SCIENCE CLUBS

HANDBOOK 2022

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SUMMARY

SCIENCE CLUBS

This science club series is an extra-curricular, mentor-based science programme for Zimbabwean high school students. The science clubs are being conducted in schools where permission has been granted by the Ministry of Primary and Secondary Education for students to take part in health research being carried out by the Biomedical Research and Training Institute (BRTI). These research projects include health research study titled the IMpact of Vertical HIV infection on child and Adolescent SKeletal development in Harare (IMVASK) and Community based interventions to Improve HIV outcomes in young people: A cluster randomised trial in Zimbabwe: (CHIEDZA) which are funded by the Wellcome Trust.

In addition, two EDCTP-funded studies: VITALITY (VITamin D for AdoLescents with HIV to reduce musculoskeletal morbidity and ImmunopaThologY) and ERASE-TB (Early risk assessment in TB contacts by new diagnostic tests) will provide opportunities for pupils to experience how research studies are conducted through internship attachments.

As part of the IMVASK study, children without HIV were randomly selected from three primary and three secondary schools in Harare which provided the opportunity and platform to engage teachers, parents, guardians and students regarding the research carried out by all the studies outlined above. As part of their activities, team members from each of these research projects will participate and facilitate science club and science fair activities as part of their outreach. It is hoped that materials from these science clubs and science fairs can be shared and replicated with other high schools in the Harare and the country at large.

This manual has been created as a guide for BRTI researchers/staff conducting the four facilitated sessions for the school science clubs. The expectation is that the science clubs will meet regularly (once weekly or alternate weeks during the term) and that four of these sessions will be facilitated by BRTI staff, the others will be run by teachers and students. This manual is to be used alongside the prepared slide sets and the handbook for students.

The aims of Science Club are:

- to encourage independent and self-directed scientific curiosity to encourage high school students to develop scientific projects in a structured fashion.
- to encourage a structured approach to scientific communication
- to allow students to interact with health care professionals in science to explore how science is applied to health and open up their career options and aspirations.

The science clubs will meet regularly (once weekly or alternate weeks during the term) and four of these sessions will be facilitated by BRTI staff, the others will be run by teachers and students. Science clubs will aim to include student participants from each level (ZJC, 'O' level and 'A' level) – target 20 to 30 students and among those numbers, establish a gender balance.

Support will be provided to students to allow them to source materials they require for their science project, provided they are not expensive. Access to the internet and a laptop will also be provided during science club sessions to allow students to refer to electronic book resources and conduct research on a first come-first served basis in booked slots.

There will be scheduled field trips to the BRTI labs and study sites for students registered in the science club.

Four A-level students, aged 16 years and over, who are able to produce the best written summary/abstract of their science project will be selected to take part in a 1 - 2 week internship with the IMVASK, CHIEDZA, VITALITY and ERASE-TB research teams. Interns will be given a US$50 stipends per week to cover transport & food costs for their internship period. Students will be encouraged to submit project summaries/abstracts to session facilitators. They will also be asked to write a brief motivational letter explaining why they would like an internship opportunity. Students scoring highly, with strong motivation letters will beselected for 1-2 week internships.

