as relevant to their daily lives?
- How to develop a positive culture around thinking scientifically and maybe even pursuing STEM careers?
- How to prepare science and technology professionals to effectively engage youth in their research and discoveries through discussion and other activities?
- How to build a program that will be professionally rewarding to the scientist participants?
- If it is built, will the scientists and youth come?

Answers to the questions became key objectives in the program development and led to the following goals for the Café implementation. Teens will develop:

- an informal community that engages in scientific discourse, thought, and exploration;
- a deep and nuanced understanding of current issues in science and technology and be able to communicate that understanding confidently and expertly;

Enriching the Lives of High School Teenagers With Science Cafés

- skills and attitudes for lifelong learning and an appreciation of science as a career and as a way of thinking.

The program summative evaluation results (Hall et al., 2010; Foutz and Luke, 2010) indicates that the program was largely successful in achieving these goals.

IMPACT ON TEENS

The following two questions guided the teen impact evaluation:

- (1) Does engagement in the program enhance teen participants'
 - (a) understanding of current STEM content and issues?
 - (b) sense of confidence and competence in their ability to develop and communicate factually supported positions on STEM issues?
 - (c) appreciation for and interest in STEM careers?
 - (d) attitudes toward science, the process of science, and scientists?
 - (e) personal development, such as growth in character, perceived contribution to their community, and leadership skills.
- (2) To what degree do teens feel a sense of belonging to and ownership of the Café community?

The evaluation drew from a framework described in the field of Positive Youth Development. The study used an outcomes-based framework in which six outcomes called the six “C’s” (competence, confidence, connection, character, caring and compassion, and contribution) are the basis for a successful program. In addition, related participant impacts, such as attitudes toward science, were also important to the program model, and therefore were also investigated.

METHODS

Written quantitative surveys were used to investigate the program outcomes for teen participants. A quasi-experimental design was used, allowing for a matched (non-randomly selected) control sample. The design allowed for two types of comparisons: (1) between teens who participated in the Café program (treatment group) and teens who did not (control group), and (2) retrospective pre-program participation and post-program participation for teens who attended the program.

CONCLUSIONS

The most essential elements of the Café model are the people involved (program leaders, scientist-presenters, youth leaders and attendees). The strength of the model is that it has been implemented and evaluated at more than 130, diverse sites. The program is successful because the benefits of participation outweigh the challenges for both the teens and the scientist-presenters. Evaluation data show very clearly that café programs positively influenced participants' attitudes toward science, including interest

Enriching the Lives of High School Teenagers With Science Cafés

in science and science careers, knowledge of scientists' work, awareness that science affects their daily lives, and interest in science careers. It also positively influenced their self-efficacy and cognitive competence toward science including understanding of the nature of scientific research, their understanding of science issues in the news, the ability to use facts to support scientific points of view, and considering multiple sides of an issue before making a decision. This was true both for analyses that compared the ratings of participants to non-participants and for the retrospective-pre-to-post ratings of participants.

Learning from experience, as well as the formative and summative evaluations, the authors have made continual improvements in the program—both on the teen side and the scientist-presenter side. The maturity of the program and its clear impacts make a strong case for other communities to start their own programs.

SUPPORTING TEENS' DEVELOPMENT IN SCIENCE, TECHNOLOGY, ENGINEERING AND MATH (STEM)

Teens are going through a unique and important time in their lives—transitioning from childhood to adulthood. They are in the process of defining who they are and how they fit into the world. Teens need safe, secure, and trusting relationships with peers and adults to help them explore new challenges and opportunities, as they become independent adults (McLaughlin, 2000). Science cafés can be an important element of this exploration period in teens' lives, and have been shown equally effective for girls and people of color (Foutz & Luke, 2010; Gambone et al., 2002; Gambone & Connell, 2004; Kekelis, L., 2005).

Teen science cafés open the eyes and minds of teens to the importance of understanding how science, technology, engineering, and mathematics (STEM) affect their lives now and into the future, and inspire lifelong learning (Mayhew & Hall, 2011). These programs have been shown to positively increase teens' interest in STEM and STEM careers. Teens often come away from a Café experience with new understanding about how the basic science they learn in school applies to solving real life challenges.

One of the most effective ways for this to happen in a science café is for teens to learn more about the day-to-day work of STEM experts, and to see first-hand the passion they have for their work. Thus, presenters share their personal story describing the journey they have taken to arrive at their current career, and revealing a pathway for teens. Teens are interested in how adults advanced from their first job in high school to the career they have today. They enjoy stories about the twists and turns in the scientists' career and the people who helped them find a path to success. They also are interested in learning about careers requiring varying levels of education. These stories help teens envision the opportunities and steps they will need to take on their own journey.

Launching Café Scientifique New Mexico

In 2006, the authors were inspired to start a novel science café program for high school teens in northern New Mexico after learning about the proliferation of adult science cafés world-wide. The popularity of science cafés stems from its stimulating informal conversation, intriguing topics, and cutting-edge experts who make the topics come alive and accessible (Nisbet & Mooney, 2007a; Nisbet & Mooney, 2007b). The programs are typically held in cafés or other social venues serving light refreshments; it includes a brief presentation by an expert on a topic, followed by discussion during which civil discourse and debate

Enriching the Lives of High School Teenagers With Science Cafés

is encouraged. This blend of ingredients accounts for the café model's global popularity. The authors wondered if this science café model could appeal to that hard-to-reach segment of the public, the high school teen and serve an unmet need for high school age teens interested in peer-to-peer exploration and discussion of science issues affecting their everyday lives (Bell, et al, 2009).

