



Intel ISEF Middle School Science Fair

# A Guide for Teachers



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*Some parts of this Guide pertain to after school clubs. They start with the mark "Club:"*

*Some parts pertain to use of the Guide in classrooms. They start with the mark "Class:"*

## Purpose

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This guide book is primarily intended to assist teachers who are getting their students ready for a middle school science fair. The group investigations, student activities and specific inquiry lessons found in this *Guide* will be useful to any teacher helping middle school students conduct science inquiry investigations. The *Guide* can be used in a science classroom setting or in a school holding an inquiry science fair using after-school science clubs. Appendix B contains typical calendars for groups that meet two, three, or four times a week.

## Introduction

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Welcome to the exciting, sometimes-hectic but always-rewarding world of preparing students for a science fair. Congratulations, you are embarking on a journey full of discovery for students and teachers alike, and one that creates more motivated, critically thinking learners in the process.

Any new trip requires a road map to help with navigation. This *Guide* is your road map. It is divided into three sections:

**Section I** provides general information about the Fair program, scientific inquiry, and planning guidance information.

**Section II** is a detailed Teacher Timeline that will lead you, step by step, through the more than 30 weeks leading up to the Fair. It offers activities for Club or class meetings, Teacher to Teacher Background notes and sample letters and handouts. If you and your students already have experience with scientific inquiry or you have prepared students for other science fairs, this section may still offer some new ideas. Its comprehensiveness, though, is intended to help the novice through uncharted science fair waters. Please try not to be intimidated by your initial encounter with the explained jargon and acronyms as you delve into these pages. The first year is always the toughest as you familiarize yourself with new terms, forms and schedules. Hang in there!

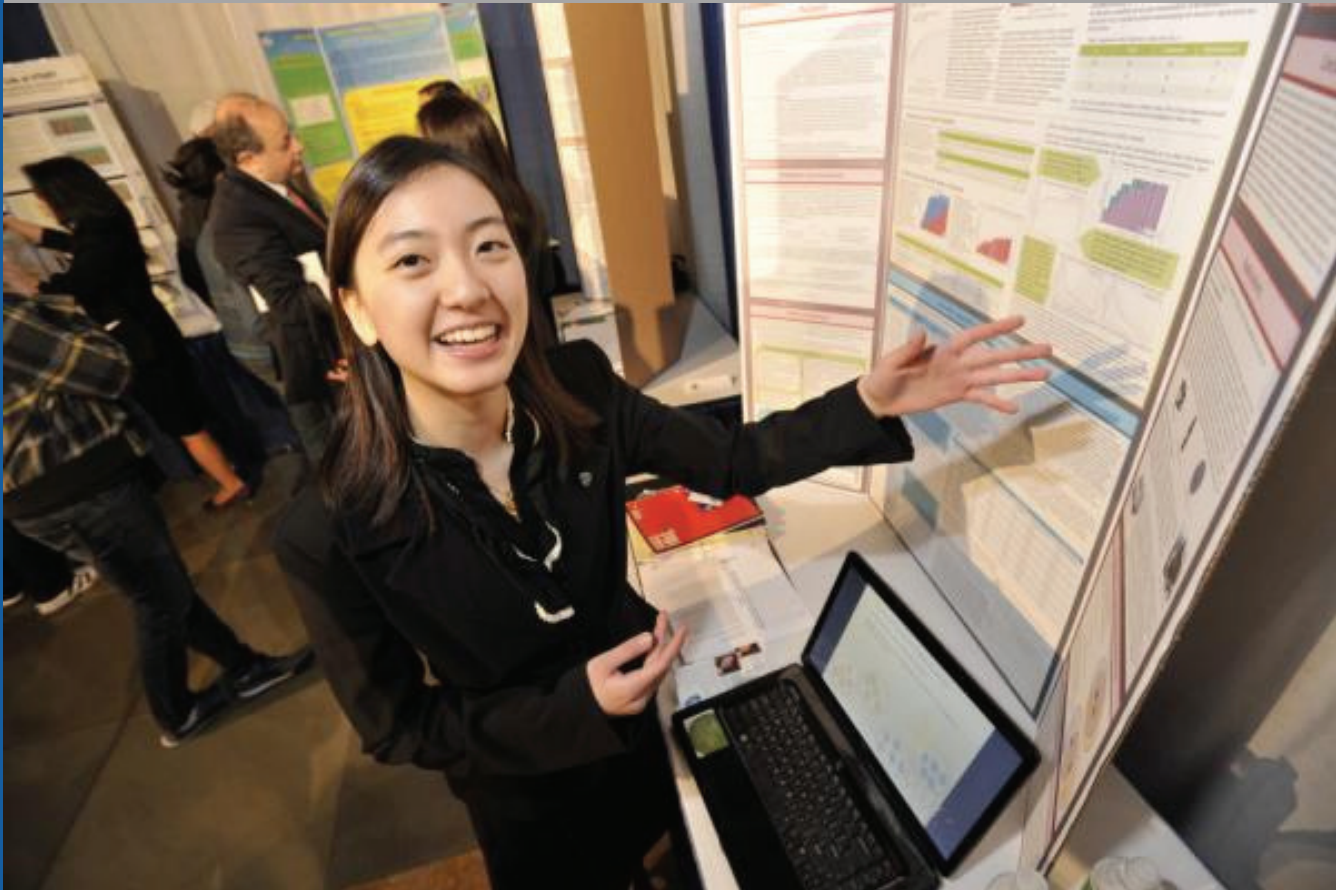
**"My students were excited by attending the Fair. They are looking forward to an opportunity to compete in the Intel ISEF event when they enter high school."**