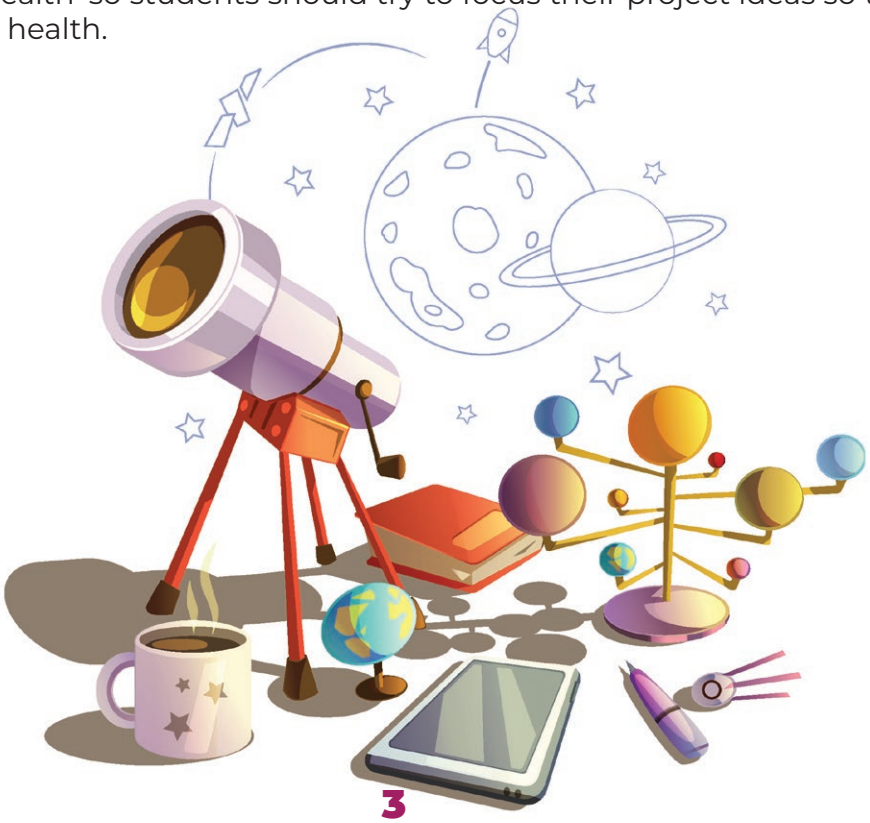
SCIENCE FAIRS

Two one-day science fairs will be hosted by the study team at the two secondary schools taking part in the study.

The science fairs aim to:

- give students passionate about science the opportunity to test and present their ideas to peers in a stimulating creative environment.
- allow students to interact with health care professionals in science to explore how science is applied to health and open up their career options and aspirations.

The fairs will take place on the school grounds, during term-time and consist of 'set-piece' table stalls supervised by the research team and stalls where students will present their own science projects. The theme for the science fairs is 'Ideas for Science and Health' so students should try to focus their project ideas so that they are relevant to health.



SCIENCE CLUB

Please use this handbook to write notes during your science club sessions. Please make sure you complete the evaluation form after every session.

SESSION 1 - What is science? How to communicate and present scientific ideas

This session aims to:

- introduce the key principles of science and the variety of scientific disciplines including those related to health.
- introduce previous projects presented at science fairs by other students.

School:
Facilitator name and institute:
Date:

Session Outline

LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

1. Science Club overview
2. Definition of science
3. Developing and presenting scientific ideas (for science fairs)
4. Adjudicating science presentations
5. Science games
6. Summary and close

Session Overview

LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

- **Aims of science club**
  - to encourage independent and self-directed scientific curiosity
  - to encourage students to develop scientific projects in a structured fashion
  - to encourage a structured approach to scientific communication
  - to allow students to interact with health care professionals in science and explore career options and how science is applied to health
- **Activities**
  - Project development
  - Four facilitated sessions and other sessions with your school teachers
  - Science fairs
  - Field trips
  - Attachments/apprenticeships

Developing scientific ideas

LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

- Is there a clear scientific question (hypothesis) ?
  Clear and structured written/oral communication is essential for presentation (**IMRD** format):
  - **I**-introduction (aims and objectives)
  - **M**-methods (scientific approach taken)
  - **R**-results
  - **D**-discussion (summary of findings and their implication)
- Some projects will not be pure science but applied science
- Science fairs will often have a theme/area to which science should be applied e.g. health or the environment.

- Relevance, creativity/innovation and practicality are then considered

Notes

Science Quiz

1.
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Notes

SICENCE CLUB EVALUATION - SESSION ONE

Pre-science club questions

1. What is science?
2. Why do you think science is important for Zimbabwe?
3. How interested are you in developing and presenting your own science project idea at a science fair?