The authors reached out to teens in four culturally, demographically and economically diverse towns and cities in northern New Mexico: Santa Fé, Los Alamos, Albuquerque, and Española. The authors sought the teen audience due to the importance of encouraging youth to appreciate the relevance of STEM to their lives and to spark their interest in STEM career paths.

In each community, the authors visited schools and shared the idea of starting a teen science café. Teens were overwhelmingly positive about the idea, especially meeting a scientist, and learning about STEM careers. The goal was to have teen leaders organize their programs with the help of a caring adult, so they would become personally invested in the program.

The authors proposed that the programs would be organized by teens and for teens, and that a group of volunteer teen leaders would have a voice in all decisions. These included suggesting topics and presenters, choosing and buying the refreshments, and providing critique on the scientist's presentation before the main event. The teens also wanted to have some form of active learning in the program. So, the teens and adult leaders work with the presenters to incorporate a hands-on component. It may be analyzing malaria outbreak datasets, unraveling a mock crime scene, identifying species of crickets by their sounds, or hosting a white-hat hackathon to explore careers in cyber-security. When some of the early presentations and discussions did not inspire, teens began coaching the presenters in what makes the program the exciting and engaging event they desired. Thus, the program is now led by teens, for teens.

Teachers were supportive of the concept and committed to help the teen leaders promote the program, and invited the adult leaders of the programs to make a pitch to their students to develop and lead their own program. By hosting teen cafés out of school, it allows any teen the free choice to expand their mind and make new connections with STEM experts.

However, transportation was a challenge for some, as not all teens can drive and public transportation was not feasible in the rural towns. So, the scientists volunteered to travel to the four different communities, rather than teens coming to the scientists.

The authors applied and received a grant from the U.S. National Science Foundation to try the experiment and develop a model for teen science cafés. The authors knew that teen science cafés were being held in schools in the United Kingdom, and connected with the leaders in the U.K. to learn from them. This was to be an out of school program, as teachers are pulled in too many directions already. This appears to have been a good choice, as the U.K. programs led by teachers have ended due to lack of time and resources. Thus, adult leaders only ask teachers to help the teens promote their program to their peers.

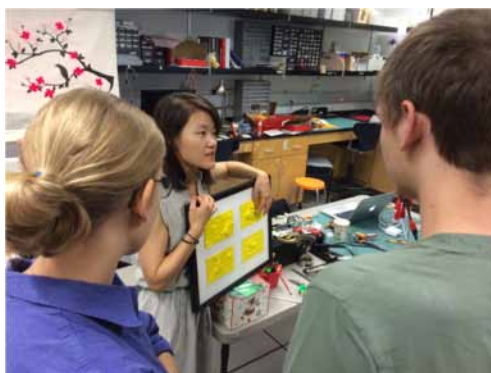
The primary goal was for the teens to get a significantly increased understanding of the nature of science and to develop a realistic perception of scientists and the lives they lead (NRC, 2010). The authors wanted teens to understand that a scientist is a real, complex, multidimensional human, like them, with his or her own unique set of motivations, delights, abilities, and challenges. The authors wanted presenters to convey that—because of a career in science—she or he has had, and is having, a particularly interesting life. The authors wanted to instill a passion for lifelong learning and an appreciation of the relevance of all kinds of science to their own lives.

The top reason the teens cited for attending the teen café was to meet a scientist. This surprised the authors at first, as the authors are scientists. However, there are 42 million teens in the U.S. and 7 million scientists and engineers (Sargent, 2017). For most, the only scientists that teens meet are their high school

Enriching the Lives of High School Teenagers With Science Cafés

teachers. The secondary goal was to help scientist-presenters to effectively communicate their science to the public. And finally, the authors wanted to create an informal community of teens that engages in scientific discourse, thought and exploration. Youth in the focus groups were enthusiastic enough about the project that the majority volunteered to be on the site-based teen leadership teams.

Figure 1. Teens visit a scientist's lab and learn how to make 3-D Braille books. (Photo credit Teen Science Café Network by permission.)



The twelfth season of Café Scientifique New Mexico (cafénm.org) is now completed having served over 48,000 teens. The Teen Café model has evolved through trial and error and formal evaluation over those years. Contrary to the initial trepidation—what if there is a Teen Café party and no one comes?—the program has proven highly popular with the teens, and the evaluations indicate the program has been quite successful in achieving the goals. In fact, more than 10 sites are led exclusively by teens for teens, with no adult guide!

But there are other secrets of success associated with this particular audience. One is that the teens achieve a sense of ownership of the program thru participating in the Teen Leadership Teams in each program.