-Intel ISEF Middle School  
Outreach Teacher

**Section III** wraps up with an appendix, glossary, Guide to forms, discussions of Intel ISEF rules, suggestions of adaptations for other fairs and a resource list.

We hope you'll find this process a trip worth taking year after year, as you prepare new groups of students for subsequent fairs in your area.

# Section I



Start-Up Information

## Background Basics

### What is the Intel® ISEF Middle School Fair Program?

The Intel® ISEF Middle School Program is a complementary program to the Intel® International Science and Engineering Fair (Intel® ISEF) that focuses on engaging middle school students (grades 6, 7 and 8) in science education and fairs.



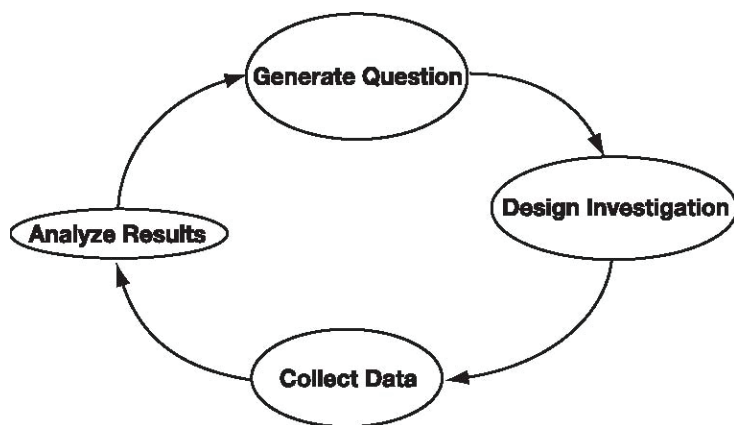
More information about [Intel® ISEF Affiliated Fairs](#) can be found on the Society for Science & the Public (SSP) website.

The Intel® ISEF Middle School Program is intended to expose students to research methodology, inquiry-based learning activities, science careers and science mentors. Your students will be prepared to participate in an Intel® ISEF Affiliated Fair at the community, regional or state level. You might also have a school inquiry science fair. Students are offered hands-on opportunities to learn about science fairs, develop a science project, and to compete for awards.

