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**GLOSSARY**
Vision

Inspiring Young Scientists and Researchers

Mission Statement

We develop young scientists who are able to identify a problem, analyse information, find solutions and communicate findings effectively.

An association incorporated under Section 21 of the Company’s Act, 1973
Registration number 1992/006939/08
Non-profit Organisation NPO number 008 350
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Eskom Expo for Young Scientists is proudly sponsored by:

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Regional Eskom Expo Sponsors
Provincial Departments of Basic Education

Eskom Expo for Young Scientists is affiliated to:

National Science and Technology Forum (NSTF)
The Association of Science Technology Engineering Mathematics and Innovation (ASTEMI)
Society for Science & the Public (SSP)
Beijing Youth Science Creation Competition (BYSCC)
Kenya Science and Engineering Fair (KSEF)
Oğuzhan Özkaya Educational Institutions – Karademir Science Engineering Energy Project Fair (OKSE²F)
SECTION A: ABOUT ESKOM EXPO

What is Eskom Expo for Young Scientists?
Eskom Expo for Young Scientists (Expo) is the only national initiative in South Africa where learners are provided a platform to showcase their research projects. Expo is proud to have 35 affiliated regions in all 9 South African provinces in which learners can participate. Learners get to discuss their work with judges, teachers and learners from other schools, with parents and with other interested people.

It is a resilient science foundation that has been built over the years by dedicated and highly skilled individuals, who have ensured that learners move in the direction of Science, Technology, Engineering, Mathematics and Innovation. Expo seeks to engage young people from across South Africa in high-quality scientific research in 13 categories that cover scientific investigations, engineering projects, mathematics, computer science or social science projects. Learners have an opportunity to exhibit at various stages of expo and if successful, may proceed to the next level. The first level is at school, proceeding to a district expo, followed by a regional expo and eventually to the International Science Fair (ISF). Some winners are then selected to represent South Africa at various international science fair across the world.

Who can participate in Expo?
Expo district/ regional competitions are open to all learners in school, including home schooled learners. However, only learners from grades six to twelve are eligible to be selected for ISF. Check with the Regional Science Fair Director (RSFD) of your region about grades that are accommodated in your area.

To take part in Eskom Expo you need to be a self-motivated and curious learner.

What are the benefits in doing an Expo Project?
- Expo stimulates learners to pursue their passion in the STEM related fields of study and also prepares them for careers by engaging in inquiry-based research in the informative years of their education.
- Learners acquire 21st century skills which are used throughout their lifetime:
  - Critical thinking and Problem solving
  - Communication
  - Creativity
  - Collaboration
- Expo makes science relevant by allowing learners to conduct research based on their own interest, which also helps them identify a career path at an early age.
• It is a great way for learners to explore the world and how it works.
• Learners engage in research and inquiry learning which then prompts them to ask questions and test possible explanations.
• Hands-on-learning in research leads to a better understanding and longer retention of information acquired.
• Learners get an opportunity to connect with experienced researchers, scientists and engineers and gain an appreciation of science and engineering in the context of the bigger picture in the real world.
• Learners can showcase projects they have completed for assessment within the school environment, while also extending their research capabilities to well beyond the school environment.

How do I enter an Expo project?
To enter your project into a district/ regional expo, your school/ teacher must contact your nearest RSFD. The RSFD will provide the school with information on the steps to follow when registering for that particular region. The process may be different, depending on the region.

Learners are encouraged to do and enter projects individually, however, a group project with only two members is also accepted. Learners need not be in the same grade or same school to be in a group project. Learners who enter any level of Expo have to abide by the code of conduct, details can be found in Appendix A. You may only enter one project in one Expo Region per year.

Role of the Teacher
The role of the teacher is to be a mentor to the learners and a facilitator of the Expo processes. Teachers assist by ensuring that projects are done following the correct expo guidelines, and that the projects are ethical, thus meeting the project approval criteria. A teacher can guide learners through all the stages of a research project and ensure that their selected type of project, is done according to the guidelines in this book. The teacher can also arrange an internal school expo for learners to display their projects and be judged by a panel of teachers and/ or external judges. The school expo should be set up in a large enough room/hall or use multiple classrooms, so that each learner has a table about 100-150cm long and 50-80cm wide, on which to set up his/ her project display board. The Teacher is also the liaison between the school and the district or regional level expo where he/ she should register the school.

Expo depends on teachers to share information about Expo with learners, assist with projects and to display notices about School, District and Regional Expos. Enthusiastic teachers inspire learners to achieve great things, simply through their encouragement and support.