Teens are encouraged to lead all aspects of the program to the greatest extent possible, with adults in the background for support as needed. Another is that, with few unusual exceptions Cafés are deliberately not held Cafés in schools. However, the authors have made a point of building relationships with high school teachers, who have proven supportive and helpful in innumerable ways, such as lending scientific equipment for experiments at the Cafés and making connections between what teen learn in school with what they learn in the science cafés. And a third is that for every Café event, the authors work with the presenter to develop an activity or deep discussion that the teens can engage in as an adjunct to the interaction between the presenter and the teens—teens like to do stuff. Hands-on activities that actively engage the teens help to cement the science message.

The degree of engagement needed to spark interest in science topics—especially for the teen audience—is unfamiliar and daunting to many Café scientist-presenters, even those with experience in public speaking. Most have been trained to approach science communication in the “information deficit mode” (Nesbit and Mooney, 2007a.b). But with coaching from the program staff, after some initial trepidation the scientists typically rise to the occasion.

Enriching the Lives of High School Teenagers With Science Cafés

Finding and Preparing Presenters

The authors identify potential Café presenters within local organizations with a science mission and look particularly for scientists working in areas that Teen Leaders have expressed interest in learning about. Asking multiple people about the presentation skills of the potential presenter helps to ensure a great presentation. After informal conversations with a presenter in which the essential ingredients of a successful Café are conveyed, the authors provide him or her with “Guidance” documents intended to formally frame their preparation for and conduct of the Café sessions. It stresses the importance of knowing the audience. Teens will readily engage with a presenter on some hot science topic if it is accessible to them. The presentation organized around one essential provocative idea or concept are encouraged, and the presentation needs to be free of jargon, while full questions to engage the audience in discussion. Presenters are encouraged to *tell a story, but leave some mystery in the story*, and stress that *interactivity* is one of the most important ingredients of a Teen Café (Mayhew & Hall, 2011). In a Café presentation, communication—meaning two-way verbal interaction, supported by a few key graphics—is of the essence.

Finding great presenters who can make their research topic relevant and exciting to teens can be challenging. A good place to start is to ask colleagues for help. Explain what a teen science café is and is not...it is not a lecture! Describe the characteristics of the type of presenter you wish to recruit—someone who is funny, relaxed, flexible, and can explain the science behind their work in plain language.

Attend local adult cafés, and lectures at colleges, universities, and museums to observe potential presenters first hand. Ask the Public Relations Office of local STEM organizations about experts who have given particularly good interviews. Call the science editor of the local or regional newspaper or TV station and ask them for recommendations of STEM professionals that have given great interviews. Outreach centers at the local college may have recommendations. Ask staff of the U.S. Representative’s office about names of scientists they use to help them keep abreast of current STEM research.

Science is everywhere! For teen science cafés in larger cities, finding presenters is often fairly easy. There is often a zoo or aquarium and there may be museums, colleges or universities, and science and technology companies. But one of the wonderful aspects of science and teen science cafés is that they have no limits on topics or places to convene. There are scientists everywhere and all you need is some dedicated teens and an adult leader to pull things together, even in small-town and rural areas. It might not be so obvious at first where to find scientists, but you may in fact have many hidden opportunities for both great presenters and really unique hands on opportunities.

Every community has utility systems – electric, water, sewage, waste and recycling, gas, cable, phone. Some homes and farms may have septic tanks and wells. How do they work? Where does the recycling go? There are scientists and engineers in each of these utilities that can answer that question and even show teens how they work with an onsite presentation. Then, there are civil engineers that build the roads and transportation engineers that manage traffic lights. Even small towns typically have their own radio stations and maybe a public television station. Small engineering firms and renewable energy companies may have individuals with interest in sharing their knowledge with youth.

Just asking around and talking with everyone you can about what you are trying to accomplish will probably turn up at least a name or two of someone you can follow up with later. Learning about the technology behind the communications systems that are taken for granted can be eye opening. The local weather forecaster is often trained as a meteorologist and would make for an interesting café.

Enriching the Lives of High School Teenagers With Science Cafés

Agriculture, in general, is ripe for making science connections for youth as well as connecting them to where their food comes from. Animal husbandry and plant breeding require knowledge of genetics and may get kids thinking about the relevance of what they are learning in the classroom. Cooperative Extension Agents and master gardeners that can share their knowledge about animals, seeds, crops, plant diseases and many other topics. Dairies, local cheese makers or breweries can be great sources of presentations on how to prepare these unique foods. Cooking in general—the science of baking or marinating or other aspect—could be explored. There may be a Civil Air Patrol group who can teach about flight and the nuances of flying in different types of weather conditions.

Funeral homes and crematoria have experts in preparing bodies after death and what teen isn't a bit intrigued by dead bodies? A county most likely has crime scene investigators, and Emergency Medical Technicians can talk about the opportunities and challenges of emergency medicine. Local dentists and doctors, physical therapists and yoga instructors can teach about the body. Psychiatrists can talk about brain and emotional disorders. Teens are keenly interested in the brain, especially their own.

Continue to vet them. Always get multiple independent recommendations for a potential presenter, unless you can observe the presenter in action first hand. When you feel confident you have a strong candidate, contact them to see if they can meet with you to explore the possibility of presenting at the teen café. The in-person invitation is critical to ensuring the presenter understands what you are seeking to ensure a great experience for everyone at the teen science café.

Make the pitch. A key element of recruiting a presenter is helping them understand what is in it for them. Why should they do this when their calendar is already overflowing with demands? Maybe they teach all day at the university and see this as just another lecture. Maybe they are afraid of committing because they know nothing about teens. Maybe they are not sure they can do a good job presenting to teens.