### What is science inquiry, and why should students experience it?

You will be getting students ready for a science fair that requires them to present the results of investigations they design to answer questions they ask. This process is also known as scientific inquiry, an area highlighted in the National Science Education Standards: "Science as inquiry is basic to science education and a controlling principle in the ultimate organization and selection of students' activities...Students at all grade levels and in every domain of science should have the opportunity to use scientific inquiry and develop the ability to think and act in ways associated with inquiry..."<sup>1</sup>

What could be more motivating to students — many of whom may never have considered science as a possible career, let alone thought of themselves as scientists — than to conduct real research to answer their own questions?



Here are the four basic steps of scientific inquiry as we teach them. If your state or school district uses a different model, please modify our diagram and lessons to fit vocabulary familiar to your students.

<sup>1</sup>National Science Education Standards, 1996

When students use the steps of scientific inquiry, they learn science in a most empowering way. They also must employ a multitude of skills across curricular areas to complete a fair project, including reading, organizing, synthesizing, calculating, graphing, analyzing, summarizing, and communicating both visually and orally and in writing. For students, the rewards of completing a project are immense. Students who perhaps never have been successful in science (or any academic area) before will show a marked determinedness and enthusiasm when involved in their own research project. Their self-esteem and self-discipline can improve. They may discover a whole new world of science, technology, or engineering and be motivated to seek out science experiences beyond the classroom not to mention to working harder in that classroom. In addition, going to a fair teaches lessons in sportsmanship and gives students a taste of the collegial nature of science. Chances are, a first-time participant will be highly motivated to participate in other fairs the following year, and it is hoped, into high school.

For your school, participation in the Intel® ISEF Affiliated Fair and a school fair can garner good publicity in the community; but, more importantly, it actually gets the community involved in the process. Imagine local science professionals coaching and supporting your students with their projects. School volunteers also can be involved with support tasks. The result is the coming together of the school and host community around an activity that empowers its future leaders.

### **Program Decisions**

In planning to involve your students in science inquiry and science fair projects, you have many options. This section will discuss choices of classroom or club models, selective clubs or “all come” clubs, and whether or not to stage a school science fair and whether or not to participate in an Intel® ISEF Affiliated Fair.

#### *What Model Will Work Best For Me?*

When deciding how to best implement the use of this *Guide* and to get your students to successfully complete inquiry projects, you must consider many things. Some teachers will focus primarily on a particular group of students, the club model, and others will implement the ideas of this *Guide* in their classrooms and have many students competing in fair(s). We hope the considerations outlined below will help you decide which model will work best for you.

“I’ve been asked to visit many science fairs in my life. I could always count on seeing certain projects: models of the solar system, insect collections, reports on Mars, demonstrations of experiments. In one memorable science fair, I saw six model volcanoes using baking soda and vinegar. The skills required to do these projects – library research, model-building, field collecting and direction-following –are useful to develop in students. The Intel ISEF program, however, focuses on inquiry skills. Each student poses a research question and designs a way to gather data to answer it. Students are actually being scientists when they do inquiry projects.”

– Intel ISEF Affiliated Judge

## A. Classroom Model

I. Science Class only: The Guide can be used to teach the basic inquiry skills throughout the science course and/or as a specific unit to lead students through the scientific process and prepare them to compete at a science fair. The science class only model will work for both the experienced and new teacher. Science teachers can use the Guide as a supplement or as a standalone unit. Depending on the skill level of your students, the timeline for the lessons will vary. The lessons are simple, do not use very many materials, are low cost and can be done with various groupings of students. Using the Guide in the science classroom only model can be a lot of work for the science and will take longer to complete than using the Integrated schedule. However, for teachers who do not have “teams” of students, this may be your best choice. The model ensures that all of your science students are gaining a strong understanding and meaningful experience in scientific inquiry.

A model calendar for the science class only model is also in Appendix B. It assumes that a typical class can devote four days per week to inquiry science fairs during the unit. It is imperative that you design your own calendar taking into account your school holiday calendar, your Affiliated Fair date, and your start date.