Teachers should use the project as part of class work CAPS assessment.
Since Expo is an official programme of the Department of Basic Education, the training material and activities are accredited by the South African Council for Educators. Teachers who engage with and facilitate expo activities in a school can earn type 3, type 2 and type 1 SACE continuous professional teacher development (CPTD) points.

SECTION B: ABOUT ESKOM EXPO PROJECTS

What is an Eskom Expo Research Project?
An Expo research project involves learners independently undertaking a thorough scientific investigation of a topic and presenting this investigation in written and spoken form.

Expo project ideas.
Think about your project idea before you select a topic. Try not to focus on a topic first as this narrows your research. You should start by finding something that interests you, it could be a problem that needs a creative solution or something you know could be improved on. Try to focus on that single issue because that could be your project idea. At this stage it's just the start of your project, you are going to narrow that idea down to something that can be developed into an Expo project.

Where can I find project ideas?
- In your home
- At school e.g. in Science clubs, school grounds
- In your community
- Internet, social media, TV
- Issues at local or global level

How can I develop my project idea?
- Talk to your friends and to other people like your family, teachers, professionals
- Read books, magazines or newspapers, online articles
- Do background research, by finding a gap (what has not been done or what needs further research)

You need to ask yourself these questions: why am I doing this project, how will I do this project and when must it be done, who else has done a similar project?

» Tip: To find out what research has been done in your project idea, you may go to Google Scholar and type your project idea in the search area.
Types of projects
Once you have a project idea and you have identified the problem or phenomenon you are going to address, you must start your planning: There are 4 basic types of Expo projects that can be entered, though some projects may be inter-disciplinary.

Scientific Investigations/ Experimental – these are projects that follow a method that answers a research question and tests a hypothesis, usually through observations and experimentation. It involves collecting and analysing data to reach a conclusion.

Engineering/ Computer Science – these types of projects follow a design process according to the criteria, to build, test-redesign and retest a prototype/product/solution e.g. a device or a computer code.

Social Sciences – these projects follow a systematic approach that involves answering questions or testing a hypothesis of the functioning of human society by observations and analysing of human behaviour, social relationships, social issues, and other phenomena. Its method involves collecting qualitative and/or quantitative data. Surveys are often used to collect data. Details on planning a survey can be found in Appendix B.

Mathematics/ Theoretical – these projects explore quantity, structure, space and change. Starting with an observation, problem or question, make conjectures/hypotheses, prove your claim using new or existing methods, make valid deductions and test your ideas theoretically. Your reasoning and arguments must be logical. All Expo projects must contain evidence that the learner(s) completed the project and must include current year results of their own investigation.

Categories
Once you have figured out the type of project you will be doing, start thinking about the category in which it will fall under. A research project can go in various directions, however; the emphasis/focus/experimentation of your research – not the application of your results; will determine the category in which the project will be entered. There are 13 different categories in which an Expo project can be entered.

E.g. when your project is about water hyacinth (Eichhornia crassipes) – to place your project in a category, ask yourself what you are trying to find out about the plant. If you are looking at the:
• effectiveness of all established biocontrol agents on water hyacinth plant growth  - Category: Environmental Studies
• use of water hyacinth in waste water treatments, focusing on the chemicals  - Category: Chemistry & Biochemistry
• water hyacinth as a potential biofuel crop - Category: Agricultural Sciences
• phenology and growth of water hyacinth in two different locations - Category: Plant Sciences
• allelopathic effects of water hyacinth - Category: Biomedical and Medical Sciences (Microbiology)
• socio-economic utilization of water hyacinth and how it has impacted the local communities - Category: Social Sciences;

Check out the Expo category list below and the descriptions in Appendix C. Ask your teacher or mentor for help with choosing a category if you are unsure.

**Note:** At District or Regional level, the judges may recommend that your project be moved to a new category, which is most appropriate.
## Category List

*See Appendix C for category descriptions.*

### 1. AGRICULTURAL SCIENCES (AGR)
- Animal Production
- Aquaculture
- Crop Sciences

### 2. ANIMAL SCIENCES (ANI)
- Animal Behaviour
- Animal Genetics
- Animal Physiology
- Aquatic Animals
- Entomology
- Wildlife Management
- Zoology

### 3. BIOMEDICAL AND MEDICAL SCIENCES (BIO)
- Diseases and Illnesses
- Food Science and Technology
- Health Care
- Human Genetics
- Human Physiology
- Medical Science
- Microbiology
- Pharmacology
- Sports Sciences
- Veterinary Sciences