Very interested	**interested**	**unsure**	**not interested**

Please let us know if you have any other comments:

Session 1: What is science? How to communicate and present scientific ideas

1. What have you enjoyed most about today?
2. How interested are you in developing and presenting your own science project idea at a science fair?
3. How would you rate Science game 1? Poor Good Excellent Not able to say
4. How would you rate Science game 2? Poor Good Excellent Not able to say
5. What do you think is the most valuable thing you have learned today?
6. What would you like to see or do at the next science club session?

What would you like us to do differently in future sessions?

Please let us know if you have any other comments:

SESSION 2 - Development of scientific ideas and projects

This session aims to:

allow students to develop their own science project ideas and gain practice presenting them and feedback from facilitators and teachers in an informal environment.

School:
Facilitator name and institute:
Date:

Session Outline

1. Adjudicating science project presentations
2. Student project presentations
3. Adjudication of presented projects
4. Summary and close

1. Adjudicating science project

- Is there a clear scientific question (hypothesis) ?
- Clear and structured written/oral communication is essential for presentation (**IMRD** format):
    - **I**-introduction (aims and objectives)
    - **M**-methods (scientific approach taken)
    - **R**-results
    - **D**-discussion (summary of findings and their implication)
- Some projects will not be pure science but applied science
- Science fairs will often have a theme/area to which science should be applied e.g. health or the environment
- Relevance, creativity/innovation and practicality are then considered

1. Adjudicating science project

- Presentation 1
- Question and answer
- Adjudication and feedback

- Presentation 2
- Question and answer
- Adjudication and feedback

- Presentation 3
- Question and answer
- Adjudication and feedback

- Presentation 4
- Question and answer
- Adjudication and feedback

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SICENCE CLUB EVALUATION - SESSION TWO

Session 2: Development of scientific ideas and projects

What have you enjoyed most about today?

What do you think is the most valuable thing you have learned today?

What would you like us to do differently in future sessions?

Please let us know if you have any other comments:

SESSION 3 - Scientific careers

This session aims to:

- allow high school students to interact with health care professionals in science to explore how science is applied to health and open up their career options and aspirations.

School:
Facilitator name and institute:
Date:

Session Outline

Recap of previous sessions
2. Career presentation 1
3. Student project presentations
4. Career presentation 2
5. Summary and close

Summary

- General feedback and prize giving
- Field trips
- Submission of project summaries/abstracts for internship opportunities
- Resources for further career information or guidance