II. Integrated Model: An Integrated model will work for teams of teachers who teach the same group of students. The model is designed to make the scientific inquiry process an integrated unit that incorporates the classes of math, science, language arts, and social studies. The lessons are designed to be flexible, so that a team of teachers can adjust as they see the natural connections in their curriculum. The unit outline is only meant to be a guide. We strongly encourage all teams, knowing the skill level of your students, to design the unit for your students. This model shortens the overall time spent on the inquiry for one class, requires good relationships and teamwork from teachers and is a rich experience for students. It is wonderful to watch a student explain their experiment to the math teacher so they can examine their data format. The students, when engaged with more than one adult on the project, typically the science teacher, examine their projects more closely and see the natural connections between the core subjects that are often missed. This is a rich experience for all involved!!

## B. Club Model

The club model may be your best choice, particularly if you want to start out with a smaller group of students. There are further suggestions on organizing an after school science club on page 15.

Model calendars for groups meeting once, twice, three or four times per week are included in Appendix B. It is imperative that you design your own calendar taking into account your school holiday calendar, your Affiliated Fair date, and your start date.



If you decide to use a club model, you have other choices to make. Will you use the Guide program with an existing after school group or will you form a new group. If you form a new group, will you invite all students or will you limit the numbers involved?

I. Existing Student Group: For science teachers who already sponsor a science club, this Guide can be a useful addition to your plans. If your goal is to get your club members to a science fair, the lessons included can be utilized immediately. The club model allows the teacher to work closely and spend more individual time with students. If your group is already formed, you can skip the lessons on recruitment.

II. New Student Group: The Guide has specific ideas, forms and checklists to help with recruiting students for a new club. The club model is preferred by some teachers because of the small number of students doing projects. If you are committed to a club, make sure you get lots of volunteers. The inquiry experience of your students will greatly affect the rate of their progress. If you have students new to inquiry, make sure you get some help.

1. Selective group of students or all come? Once you decide to sponsor a club to get students to engage in inquiry, you will have to decide if there are parameters specifying who can and who cannot be in the club. It is a good idea to discuss this with your administrator. If you decide to exclude or include students based on some criteria, you will have to determine how to convey to students who do not qualify why they don't qualify and what other options are available to them. Some clubs have financial sponsors who strictly outline the intended participants of the club. Make sure you are clear with your financial contributor (if it applies) and especially that you have the support of your administrator. You will want his/her support if problems arise.

### What Fair(s) should my students participate in?

The answer to this question will rely heavily upon YOUR experience with scientific inquiry and your experience with science fairs. We suggest that you begin slow and small and work your way into bigger fairs over time. If you "shoot for moon" the first year, it may be your last. It is the goal of this Guide to get students into school fairs and then on to a local Intel® ISEF Affiliated Fair.

**A. School Fairs:** School fairs are a great way to get teachers, students and community members excited about scientific inquiry. If this is your first year doing science fairs, this is a great start. Be sure to enlist the help and participation of other teachers, particularly science teachers in your building. Contact other teachers in your area who have successfully organized school fairs and use their suggestions. You will need to consider the following when staging your own school fair:

1. **Approval: Administrator approval and scheduling:** Be sure to discuss the fair with your building administrator and get the date approved on the school calendar.



Information about additional Science Fair Competitions can be found online.

- [Discovery Channel Young Scientist Challenge](#)
- [Broadcom MASTERS National Middle School Competition](#)
- [Google Science Fair](#)

2. Facilities: Enlist the early support of your custodial staff. You will need the space prepared, table set up and taken down, doors unlocked and more. Bring coffee and food the week before!
3. Number of Participants: How many students will participate and where? The space available might determine this. Plan early.
4. To Judge or Not to Judge?: Will you judge the fair or will it be an exposition? If you decide to judge, who will organize the judges and what scale or rating form will be used. Organizing judges for a school fair will take lots of advance planning; you will definitely need some help here. If you judge and want to hand out ribbons or certificates, those will need to be ordered early.
5. Display Boards: Order early!!
6. Supplies: Students doing inquiry will require materials for their investigations. Who will pay and most importantly, who will do the shopping?