### 4. CHEMISTRY AND BIOCHEMISTRY (CHB)
- Analytical Chemistry
- Biochemistry
- Inorganic Chemistry
- Organic Chemistry
- Polymer Chemistry

### 5. COMPUTER SCIENCES AND SOFTWARE DEVELOPMENT (COM)
- Data Management
- Data Sciences
- Networking
- Software Systems

### 6. EARTH SCIENCES (EAR)
- Atmospheric Sciences
- Climate Sciences
- Geography
- Geology
- Limnology
- Oceanography
- Soil Sciences
- Water Sciences

### 7. ENERGY (ENP)
- Energy Productivity
- Non-Renewable Energy
- Renewable Energy

### 8. ENGINEERING (ENG)
- Biomedical Engineering
- Chemical Engineering/Process Engineering
- Civil & Industrial
- Electrical, Electronics and Embedded Systems
- Mechanical & Aeronautical
- Mining & Metallurgical

### 9. ENVIRONMENTAL STUDIES (EVS)
- Biological Control
- Bioremediation
- Ecology
- Environmental Management
- Sustainability
- Sustainable Development

### 10. MATHEMATICS (MAT)
- Algebra
- Game Theory
- Geometry
- Number Theory
- Statistics and Probability

### 11. PHYSICS, ASTRONOMY & SPACE SCIENCES (PHY)
- Astronomy and Space Sciences
- Material Sciences
- Matter and Materials
- Mechanics
- Mechatronics and Robotics
- Optics
- Theoretical Physics

### 12. PLANT SCIENCES (PLA)
- Aquatic Plants
- Botany
- Plant Genetics
- Plant Pathology
- Plant Physiology

### 13. SOCIAL SCIENCES (SOC)
- Anthropology
- Education Studies
- Human Behaviour
- Human Settlements
- Psychology
Ethics

Ethics involves what is right or wrong, good or bad, fair or unfair, responsible or irresponsible. Learners are expected to consider ethical rules and regulations, for both conducting the research and exhibiting it at all levels of Expo. Please note that the following are not allowed at any Eskom Expo science fair:

- Living organisms including bacteria, fungi, animals, insects and plants. Even if you put these in a sealed container, they will be confiscated.
- Agar plates (petri dish) and other growth mediums for microbiology studies.
- Human or animal parts including tissues and body fluids (for example blood, urine, hooves, skins etc.).
- Dangerous chemicals: Poisons, drugs, medications, controlled substances, hazardous substances.
- Dangerous devices (for example firearms, weapons, ammunition, reloading devices, knives and any sharp instruments).
- Flammable substances e.g. methylated spirits.
- Photographs or other visual presentations depicting humans or vertebrate animals in surgical techniques, dissections, necropsies or other lab procedures, or which belittle people in any way, or show animals/humans being harmed in any way.
- Brand names or any branded products e.g. Coca Cola, Raspberry Pi, Valpré, Woolworths, etc.
- Non-perishable food substances that are not in completely sealed containers (plastic wrap is not acceptable as it can be easily removed). Perishable foods may not be part of any Expo display.
- No water is allowed as part of the display.
- Any apparatus or display deemed unsafe by the Eskom Expo organisers.
- You are not allowed to ask judges/learners/public to TASTE an edible product that you made. – this can trigger health complications.

Any research involving testing on vertebrates (human and animal), including psychological tests, must be done in a recognised research institution, where ethical clearance has been granted by the institution. Such testing has to be done in the presence of a qualified scientist. Evidence of ethical clearance from the institution and proof of supervision from the qualified scientist must be presented to the judges, at any Expo event. The Judges/Ethics Committee will then review the evidence provided and make a ruling regarding the ethics of the project. In the event that the testing or any procedure has been classified as unethical, according to Eskom Expo for Young Scientists regulations, the project will be disqualified and removed from the exhibition.

Parents should individually give written permission for testing on children under the age of 18 (e.g. bleep test).

Any survey done at school level, must have a written letter from the principal of that school giving permission for the survey to take place. DO NOT share/disclose interviewee’s personal information.
Plagiarism

Eskom Expo promotes ethical research behaviour regarding all aspects of the research conducted. Using another person’s words or ideas and presenting them as your own is known as plagiarism. Plagiarised projects will be disqualified at all Eskom Expo events.