The pitch needs to include how you will help them better understand and prepare for this audience. The TSCN website has many resources and trainings to enhance adult leader' skills in coaching the scientists. The research shows (Hall et al, 2010) that presenters gain valuable skills in presenting their work to this audience that carries over to how they present their work to other non-technical audiences such as funding managers, the press, peers outside their narrow area of research and even family members. So, they have much to gain from this experience, if they take a chance and give it a try, they will be glad they did!

The Essential Rehearsal

It is highly valuable—and indeed essential—for presenters to do a rehearsal with a small group of Teen Leaders before presenting to a full house. This has proven exceedingly valuable in getting the presentations pitched at the right level and any graphics comprehensible. It also serves to overcome a certain intimidation factor for many presenters. The attitude of this presenter about the value of the dry run is typical: *“The dry run was immensely valuable. It helped me select appropriate verbiage and content for the presentation. It also helped me gauge the level of delivery....After the dry run, I made significant changes to the presentation, including the elimination of confusing content, identification of real-world connections, and simpler examples.”*

Café Scientifique New Mexico has hosted over 100 presenters. Without exception, they considered their experience engaging with teens via the Café program to have been enjoyable and of value. They have improved and broadened their communication skills. Some have also benefited in an unexpected way: they have come to a new perspective on their own research. As one presenter put it, *“The Café*

Enriching the Lives of High School Teenagers With Science Cafés

Figure 2. Vetting and training presenters is often done through role play in groups, which gives them confidence in their presentation. (Photo credit Teen Science Café Network by permission.)



experience was beneficial to me as a scientist in that preparing an interactive talk for an audience of young people helped me identify the critical issues in my work: why I was doing it, why it is challenging, what we are trying to accomplish (vs. being bogged down in technical details). This really focused my thoughts about my work.”

What is the Teen Science Café Network (TSCN)?

Based on the success of Café Scientifique New Mexico, the NSF provided funding to take the model nationally as the Teen Science Café Network (teensciencecafe.org). The TSCN is a dynamic, rapidly-growing community of practice (Wenger, 2009) with the mission of connecting high school teenagers with science and scientists. From its first phase, starting with 5 sites in 2012, the Network has grown at an almost geometric rate to ~133 sites and 46 states and Canada. The long-term goal of the Network is for it to become a widely recognized and self-sustaining movement among a diverse American culture, such that it provides many thousands of teens across the country each year with an understanding of the nature of science, an appreciation of scientists as real people leading interesting lives, and a motivation for lifelong learning in science as adult citizens, a significant number of whom will follow myriad pathways into the U.S. STEM workforce.

How do I Join the Teen Science Café Network and What Will I get out of it?

Any organization or person that wishes to do so can become a member of the Teen Science Café Network and start its own teen science café program; membership is free. Working closely with new members to ensure a successful start-up and continued operation is essential. Using video chats with prospective members, then follow up with more chats until they have hosted their first café event. As part of a simple application, prospective new members commit to seven “Core Design Principles” of the TSCN. Within that framework, a member organization has flexibility in designing the particulars of its program. Some Cafés are theme based, such as astronomy, oceanography, or emergency response, but most programs explore STEM topics more broadly.

Enriching the Lives of High School Teenagers With Science Cafés

Members become part of a *community of practice*, in which they share a common sense of purpose and are able to contribute to and receive benefit from participation; this sense of common purpose and community is something that the members have readily embraced. One of the best ways to promote this is at the annual workshops, at which members get to know each other on a personal basis, share knowledge, and form collaborations. Evaluations of the workshops document that they are perhaps the best way of all of fostering the community of practice.

What are the Core Design Principles?

Using the initial experiment in New Mexico and the formative and summative evaluation results, a set of Core Design Principles that ground the Teen Science Café model was developed. Rather than a strict recipe for a program, the Core Design Principles represent a framework that gives a prospective café leader flexibility in program design to be responsive to their context, teens, and community. A common attribute is that a teen café is a STEM program with a low barrier to entry that is primarily lead by teens, for teens. The principles are:

1. Café programs are highly engaging and interactive. *Cafés are structured to promote lively conversation and interaction among teens and the presenter; a Café program is not a lecture.*
2. Scientists are carefully vetted and provided guidance in communicating with teens. *Focusing on storytelling, the big ideas, why it matters, and how it will change the world—supported by a few key, jargon-free graphics—is of the essence.*
3. Teens gain a sense of ownership of *their* program through opportunities for leadership. *Teen Leadership Teams are responsible for all aspects of their program, with adult leaders providing support in the background.*
4. Each Café site has one or more adult leaders who are committed to the program. *The adult leaders have the energy and dedication to organize and support the work of teen leaders.*
5. Café programs seek to attract teens with diverse motivations and life experiences. *Diversity includes ethnicity, culture, and gender, but also motivations to learning about science. Teen Cafés are not just for the science geeks; they are for all curious teens.*
6. Café programs actively cultivate strong community relationships. *Building relationships with scientific and teen-serving organizations can increase participation of both teens and scientists, and support community awareness and sustainability of the Café program.*
7. Café organizers promote awareness of career trajectories and STEM opportunities beyond the Café experience itself.