**B. Intel® ISEF Affiliated Fair:** Participation in an Intel® ISEF Affiliated Fair requires some knowledge of the Intel® ISEF rules. Certain projects require advance approval so make sure you prepare prior to your students conducting investigation. Once your students understand the inquiry process and have practice with science fairs, this is the next step. These fairs are competitive.

## Where Can I Find Help?

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### **Finding your local Intel® ISEF Affiliated Fair**

An Affiliated Fair is one that follows the Intel® ISEF rules and procedures and sends its winners on to compete at the next level in the Intel® ISEF system of fairs. Approximately 500 regional and state fairs all over the United States and around the world affiliate with Intel® ISEF each year. The best way to find one near you is to go to the Intel® ISEF Web site: [http://sciserv.org/isef/aff\\_fairs/aff\\_fairsearch.asp](http://sciserv.org/isef/aff_fairs/aff_fairsearch.asp). Not all fairs accept middle school projects, but the Fair Director listed at the Intel® ISEF site can be a great local contact and will direct you to a fair that does. If it is not immediately apparent which fair serves your location, feel free to contact the Fair Director on any nearby fair and ask which fair you should plan to attend.

The workload of preparing students for a middle school fair can be significantly reduced by incorporating community and school volunteers into your after-school program. So where do you start? First stop: get organized!

## You need help from the following people:

### The Fair Director

The relationship you have with the local director(s) of the Intel® ISEF Affiliated Fair is a very important one! It might become one of the more valuable relationships in your work life for the next several months. The Fair Director may take care of many tasks related to your Fair, such as:

- making initial contact with your school administrator and being a liaison between your school and the Fair program throughout the year;
- providing you with information on how to access financial support for your Club;
- answering your questions on Intel® ISEF forms and rules;
- recruiting and orienting the Scientific Review Committee (SRC);
- recruiting and orienting fair judges;

Stay in touch with your Fair Director!

### Volunteer Support

You should plan to take advantage of help from volunteers. The more students you will have doing projects the more you need volunteers. Here are a few things that volunteers can help with:

- Club: publicity about your group and help recruiting for your group.
- Setting up activities and helping with take down and storage.
- Gathering materials for group use in investigations
- *Listening* to students as they work at designing investigations. Asking students questions about their inquiry designs, procedures, and protocols.
- Helping students with background research.
- Typing student writing onto forms.
- Proof reading student writing for spelling and grammar.
- Assisting students in display construction.
- Listening to student presentations and asking clarifying questions.
- Chaperoning students traveling to the local Intel® ISEF Affiliated Fair.
- Assisting with tracking student paperwork, both investigation data and fair forms.
- Reviewing student questions and helping them polish good inquiry questions.
- Reviewing student research plans in relation to the Intel® ISEF rules.
- Helping you keep track of Fair registration and timelines for paperwork.
- Serving on a school SRC or IRB.
- Helping parents understand which kinds of projects are appropriate for inquiry science fairs and which are demonstrations and displays.

We encourage you to recruit volunteers. Assure them that there is interesting work available at all skill levels and for all time availabilities. We refer to two types of volunteers both groups are valuable. Recruiting will be different for the two groups.

Science Coaches	Science Fair Support Volunteers
<ul style="list-style-type: none"><li>▪ People with some science and engineering background.</li><li>▪ They will work with students or read and comment on their questions or designs. Their background and contacts will help the students.</li><li>▪ Recruit by making contacts in local businesses and organizations with a science and engineering focus.</li></ul> <div data-bbox="256 583 743 844" style="border: 1px solid black; border-radius: 15px; background-color: #0070C0; color: white; padding: 10px; text-align: center;"><p>“Our science coaches’ reading and helping students with their questions and their design was a key element to the student’s success.”</p></div>	<ul style="list-style-type: none"><li>▪ People who can help without needing a science and engineering background.</li><li>▪ They can offer clerical support and adult attention to individual students. Their ability to give attention and encouragement and ask questions will help students. Their organizational skills will help you.</li><li>▪ Recruit from parents and community groups. Often non-science personnel in organizations where you find your Science Coaches will be sources of these volunteers.</li></ul>

Some volunteers can come to your group meetings; some can't. There are inventive ways to involve them all and reduce your workload as a teacher so you can focus on the students.