Examples of plagiarism:
• To steal or borrow another person’s work including data without their permission. **DO NOT** submit the same project your friend, sibling or relative exhibited at a science fair before.
• To pay another person to do your project for you or write it up. Acknowledge persons for the contributions they made to your project. Their contribution should not be the major part of the science project.
• To copy directly from a source without referencing the original source and without permission from the author(s). Make sure you use in-text referencing and have a reference list (see appendix J).

It is compulsory for every participant to have a signed copy of the Plagiarism Form in their file, which can be found in Appendix D.

SECTION C: PRESENTING AN EXPO PROJECT

At Eskom Expo, projects are presented in written and visual form. The presentation must include the following:

**Written**
The following are presented in written form, at an Eskom Expo fair:

**Journal:**
From the **first day** of your project, you should keep a journal where you record the date and what you did on each day. The journal can be hand written in an exercise book including data, observations, etc. This is a record of **ALL** the work of the project – no matter how untidy it is! This journal must be presented as part of the assessment. File all emails and rough data/results. File notes from interviews. Record all your conversations with people, including relevant text messages and emails. File all designs, photos, and plans.

**Research Plan:**
At Eskom Expo for Young Scientists, it is compulsory to write a Research Plan, before you start your project. Once you have figured out what you want to do for your Expo project, you must start writing a research plan. The Research Plan shows how you intend conducting your research. Hence, it is written in the future
tense i.e. before you actually do your project. It also needs to be written in the 3rd person (do not use: I, We, us, My etc.). When planning your project, consider “what”, “why”, “how”, “when” and “where” you will do your research. What resources will you need? What literature do you have to read before starting the research? What time frames are needed to complete the research? Is this research doable? Think about ethical issues you may encounter and how you will address these. Your Research Plan will guide your research process and may change as you progress with your research. In case, note the changes in your journal and why you made those changes. Do not change your research plan (see Appendix E for a detailed research plan template).

Report File:
A report file consists of a printed project report. The purpose of a project report is to communicate your ideas and results in full detail, in a way that is understandable to judges and your peers. For an Eskom Expo project report, use the passive voice (e.g., The data was collected…) in the third person i.e. do not use “I, We, Us, Me”. Convey your ideas objectively, based on what you’ve read. Your writing needs to be clear, concise and to the point. Don’t use emotive words/ slang. Simple language is preferable to jargon, if they convey the same meaning. Your report must have the following compulsory headings: Introduction, Method, Results, Discussion, Limitations and Errors, Recommendations for Future Research, Conclusion, Acknowledgements, References, and/or Appendix) have an initial capital letter, are in bold and are aligned along the left margin (left-justified). The report is completed after your research is done, so it is in the past tense (See Appendix F for guidelines).

Abstract:
An abstract is a summary of your project report that you write after you have completed your research and written your project report. Your abstract must be clearly written in the past tense and concise, does not include references/tables/graphs/images and must be less than 250 words. See Appendix G for guidelines on how to write an abstract.

Visual
The following are presented in visual form, at an Eskom Expo fair:

Poster:
A poster is a display of a summary of the project report. The poster must be printed on A4 pages (landscape or portrait) and stuck onto a project display board in logical order (see Figure 1). Information on the pages must be easy to read from a distance, use text that is large enough to be read at arm’s length. Choose colours that make your poster easy to read. Make the poster interesting and attention-grabbing e.g. through pictures. DO NOT put detailed information, this will be in the report file.
Project Display boards will be provided at Regional Expos and in some District expos- check with the RSFD for the size and dimensions. The ISF project display board dimensions are as follows; Height: 1m Total width: 2.5m (Left side: 50cm; Middle: 1.5m; Right side: 50cm). Display width is 1.5m –see example below (Figure 1)

**Project Display Board**

![Project Display Board diagram](image)

Figure 1: Project display board dimensions for the Eskom Expo International Science Fair; showing the order in which you must display your project report information.
**Prototypes (if applicable):**
Must fit onto the table within the project display space provided. The model may not obstruct the project display board. Any part of the board that is obstructed by anything on the table (including a stack of files, computers, model, bottles, etc.) will not be judged, unless it is easily visible to the judges. Furthermore, nothing may protrude over the edge of the table, be on the floor, or obstruct the Eskom Expo branding and title on the project display board in any way. Safety rules would also still apply. If prototypes are too large, a video showing how it works is sufficient.

**What happens at the Expo science fair?**
You will be allocated a space and a Project Display Board to set up your project. Use only rubber-like re-usable adhesive e.g. prestik to stick your A4 pages on to the project display board. No marking/writing is allowed on the project display board. You will be given a Project ID number based on the category your project is placed in. When you arrive at the science fair, your project must first be approved, this is known as the project approval process.