SICENCE CLUB EVALUATION - SESSION THREE

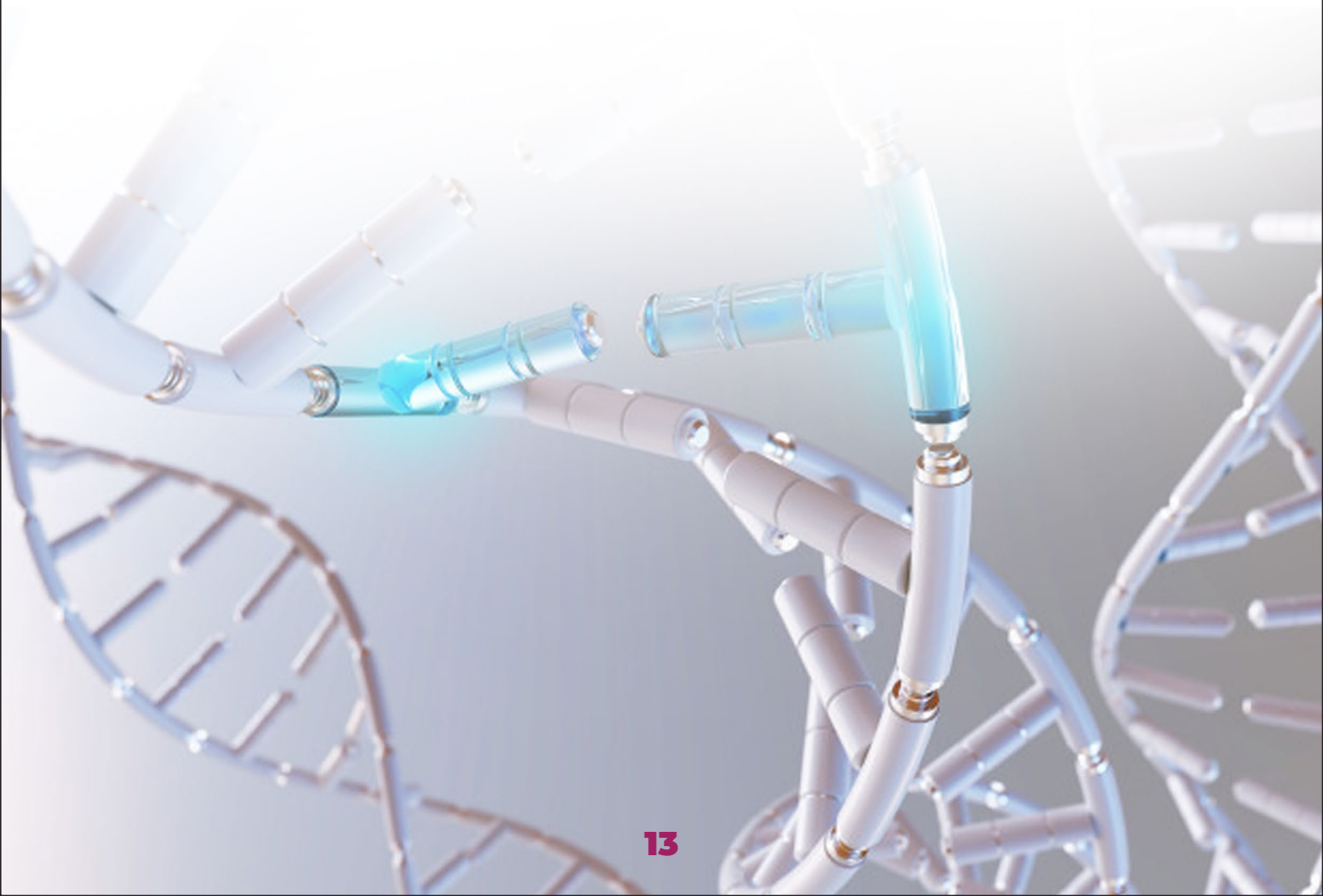
Session 3: Scientific Careers

What have you enjoyed most about today?

What do you think is the most valuable thing you have learned today?

What would you like us to do differently in future sessions?

Please let us know if you have any other comments:



SESSION 4 - Defending scientific ideas: Science Debate

This session aims to:

- allow students to practice how to outline and defend arguments informed by science.

You will have to vote on a debate topic as a group:

1. Is the world better off with or without genetically modified food?
2. Should we encourage people to opt for traditional medicine?
3. Should there be stricter regulations on fast-food chains to prevent obesity?

School:
Facilitator name and institute:
Date:

Session Outline

1. How to present and defend arguments
2. Debate preparation
3. Debate
4. Summary and close

Presenting arguments

- Critical thought and defending arguments is an important part of scientific life
  - Keep your argument simple
  - Rest your argument on solid facts and evidence from credible robust sources
  - Be specific - avoid generalisations
  - Understand the opposing point of view

Debate Contest

- Choose a debate topic (vote)
- Form two teams: black team and red team
- One team will argue for the motion, other team against
- Arguments will be judged and scored - one team will win

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SICENCE CLUB EVALUATION - SESSION FOUR

Session 4: Science Debate

What have you enjoyed most about today?

What do you think is the most valuable thing you have learned today?

What would you like us to do differently in future sessions?

Please let us know if you have any other comments:

Post-science club questions

What have you enjoyed most about the science club?

What have you found most valuable about the science club?

What would you like us to do differently in future sessions?

How interested are you in developing and presenting your own science project idea at a science fair now?

Very interested	interested	unsure	not interested

Notes

Notes

Notes

Notes

SCIENCE FAIRS

Two one-day science fairs will be hosted by the study team at the two secondary schools taking part in the study.