### Community Support

Your Fair Director also can connect you with science and engineering professionals in your area (or with organizations that can link you to those professionals). Think doctors, researchers, engineers, retired science teachers and science museum workers. This *Guide* refers to these individuals as “Science Coaches,” and the help from these professionals will be the most useful when your students actually begin their Fair projects. In addition, you will need what we will call “Science Fair Support Volunteers” to assist with other tasks, such as typing, editing or translating. You, as the teacher, may have success rounding up these individuals from your school community. (See **Parent/Family Support** below.)

### Collegial Support

You may or may not have to convince your colleagues that what you are undertaking is beneficial to their students and them. Here are some talking points if you do:

- Club: Many science classrooms already provide an atmosphere of investigation. However, the targeted students recruited for the after-school Club may not fully participate or take advantage of those classroom opportunities. Those students may need the more focused attention that a Science Club atmosphere can provide. The Club offers a model of inquiry for these students, reinforcing the investigational strategies already being taught in the science classroom. Students can't help but become more successful in their science and other classes due to their experiences in the Science Club.

- Completing a Fair project involves skills that cross many curricular areas such as critical thinking, mathematics, organization of information and ideas, descriptive writing and both visual and oral presentation.
- All lessons in this *Guide* are appropriate for Club and classroom use. Offer to share them with other science teachers in your building.

## Parent/Family Support

Many parent/family volunteers at your school are happy to help wherever there is a need. Perhaps you have some parents in your school who are scientists or engineers and are willing to donate their time and talents to your program. Perhaps you have parents willing to help edit student work or help students create their Fair display boards.

### *Getting the word out to the parent community*

If your school has a general form for recruiting volunteers at the beginning of the year, is there a place on the form for the following?

- "I am a science/engineering professional and am interested in being a 'Science Coach' (mentor) for students going to the local Intel® ISEF Affiliated Science Fair."

#### *Science Coaches help in ways such as:*

- Meeting other coaches and reading proposed student research questions and providing advice
- Meeting other coaches and reading proposed student investigation procedures and providing advice.
- Coming to school and working with students as they conduct their investigations.

- "I don't have a background in science, but I am interested in being a Science Fair Support Volunteer."

#### *Science Fair Support Volunteers help in ways such as:*

- Typing or do clerical work for students going to the Science Fair.
- Handling organizational details for the teacher
- Coming to school as students work on their investigations and providing encouragement and asking questions which help them learn to explain their work to non-scientists.