What is the Format of a Typical Teen Science Café?

A teen science café begins with an icebreaker, and period of socializing. Teens have simple food and drink to create a welcoming and comfortable atmosphere. Next, the presenter engages in an interactive conversation with the teens aimed at framing the topic of the program and shares personal stories about experiences in doing the science that has shaped his or her career. A wide-ranging discussion can go back and forth between the presenter and the teens, and among the teens as well. When the conversation has reached its logical end, the teens and presenter engage in an active learning experience aligned with the topic. This helps the teens digest the new ideas and formulate additional questions for the presenter

Enriching the Lives of High School Teenagers With Science Cafés

Figure 3. Teens explore strategies for reducing climate change through games.



that can be answered in the wrap up conversation. In a typical 90-minute café, this usually works out to a presentation of 15 - 20 minutes, an activity for 10 to 40 minutes, and the remaining time for discussion.

Who can Host a Teen Science Café?

Any teen or adult who is motivated to organize the program. It may be easier to connect with partner organizations in the community to spread the word and work, and to get access to a venue, but teens have started programs on their own.

Where are Teen Science Cafés Located?

Network sites are located across the United States and in British Columbia. A directory of teen science cafés is located on teensciencecafe.org. They are held in libraries, museums, zoos, universities and community colleges, aquaria, Boys and Girls Clubs, 4-H, 21st Century Community Learning Centers, and many other organizations.

How to get Started?

1. Develop and make a pitch to diverse groups of teens and community partners about the value of cafés. Include why you want to make this happen in the community.

Enriching the Lives of High School Teenagers With Science Cafés

2. Develop contacts with both teens and scientists to market the program. Capture the email and phone numbers of all teens and their parents in an Emergency Response form to be able to respond in any emergency, and to be able contact the teens beyond the years they attend.
3. Motivate and inspire teen leaders to bring friends to a meeting to learn what it takes to create the program and what they will gain from attending a teen café. Pizza helps a lot!
4. Organize a teen leader training in which the teens roleplay every element of the event. Use resources on the TSCN site for ideas on leadership training,
5. Find a suitable venue for the event and determine schedules that best meet teens' needs. Seek out venues that are free to use and that have plenty of space for the teens to move around.
6. Explore the topics teens want to learn about and find high quality presenters by asking friends and colleagues.
7. Coach the scientists in how to work with teens in the café setting using the resources on the TSCN site.
8. Schedule the events well in advance and market, market, market the program. Marketing with social media, flyers on the STEM teachers bill boards, announcements at school sports events, notices on the school's marquee and more ideas on the TSCN site. This will help you in fundraising for refreshments.
9. Capture systematically the attendance and participation (as well as emergency contacts). Having parents contact info is crucial for safety and for following up with the teens years after the program.
10. Debrief with the teen leaders to ensure continuous improvement and buy in of the program.

Many more resources for launching the program are freely available on teensciencecafe.org.

What are the Crucial Roles of an Adult Leader?

Mentoring and inspiring teen leaders. The “secret of success” of a teen café is that it is primarily lead by teens, for teens. Teens embrace a program when they feel it is *theirs*, as opposed to one created and run by adults for their intended benefit. Sites in the Network achieve teen ownership of their program via teen leadership teams, led by a dedicated adult leader who fosters a sense of ownership and proactivity in the teen leaders, such that they take on responsibility for the operation of their program and in the process develop lasting leadership skills. Promoting positive mentoring relationships between teens and adults increases retention and commitment to the program (Gambone et al., 2002; Sullivan & Reed, 2009).

Teen leader responsibilities include engaging and introducing the presenter, conducting a closing ceremony, preparing and serving at the food table, welcoming attendees at the check-in table, making teen attendees feel at home, orchestrating an ice breaker, and promoting the program in their schools and communities. These responsibilities all require skill development through practice; most importantly, teen leaders need to feel empowered to step up to their responsibilities.

The role of the adult leader in mentoring teen leaders is critical. It is first and foremost to instill in the teens a proactive mind set and a sense of freedom to take charge, to take responsibility for doing what needs to be done to make their program a success, in short, to grow as leaders. With this mindset teen leaders will seek to improve and perfect their program. The teens will also have the freedom to make mistakes, but then learn from them and improve. Adult leaders can be “gateways” or “gatekeepers” and the outcomes from these two approaches are stark, based on the program evaluations.

Enriching the Lives of High School Teenagers With Science Cafés

“Adult leaders play a pivotal role in the teen leader experience in terms of how they treat teens, how much support they provide, and the kinds of guidance they give. They serve [either] as gateways [or as] gatekeepers of information about the program and the partner institutions.... As gateways, adult leaders provided teen leaders with information and resources needed to run cafés as well as to grow personally. One teen leader reflected, ‘I think it’s a really strong mutual support system, in that we support them [the adult leaders] in whatever they need us to do to get everything together and they support us into like forming it into what we want it to be’.... Teens who experienced the gatekeeper–type of adult leaders expressed frustration about the support they received from the adult leaders, particularly when the teens sought to take initiative beyond the more traditional roles of marketing, organizing, and running the cafés.”