The science fairs aim to:

- give students passionate about science the opportunity to test and present their ideas to peers in a stimulating creative environment.
- allow students to interact with health care professionals in science to explore how science is applied to health and open up their career options and aspirations.

The fairs will take place on the school grounds, during term-time and consist of 'set-piece' table stalls supervised by the research team and stalls where students will present their own science projects. The theme for the science fairs is 'Ideas for Science and Health' so students should try to focus their project ideas so that they are relevant to health.

The information below will help you prepare for the science fair at your school and other science fairs in Zimbabwe and other countries.

Science Fair Rules and Guidelines

International guidelines for science and engineering fairs are published annually to support students doing independent research safely. These rules are also the official rules of the Zimbabwe Science Fair. The rules and guidelines can be accessed from: https://www.societyforscience.org/isef/international-rules/

It is important to bear in mind a number of important rules when preparing or participating in a science fair to ensure your safety and the safety of others; especially when lab experiments are involved.

1. Never eat or drink during an experiment and always keep your work area clean.
2. Wear protective goggles when doing any experiment that could lead to eye injury.
3. Do not touch, taste, or inhale chemicals or chemical solutions.
4. Respect all life forms. Animals are not allowed to be used in experiments. Do not perform an experiment that will harm a person.
5. Always wash your hands after doing the experiment, especially if you have been handling chemicals.
6. Dispose waste properly.
7. Any project that involves animals, drugs, firearms, or explosives are NOT permitted.
8. Any project that breaks district policy, and/or local, state, or federal laws are NOT permitted.
9. Use safety on the internet! NEVER write to anyone without an adult knowing about it. Be sure to let an adult know about what websites you will be visiting, or have them help you search.

Science Fair Registration Form

Name of school: _____

DATE OF SCIENCE FAIR: _____ REGISTRATION DEADLINE: _____

This form is for students who would like to present a project at the science fair. Please return your form to the lead science teacher [Name Surname] who is responsible for the science fair. Only students who register on time will be permitted to present a project at the science fair.

Student name: _____

Form: _____ Class: _____

Subject classes (if A-level): _____, _____, _____

Project title: _____

Brief project description:_____

_____

_____

_____

_____

Please indicate if you need an electrical outlet/power point for your project

Yes ☐ No ☐

Please indicate if you need assistance sourcing materials for your project

Yes ☐ No ☐

Please list some of the materials you will require:

_____

_____

_____

_____

I acknowledge that I have reviewed the materials of the science fair and what is required to complete a science project

I confirm I would like to participate in the science fair

Students signature: _____ Date: _____

Teacher approval of project Yes ☐ No ☐

Teacher's signature: _____ Date: _____

Science Fair Projects

There are a number of science disciplines from which you can choose to develop your project. The following steps are for developing an experimental or laboratory based project. If you are working on a project that is not experimental or lab based, although some of the principles below will apply, you will need to seek advice from your teachers and mentors to ensure you develop a strong project.

Steps for developing your science project:

1. Choose a topic. Be sure it interests you. Don't pick one because you think it will be easy. Talk it over with your parents and when you have decided, inform your teacher, and do not ask to change your topic later. Get your Registration form for your teacher signed by your parent and turn it in.

2. State your purpose as a question. What is it that you want to find out by doing this project?

3. Research your problem. Look at any books/websites that might help you, make observations by simply looking at things, talk to people, and find out as much as possible about your topic. Write down any ideas you have and where you got them. Also, keep note of all information needed for citing your resources.

4. Form a hypothesis. What do you think is going to happen? Based on what you know or found out from step #3, what do you think the results of your experiments will be? After doing the experiments, it may turn out that your guess was wrong. It is okay if this happens.

5. Plan your project. How will you test your hypothesis? What experiments will you do? How will you measure the results? Where will you keep your information? Be sure to keep notes and write down everything you do and what happens.