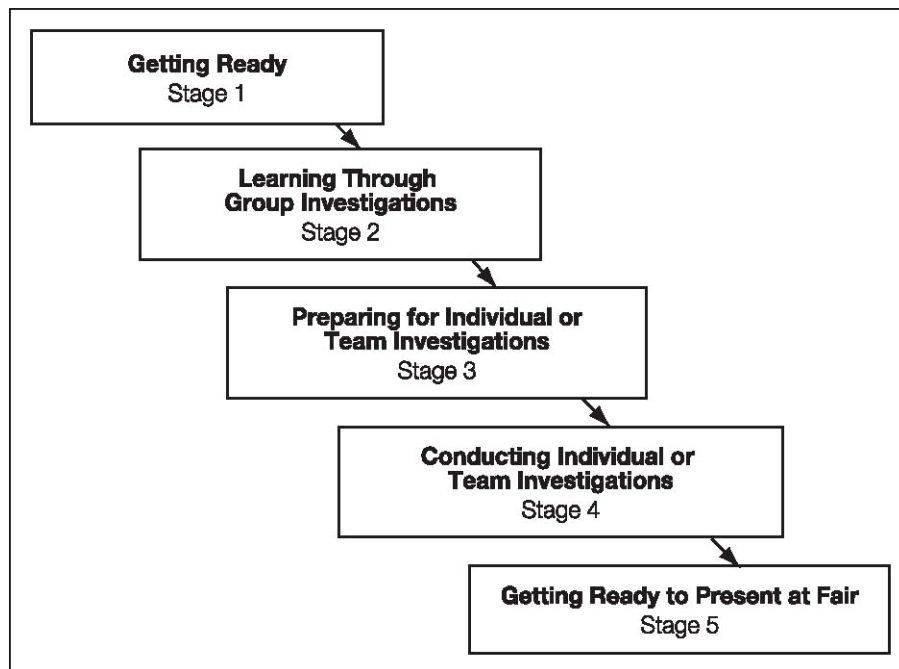
### **A Note on Volunteers**

- Successful science fair participants usually have the advantage of additional adult support. The Middle School Program outlined in this Guide ensures that all students have such support with Science Coaches and Science Fair Support Volunteers.
- Know your school's policy about volunteers working with students and follow it. Inform volunteers of any procedures and policies at your school (e.g., signing in at office, wearing nametags in the building).
- Do not allow your volunteers to be alone in a closed room with a student. Always have a third person present. Make sure work sessions are in an open or community area.
- Give your volunteers guidelines on student confidentiality and other issues. (See Guidelines for Volunteers)

## A Brief Look at the Year

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This diagram provides an overview of the year ahead.



## Getting Started With Students

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### Getting students excited about Science Fairs

#### *Club: Get the word out!*

In order to motivate students to stay after school to do “extra” science work, you must be energetic and creative. One possible way to entice students to attend the Club is to have volunteers do classroom presentations on inquiry. (A sample presentation is provided in Week 2 of the Teacher Timeline, Section II.) This can set the stage for what students might expect in the Club. Have membership applications ready to hand out after these motivating demonstrations.

A second way to get the word out is for willing science teachers to present the inquiry investigation and/or describe the purpose of the Club in their classes. Other forums for announcing the Club: student announcements, newspapers or assemblies.

#### *Club: Food, glorious food...*

A must for any recruiting and retaining of Club members is food! Always be prepared to have quick snack available. If you decide to hold a meeting to introduce yourself and the

Some parts of this Guide pertain to after school clubs. These start with the mark “Club”.

Some parts pertain to use of the Guide in classrooms. These start with the mark “Class”.

reason for the Club, consider having pizza or ice cream sundaes; students will definitely come back!

### *Class and Club: Wow 'em with a little Hollywood...*

Students may be unfamiliar with the concept of a science fair. Current efforts have been to steer students away from the traditional, library-research fair project and instead have them ask their own inquiry questions and answer them with data they collect. The movie *October Sky*, based on a true story, offers a wonderful introduction to the work required to succeed in such a fair. (Brief synopsis: Four teenage boys from a small town have an interest in building rockets. These boys overcome great scientific and personal struggles to successfully launch a rocket. Their efforts are rewarded by an invitation to their regional science fair.) Note: A parent permission slip may be required for the movie because it is rated PG.

After seeing the movie, students undoubtedly will be excited to begin their own research. They can see the possibilities of discovery when they are allowed to investigate on their own. Students who conduct their own investigations often continue these investigations long after the Club and Fair are over. Much like the spark that ignites the boys' rocket in the movie, you will be igniting a spark in your students.

## **Club: Selecting and Notifying Students – following your school's plan**

After you've lit that spark and accepted applications from students, it's time to select and notify the members. In the week-by-week Teacher Timeline in Section II, this is done through letters home. How your school chooses to accomplish these tasks is part of its own recruitment/selection plan, which should be well thought-out in advance.

## **Club: Organizing for an After-School Science Club**

Several items need to be considered and organized in order for your after-school Club to run smoothly over the next several months. Club meetings are spent working with students as much as possible, so you'll want to have these logistics sorted out ahead of time. Below is a list of items to consider before beginning your Club.