Thus, an adult leader will be there to provide resources and to regularly frame the work that needs to be done, but will allow the teens to take on full responsibility for carrying it out, staying in the background for selective guidance as needed. The qualities that an adult leader seeks to instill in teen leaders are much the same as those articulated by the 4-H: confident, responsible, team players, resilient, self-motivated, compassionate, problem solvers, decision makers.

As experience within teen café programs in the Network has demonstrated, an adult leader who is heavy handed in directing the teen leaders will discover that they have a group that is unmotivated, will tend to stand around waiting to be told what to do, and will likely carry out their tasks in a careless and sloppy manner. The program will not function well and its reputation will suffer. The teens will have little opportunity for personal growth.

The adult leader is thus the lynchpin of the café program. A whole section of the Resources library on the TSCN website is devoted to teen and adult leadership. The Network provides mentor training of adult leaders across the Network at the annual summer workshops.

Coaching Scientists in Effective Communication

Few scientists are well prepared to do an effective teen café; most need coaching. The “information deficit” (Nisbet, & Mooney, 2007a,b) approach to science communication too often used in the context of professional society meetings, lecture series, or the classroom—is ineffective. This one-way transmission of facts from an expert to an information-deficient lay audience is especially ineffective for teens.

An effective café presentation requires full engagement between the presenter and the teens, who need to be met where they are. The presenter needs to be able to calibrate his or her presentation—often on the fly—to existing knowledge. One way to achieve that is to ask questions of the audience. It is important to make a connection to their daily lives. Hands-on activities that actively engage the teens help to cement the science message. Ideally, these interactions take account of current knowledge, misconceptions, biases, and cultural and other affective responses.

The degree of engagement needed to spark teen interest in science topics is unfamiliar and daunting to many café scientist-presenters, even those with much experience in public speaking; most have been trained to approach science communication in the information deficit mode. However, with coaching, after some initial trepidation the scientists rise to the occasion.

Using small groups and think-pair-share techniques (Davis, 1993) to build teens confidence in speaking in a group can open up the conversations quickly. Having scientists implement wait time protocols (Swisher, 1994; Moore, 1987) when asking and answering questions can create a relaxed, respectful and supportive environment. These techniques are effective in encouraging discussion with all learners (Kekelis et al., 2005), especially Native American youth and with females.

Enriching the Lives of High School Teenagers With Science Cafés

Once a prospective presenter has been identified and vetted, he or she receives an email summarizing the program and indicating that they have been recommended as someone who could do a good café presentation. The email also emphasizes the importance of interactivity, meeting the teens where they are, and the desire to have an accompanying “hands-on” activity. Often there will be a follow-up phone call to answer initial questions. Rarely will a scientist simply say they are not interested—most are likely to say, “sounds like fun”—*provided they are contacted months in advance*.

Next, the presenter is sent the “Presenters Guide to the Essence of a Teen Science Café” document, which stresses the importance of knowing the audience. Teens will readily engage with a presenter on some hot science topic if it is accessible to them. The presentation needs to be free of jargon and delivered in an engaging manner at an entry level so that teens will be pulled in and be able to develop new mental images. It is important that presenters not try to cover the whole breadth of a science topic, thus creating too many new mental pictures for the teens to try to process at once. A better approach is to organize the presentation around one essential provocative idea or concept, and let everything flow to it. This is referred to as the *Most Important Thing*, an idea deliberately designed to be accessible to the teens. It is most effective if a presenter gets across the *Most Important Thing* by *telling a story*.

Presenters are provided with a simple checklist:

- ***Make it highly interactive.*** A Café is not a lecture! Make the presentation a *conversation*.
- ***Watch your pacing.*** Pause frequently to allow them to mentally catch up with you.
- ***Be lively and animated...*** like you just love the subject!
- ***Meet them where they are.*** You will need to verbally paint very simple mental pictures for them.
- ***Tell a story.*** Story-telling will engage them emotionally and mentally. Weave in your own story!
- ***Keep it light.*** Include jokes, cartoons, funny stories, that is always engaging.
- ***Keep it simple.*** Avoid technical words and jargon. If you can say it more simply, do.
- ***Keep it focused.*** Organize the presentation around ***a very few*** simple take-home messages.
- ***Take care with graphics.*** Keep slides simple, colorful, jargon-free, and few.
- ***Make it personal.*** Convey the challenges, delights, and passions of your own life in science.
- ***Relax!*** You will find that interacting with teenagers is a lot of fun.

Next the adult leader arranges to meet with the presenter informally to talk over what he or she will present. This is an opportunity to help the presenter identify the *Most Important Thing*—plus no more than three take-away ideas or images—and thus focus his or her thinking. It is an opportunity to emphasize that it is best to assume the audience knows nothing at all about the topic. It is also an opportunity to review best practices in PowerPoint presentations. This is the time to brainstorm with the presenter about a hands-on activity and work with them. These meetings are also of great value in establishing a personal connection with the presenter, which will carry through the café series and beyond.