6. Collect all your materials. Find a place to keep things where others won't bother them. Let other family members know what you are doing so they do not throw your materials away by mistake.

7. Conduct your experiments. Remember, the more times you do an experiment the more reliable and accurate the results will be. Do each experiment at least three times and get an average of the results for your graph.

   Use something to measure your experiments: a ruler or yardstick if you are measuring distance, a clock to measure time, etc. Check the measurements to be sure you are correct.

8. Record your data. As you do your experiments, you will want to write down what you saw or found out. Organize this information in an orderly manner. Put the date, time, and any other useful information.
   Write your measurements clearly.

9. Draw conclusions. What did you learn from your experiments?
   Have you proved or disproved your hypothesis? You made a guess about what you thought would happen. Now tell what really did happen. You don't lose points if your guess turned out to be wrong.

10. Prepare your titles, charts, graphs, drawings, and diagrams. Make them large enough to see, neat and colourful.

11. Construct your science fair display. Get your cardboard display board from your teacher so you can show all your work and have your hands free to point to sections when you give your presentation.

12. Prepare and practice your presentation. Be able to tell about what you used what you did in your experiments, and what you found out. Know it well enough that you don't have to read it from the display.

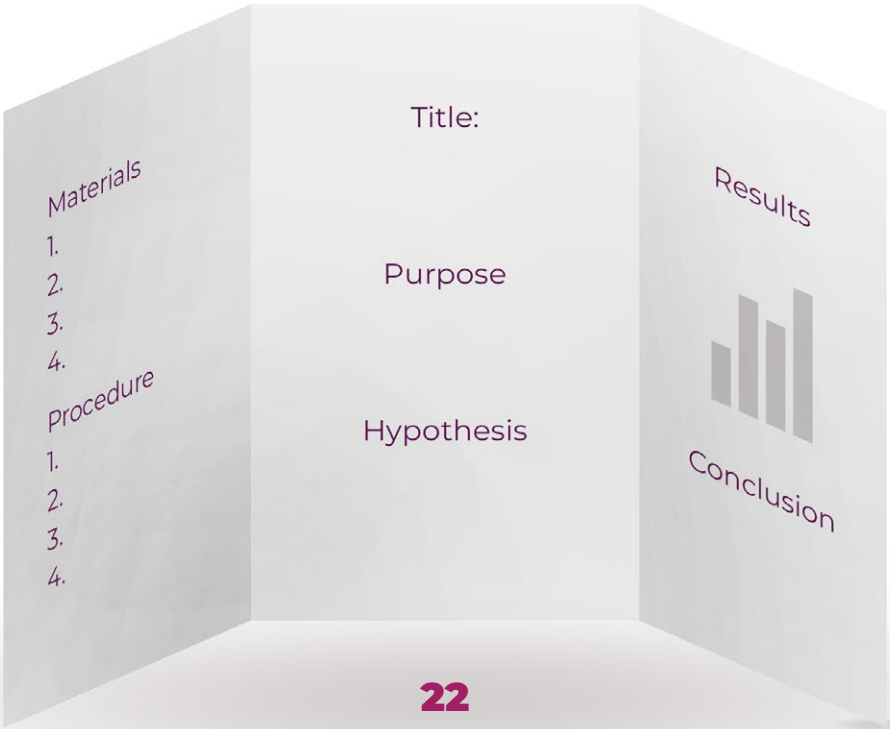
13. Plan a time line so you don't leave everything until the last minute. If you need help, tell your parents and your teacher, the earlier the better.

14. If you need some help to source some of your project materials, please create a list of the items you need and let your teacher or mentors know so we can try and assist you with getting everything you need.