- CLUB SIZE:** The size of your club should be governed by the needs of your students for adult mentoring as they do their investigations. If your students are inexperienced with inquiry investigations; if they have language or other challenges; if you, the teacher, have not assisted students with inquiry investigations before; or if your setting is cramped, you will want to hold the group to a small size. If you and your students are experienced in inquiry investigations; you have additional, reliable, adult helpers at most club meetings; and your meeting site and storage facilities will support them, you can probably be successful with a larger group. We recognize that the club size represents a balance between the desire to work with the maximum number of children and the desire to provide a positive, supportive situation for each student investigator.
- STUDENT MOBILITY:** If you have a high mobility rate in your school, you may want to accept more students in the beginning. It is somewhat difficult to integrate additional members once the Club has started and once the Club has begun individual investigations, it is almost impossible to bring new students on board.
- MEETING SPACE:** The space in which you hold your Club meetings will need to accommodate several experiments occurring simultaneously, as well as allow for

storage of those projects between meetings. Some experiments will need specific equipment such as sinks or glassware. For these reasons, it is suggested you use a science classroom for Club meetings. Later in the year, when students are working on typing up the parts of their investigations, you may want to use your school's computer lab. You will also have volunteers helping during the Club, so a larger space is the ideal.

- ❑ MEETING LENGTH: A typical club meeting should last from 45–60 minutes once a week. Most Clubs will meet after school, but you could choose to meet before. Your meeting time and length may depend on when transportation is available for your students.
- ❑ TRANSPORTATION: You will have to communicate clearly with students at the first organizational meeting about transportation issues. As a group, you will need to determine the day of the meeting and the time. After these are determined, you'll need to inform families and building administrators.
- ❑ PERMISSION SLIPS: Permission may be required in your building for after-school clubs and attending regional or state level fairs.
- ❑ CLUB ENVIRONMENT: The Teacher Timeline provides a detailed plan for your Club. Make sure you maintain a positive, yet structured classroom atmosphere while providing students with instruction and giving them the flexibility to work on their own projects at their own pace. There will be many times when all students seemingly need your help simultaneously! Set the expectation for hard work early on, and remind students you can only help one or two at a time. It is crucial to have some volunteers. (See **Where Can I Find Help** on page 10.) Once volunteers are organized, follow normal safety rules, such as not leaving them alone with students. Be clear about your expectations of volunteers and the goals of the Club.
- ❑ DOCUMENTING STUDENT WORK: It is a good idea to take pictures of students working during Club meetings. This is a good assignment for a volunteer. You can use these pictures for recruiting in following years, and some will be used when students create displays of their Fair projects.
- ❑ STORAGE: You will have a minimum of ten experiments/display boards to keep safe during most of the year. It will be necessary to place these items in a secluded, safe area where other students won't be tempted to touch. It is a sad day when a student who has worked hard comes in to find his project ruined or display board walked upon. Avoid this scene by finding a small closet, office or cabinet in which to store your students' work.
- ❑ SPECIAL CONSIDERATIONS:
  - Some of your students will dive enthusiastically into their science work while others will want to spend less time on science and more on having snack and good conversation with their friends. Your goal is to get them to do the science and enjoy it, but realize they, just like students in a classroom, come from all different backgrounds. Some may need no help at all while others will need a volunteer to help them stay on task at every meeting.
  - Typing may be difficult for several students, so be prepared to organize volunteers or schedule several meetings for typing.



- The Science Club potentially will attract students who may not have experience at following through on assignments or long-term projects. It is essential you personally communicate to them your expectations about attendance and sticking with their project until the end. That said, it's also important that the atmosphere of the Club remain fun and not typical or reminiscent of the school day they just experienced. A personal relationship between you and each student is the key to making them feel they can achieve in this Club. This is one important reason for limiting the size of the Club.
- 
- TO TEAM OR NOT TO TEAM: If students want to team on a Fair project, we suggest that team size should be limited to two. Intel® ISEF rules allow three maximum. Before allowing team projects, keep in mind that if your school has a high mobility rate or you have trouble getting kids to commit, a group project in which one student leaves could ruin the whole experience for another student.
  - WHERE TO CONDUCT INVESTIGATIONS: Have students do their experiments at school. This way you can closely monitor their work and ensure it's theirs and not the work of their parents. Also, you'll have a better attendance rate in the Club. Some fairs may require all projects to be done at school.