Very early on the authors came to believe that *a dry run is an essential part of scientists’ preparation*. Dry runs are most effective if they are held with a small group of teen leaders; they are the ones that can give the most relevant feedback. The dry run has proven exceedingly valuable in getting the presentations pitched at the right level and the graphics comprehensible. It also serves to overcome a certain intimidation factor for many presenters concerning the prospect of presenting before an unfamiliar audience. While many presenters have initially told the authors they are experienced at presenting to the public and never do a rehearsal, every presenter has told us afterward that the experience was well worth their time. This presenter comment is typical: “*The dry run was immensely valuable. It helped me select*

Enriching the Lives of High School Teenagers With Science Cafés

appropriate verbiage and content for the presentation. It also helped me gauge the level of delivery. Furthermore, I found the student input extremely important in identifying what their peers would find interesting. After the dry run, I made significant changes to the presentation, including the elimination of confusing content, identification of real-world connections, and simpler examples.”

*Figure 4. Teens engage in an icebreaker at a café event focused on Managing Stress Through Yoga
Photo credit: Teen Science Café Network by permission*



What Professional Benefits can you Expect to Derive From Being an Adult Leader?

Our adult leaders participate in a yearlong professional development program with their peers that is focused on all the elements of leading a teen science café: science communication, leadership, organization, fundraising developing partnerships to support your program, and various other topics relevant to informal STEM education.

What can you Expect Teens to get out of it in the Short Term?

Teen café programs have proven popular with teens throughout the Network, from small towns to big cities, and the reason for their popularity is much the same as for adult cafés: the combination of the socializing with their peers—with food! —and the lively conversation with a scientist on some interesting topic. Indeed, the thing teens appreciate most is being able to interact face-to-face with a scientist. For most teens, exposure to practicing scientists and thus scientific thinking are rare.

Enriching the Lives of High School Teenagers With Science Cafés

When presenters convey their personal stories, the teens gain an appreciation of scientists as real people leading interesting lives in science. They get a better understanding of the true nature of science than they get in school, though they often find that what they learn in a café compliments what they learn in science class. Some teens may find the possibility of a life in science for themselves that had not occurred to them before. They find a relevance of science in their lives. The earliest evaluation in the New Mexico program documented the impact on teen; these impacts were later replicated in the TSCN:

- Teens gained a much more realistic perception of the nature of science, the interesting lives that scientists lead, and for some the possibility of a life in science.
- It positively influenced teens' interest in science, science careers, and the nature of scientific research.
- 71% of teens agree that the Café changed their view of the importance of science to their lives.
- The Café positively influenced teens' understanding of science issues in the news, their use of facts to support scientific points of view, and considering multiple sides of an issue.
- 90% of respondents to a survey said that they learn something new almost all the time in Cafés.
- Teens improved cognitive and behavioral competence, confidence, positive social connections, character, caring, and ability to contribute to society-the 6C's for positive youth development.

What can Teens Expect to get out of it in the Longer Term?

What are the long-term influences of teen science café participation on alumni's academic, professional, and personal trajectories? An in-depth study aimed at answering this question was carried out (J. Sickler Consulting, 2019) by engaging a substantial number of men and women who had been part of teen cafés between 2008 and 2012 in a survey and focus groups. Key results of this comprehensive investigation are best summarized by quotes from the resulting report, including quotes from participants in the focus groups.

Evaluator Note: Words in italics are from the students. Words not in italics are summaries from the evaluator.

Has the fundamental intent of the teen café program been fulfilled?

"Most alumni felt [the teen café program] had some influence on understanding of what scientists do; awareness of science careers; feeling part of a science-interested peer group; and knowledge of science."

"The mix of the authenticity of the scientists, the compelling topics, and the relaxed social environment that kept teens coming back.... In the focus groups and interviews, alumni helped interpret how these factors came together as the "secret sauce" of making [the program] so effective. They described that its value came from being a "casual" or "intimate" learning environment – a small group of friendly peers, food, and highly interactive and conversational with the scientist-presenters. Together, these factors created the casual learning environment that worked for teens. Some noted how distinct this was from most other STEM-related experiences available to teens."

Enriching the Lives of High School Teenagers With Science Cafés

Figure 5. Teens gain skills in leadership and confidence to reach out to science experts. (Photo credit Teen Science Café Network by permission.)



“For me it was the topics and the format and how it was very intimate, and everybody could kind of ask questions and have conversation, that was really nice.”

“When alumni reflected on what they remembered liking most about [the program], three things rose to the top for more than one-quarter of respondents. Alumni enjoyed it because of the combination of real scientists (talking about real research), learning about interesting topics, and that it was a relaxed, social experience.”

“Getting a glimpse at a variety of different speakers’ interests and all the amazing things that are out there in this world to be explored or worked on. New information is invaluable, and exposure to something - even if the field is only a minor interest for me as an individual - is still one of my favorite things.”

“Alumni tended to describe that [the teen café program] had made science very tangible or real for them. These comments often referred to the stark contrast between school science (a collection of facts and rote experiments) and [the teen café program], which revealed the complexity, applications, and passion of the people who pursue it.”

“Coming into it, my only experience to science before then was sitting down in a classroom that I didn’t necessarily want to be in. But then my choice, my option to be there and checking out all this cool stuff that’s happening, it was just incredible for me. Being able to get my hands really on it rather than just the theory of it was a really big game changer for me.”

“...really care about understanding the basics of science or staying literate or being able to read the news and know what they’re talking about, or [that] being able to research things on my own are important, feasible, doable things.