Science Fair Poster Presentations/Display Boards

Ensure that information about your project is organised and displayed neatly so people can follow what your project is about. It is important to ensure proper use of spelling, grammar, punctuation and capitalization on all sections on the poster/ display board. Below is a checklist of the areas that are important for a clear and striking poster presentation or display board to summarise the scientific project or idea

Component	Tick if completed ✓
Title: The title should catch people's attention and be large enough to be read from across the room?	
Purpose	
Hypothesis	
Procedures of Investigation	
Materials	
Results/Graphs/Charts: Use pictures, diagrams, graphs and charts to effectively convey information about the project	
Conclusion	



Science Fair Oral Presentations

A lot of people are scared of speaking in public or to a teacher/judge. Just imagine they are a fellow scientist who just wants you to share what you learned. Relax, smile, and have fun. Remember, you are the expert and you had fun doing the project. Presenting your ideas to your peers at science clubs will also improve your confidence with oral presentations; but if you are a little nervous, we listed some things that you need to do during the presentation.

Helpful Hints:

- Look sharp, feel sharp, and you will be sharp. Dress nice that day, be polite, and speak clearly. You will show that you have confidence. Don't forget to look at your audience.
- Introduce yourself. Point to the title of your display. Tell your audience why you chose to study this.
- State your problem that you studied (your question.) Tell them about your hypothesis (what you thought might happen.)
- Talk about what you learned while researching your topic.
- Talk about the sources (books, websites, and interviews) that helped you understand your topic.
- Tell about your project and explain the steps you took to conduct your experiment. Be sure to mention all the materials involved and point out the pictures that you may have taken.
- If it applies, be sure to show them that you tested your experiment at least 3 times.
- Show them all of the cool graphic organizers that you made, like your tables and charts. Remember to point out the labelled parts of your graph or table to show that you know what it represents.
- Be sure to explain what your data means. Make sure you can read your graphs and tables. Let them know if you were surprised by the results, or if you kno \what would happen because you studied about it.
- Make sure you sound like an expert on your topic. Always use the appropriate vocabulary especially by using words from the Scientific Method, like: Problem, Hypothesis, Methods, Results, and Conclusions.

Science Fair Written Reports

The written report is a summary of everything that you did to investigate your topic. The written report provides others with vital information on what your project is about as well as its effect on your understanding of the topic. Usually the written report is 5-30 pages in length. All information must be included in the written report. This report provides you with the opportunity to think about all the aspects of our project and share your ideas with others.

Reports should be neatly bounded in an attractive binder. It must be neatly written (by hand or typed).

- Typed, doubled spaced. One inch margins, and 12 point Times New Roman Font
- Remember to put headings/titles on graphs/charts/tables
- All photographs must have captions explaining their significance
- Before you hand in your report make sure to reread, revise, and rewrite
- Recheck your calculations, spelling, and grammar.

All written reports for a science fair project should include:

Component	Tick if completed ✓
Title Page: The first page in the report should include the title of the project as well as the name and grade of the student.	
Acknowledgment: Here is where you thank everyone who helped to make your project successful (including Mom and Dad.) Everyone that you interviewed, including teachers, scientists, and other experts in the field should be mentioned here.	
Table of Contents: This page provides the reader with a list of the different parts of the project and the page number on which each section can be found.	
Statement of Purpose: State the purpose of the project **in the form of a question.**	
Hypothesis: You must have a hypothesis before you complete the project. A hypothesis is an educated guess about what you think will occur as a result from completing your experiment.	
Research: This is the part of the report that contains all the background information that you collected about your topic. Any books or articles read from the internet/journal, authorities on the topic that you talked to, or outside materials collected should be summarized in this section. **This section should be written in your own words and NOT copied from your resources.**	
Materials: This is a list of all the materials and supplies used in the project. Quantities and amounts of each should also be indicated.	
Methods: You will list and describe the steps you took to complete the project. Usually this is listed in a numbered sequence. This part shows the stages of the project so that another person can carry out the experiment.	
Observations and Results: In this section, you will tell what you learned from the project. It is also IMPORTANT to include all graphs, charts, or other visual data (pictures) that helps to show your results.	
Conclusion: This is a brief statement explaining why your project turned out the way it did. You should explain why the events you observed occurred. Using the word "because" is a good way to turn an observation into a conclusion. The conclusion should tell whether the hypothesis was proven or not proven. Also give the reason(s) why you chose to learn more about the subject. You could also add what you know now that you didn't know before you completed your project.	
Reference Page: The bibliography should list all the printed materials the student used to carry out the project. Items should be listed in alphabetical order in a standard format. These website are a great place to go to find the proper way of writing a bibliography. http://www.bibme.org/ , http://www.easybib.com or	
http://www.knightcite.com Also http://www.Icyte.com lets you "tag" information from Internet sources as you research.	

Science Fair Online Resources

Zimbabwean websites:

Africa Science Buskers: an organization that hosts prestigious science fairs for students (Primary & Secondary schools) including the Zimbabwe Science Fair. Students that may have an interest in taking part in their events may find more information at https://sciencebuskers.org/

Zimbabwe Science Fair:
This site has information on dates and how to register for the Zimbabwe Science Fair which is affiliated with the Regeneron International Science and Engineering Fair (ISEF). https://zimsciencefair.com

International websites:

California State Science Fair: Site includes project listings by year and category from 1952 to 2001. https://csef.usc.edu

Exploratorium Learning Studio - Science Fairs: Site for The Exploratorium, the museum of science, art, and human perception located in San Francisco, CA. Includes general overview of what science fairs are about, scientific method, and how to demonstrate scientific method in a project. Includes resources for students, teachers, and parents. Information on supplies and materials
http://www.exploratorium.edu/ls/pathfinders/scifairs/index.html

Internet Public Library - Science Fair Project Resource Guide: Links to science fair sites on the web compiled by the staff of the Internet Public Library http://www.ipl.org/youth/projectguide/

London District Science & Technology Fair: Home page for the London (Ontario) District Science & Technology Fair. Includes links to other science fairs and resources, previous fair winners http://quark.physics.uwo.ca/sfair/

Neuroscience for Kids : Information on successful science fair projects, with links to other science fair web pages (http://faculty.washington.edu/chudler/fair.html).

Regeneron International Science & Engineering Fair: Site tells student all about this very competitive event, includes rules, resources, affiliated fairs, scholarships & awards. https://www.societyforscience.org/isef/

Science Fair Idea Exchange: Part of the "Science Fair Idea Exchange," this site includes biology projects that are listed as simple, medium difficulty, and advanced (http://www.eskimo.com/~billb/scifair/bio.html).

Science Made Simple: Site for children and parents with an index of science projects compiled by the publishers of "Science Made Simple" newsletter (http://www.sciencemadesimple.com/science.html).

Science buddies: Use the topic selection wizard to help you figure out what science

projects interest you most. Once you have a topic, get help doing research, setting up the experiments and completing them. http://www.sciencebuddies.org/

Science Fair Central: Includes information on science and engineering projects. https://sciencefaircentral.com/students

Science Fair Project Resource Guide: Samples, ideas, magazines, resources, and more. Includes a list of sites that explain the scientific method. http://www.ipl.org/div/kidspace/projectguide/

Scientific Method: Describes the five steps of the Scientific Method that are helpful when creating a science fair project. Includes examples of wordking and sample projects to explain certain steps. http://school.discoveryeducation.com/sciencefaircentral/Getting-Started/Investigation.html

Super Science Fair Projects: Guide to projects, topics, experiments and tips for successfully completing a science project, including the six steps of the Scientific Method. http://www.super-science-fair-projects.com/

WWW Virtual Library Science Fairs: Site attempts to provide a single comprehensive list of every science fair accessible through the World Wide Web. http://physics1.usc.edu/~gould/ScienceFairs/

What Makes a Good Science Fair Project?: Short guide written by a group of experienced judges for the California State Science Fair. http://csef.usc.edu/Resources/Good_Project.html

References

Barnette School (US) Science Packet available at: https://www.phsd144.net/cms/lib3/IL01001725/Centricity/Domain/572/ScienceFairPacket.pdf

Science Fair Ideas website available at: https://www.valleystreamlibrary.org/science.html

Science fair rules and guidelines. https://www.societyforscience.org/isef/

Reflections

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