The impact has been as great on regular participants as on teen leaders. “[The program] seemed to have stronger influence on those who were not involved in other STEM activities Alumni for whom

Enriching the Lives of High School Teenagers With Science Cafés

[the program] was their only STEM-related activity reported that [it] was much more influential on their knowledge of science. They also were more likely to report that [the program] prompted them to be more interested in STEM-related life-long learning activities, including reading science articles, talking about science with friends and family, and watching science-related television programming.... it seems that [the program's] welcoming, casual, social environment has the potential to be particularly influential at shaping science knowledge and interest for the students who might not otherwise get involved in traditional out-of-school STEM activities and/or who may not be on a STEM career pathway."

Has the program, for some, been eye-opening in terms of the possibility of a life in science?

"About one in five of alumni who answered this question reported that the program had influenced their STEM career interests to some degree. This was sometimes sparking interest, sometimes reinforcing interest, and sometimes highlighting how these careers would impact the world around them."

"Café Scientifique definitely influenced my decision to pursue research opportunities in college, first working as a lab assistant and then conducting my own research for my thesis."

"It was not often that a Café inspired their passion for a particular topic, but that it made the work of scientists tangible, so that it suddenly seemed to be a real possibility for their lives."

"For me the casual atmosphere with a scientific professional, with someone who was an expert in their field made the science and the idea of actually becoming a scientist far more tangible for me. I didn't know a lot before [the program], and now I'm in grad school for chemistry and that definitely made it seem tangible...I think that definitely affected my career path...."

"That exposure, it was life changing for me, honesty. So just knowing that these things are out there, and I can do them, huge Because, I mean, I came from a lower economic background and that just didn't seem possible...."

What has been the long-term impact on teen leaders in terms of skill development?

"Qualitative data suggested that the impacts of being a teen leader were less directly STEM-related, and were more in the development of "soft skills" of organization, leadership, planning, and confidence in one's own abilities."

"I did not end up in a scientific field, but when I reflect on my experiences, what I remember most are those planning sessions. And I think that that's pretty telling in terms of what I do now [in my job], [which] is a lot of project and people management, and a lot of strategy and planning and focusing on process. And so, I think I was realizing that through the leadership involvement with [the teen café program], that that was an interest to me, perhaps more than the subject matter itself."

What can Scientist Presenters Expect to get out of it?

While the initial focus was, naturally enough, on benefitting the teens, the authors soon realized that the program was proving to be of much benefit to the scientist-presenters as well, in particular in developing skills in communicating their science to the public, skills that extend beyond the teen audience to other public audiences, managers, and funders. One of the most significant benefits expressed by some presenters was a recognition that effectively communicating their science has fed back into their thinking about their own research. A sampling of scientist responses to a questionnaire:

Enriching the Lives of High School Teenagers With Science Cafés

“The Café experience was beneficial to me as a scientist in that preparing an interactive talk for an audience of young people helped me identify the critical issues in my work: why I was doing it, why it is challenging, what we are trying to accomplish (vs. being bogged down in technical details). This really focused my thoughts about my work.”

“Professionally, I feel it improves my ability to teach to a broad range of people. Sometimes trying to explain science in more simplistic terms helps me see the questions and potential new means of investigating them in a fresh and helpful light.”

“It helped me to think about the basics of my research and discipline, and to rephrase.”

Figure 6. This word cloud gets across desired qualities in a teen science café presenter



CLOSING REMARKS

The most essential elements of the Café model are the people involved (program leaders, scientist-presenters, youth leaders and attendees). Teen science cafés have been launched by a myriad of organizations, some with adult leaders and others that are organized completely by teens. They have been implemented in rural areas, as well as New York City. It is the mix of social engagement and learning that has drawn over 160,000+ teens to attend these events.

The TSCN is a community of practice that is passionate about creating opportunities for teens and experts to explore through stories, conversation, and activities how science and technology innovations are changing the world. Teen science cafés are free and open to all interested teens.

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KEY TERMS AND DEFINITIONS

Café Scientifique: Café Scientifique is a place where, for the price of a cup of coffee or a glass of wine, anyone can come to explore the latest ideas in science and technology. Meetings take place in cafes, bars, restaurants and even theatres, but always outside a traditional academic context.

Evaluation: Is a process that critically examines a program. It involves collecting and analyzing information about a program's activities, characteristics, and outcomes. Its purpose is to make judgments about a program, to improve its effectiveness, and/or to inform programming decisions.

Informal Learning: Informal learning is unstructured and takes place away from formal learning settings.

Science: The intellectual and practical activity encompassing the systematic study of the structure and behavior of the physical and natural world through observation and experiment.

Science Communication (SciCom): May be defined as the use of appropriate skills, media, activities, and dialogue to produce one or more of the following personal responses.

Self-Efficacy: Refers to an individual's belief in his or her capacity to execute behaviors necessary to produce specific performance attainments.

Teen: The years of a person's age from 13 to 19.

Teen Leadership: Is the practice of teens exercising authority over themselves or others. Youth leadership has been elaborated upon as a theory of youth development in which young people gain skills and knowledge necessary to lead civic engagement, education reform and community organizing activities.

Workforce Development: Trains individuals to be more productive and prosperous in the workplace, which benefits both the employer and the worker.