**Project Approval**
All projects need to be approved prior to judging. This means that it is checked for compliancy with the rules of the Eskom Expo science fair. The Project Approval team will first check for ethical violations (see Ethics Rules) – Anything that is not allowed to be exhibited will be confiscated.

At ISF, the following documents are also inspected at Project approval:
- Journal
- Plagiarism Form signed by learner
- Research Plan signed by teacher
- Report File with Project Report
- Abstract
- Binding Agreement signed by learner
- Permission Letters for surveys / scientist supervision (if applicable)

See Appendix I for the Project Approval form

**Judging/ Project Assessment**
Your project will be judged/ assessed by several specialists after it has been approved. At this stage, your forms will be checked, and a first ethics check will be done.

No teachers or parents are allowed in the hall during judging.
The following criteria are guidelines that will be used during judging:
• Introduction
• Method
• Results and Discussion
• Limitations, Further research, conclusion
• Originality and Creativity
• Communication (report, poster and interview)

Interview
The learners are given the following advice in preparation for the interview:

• Firstly, introduce yourself by name.
• Know your project very well
• Don’t prepare an oral presentation and recite it to the judges. To prepare, rather get your friends and family to ask you questions about your research project.
• Listen to the judge’s questions.
• Be enthusiastic with your answers and refer to important aspects of your poster.
• Make sure the answers are to the point.
• Speak clearly with confidence and use appropriate language.
• If you have a prototype, don’t only focus on the prototype, but rather the science behind it.

Things to Remember:
• Your cell phones must always be switched off – unless it is part of the display.
• Be aware of time constraints, the interview is only about 10 minutes long.

Judges are looking for the following from learners during the interview:
• Ability to provide a logical summary of your project, highlighting the most important information
• Ability to communicate research project effectively
• Extent of research and understanding of the research field
• Appropriate use of technical/ scientific terminology
• Extent of ownership i.e. whether the work was done by the learner

Scoring
Marks are finalised by the judging team and projects are ranked according to the following scale:
• Gold medal: 80-100%
• Silver medal: 70–79%
• Bronze medal: 60–69%
• Highly commended certificate: 50-59% (may be awarded)
At Regional and ISF level, medals and/or certificates are awarded for these projects.
PLEASE NOTE THAT AT THE ESKOM EXPO FOR YOUNG SCIENTISTS, THE CHIEF JUDGE’S DECISION IS FINAL AND NEITHER DISCUSSION NOR CORRESPONDENCE WILL BE ENTERED INTO

Note:
Not all gold medal winners at the Regional level will be selected to participate at the Eskom Expo International Science Fair. Numbers are limited at ISF so an allocation is given to each region.

For more information on the regional expos, contact Provincial Coordinators and RSFDs for assistance. Details available on the website: www.exposcience.co.za

Safety
All electrical work must conform to the National Electrical Code and Exhibition Hall Regulations. Fire regulations will be strictly enforced. The on-site electrician may be requested to inspect any electrical work on any project. The safety guidelines above are general ones and other rules may apply to specific configurations.

Patents
Some participants display projects that show innovative thinking and provide new products. Expo encourages the development of entrepreneurial products which may lead to the marketing of these products. Before you show your project in an Expo, you should consider registering it for a patent. Go to: http://www.cipc.co.za/index.php/trade-marks-patents-designs-copyright/patents/how-app/
SECTION D: APPENDICES

APPENDIX A: CODE OF CONDUCT FOR LEARNERS AND ADULTS

1. The code of conduct applies to LEARNERS (“participants”), PARENTS, RSFDS, JUDGES AND MENTORS and describes the behaviours that do not agree (are not consistent) with the values of EXPO. Any attempt to deliberately break the values laid down by EXPO may be viewed as serious.

2. Participants at an EXPO event are expected to conduct themselves in an appropriate manner so as to support the values of EXPO. The Eskom Expo values include:
   2.1. Integrity and legality (truthfulness)
   2.2. Respect for all, anybody who is involved with Eskom Expo
   2.3. Respect for company property, and the property of others
   2.4. Commitment to intellectual and personal growth of our diverse population
   2.5. Any form of plagiarism/use of material without acknowledgement is a serious violation.

3. The code of conduct applies to all participants who participate at any of the district, regional, national and international Eskom EXPO events.

4. Learners who need to travel to any EXPO event must be responsible for their own behaviour and be prepared to face the consequences should they break any of the EXPO rules.

5. EXPO shall not be held responsible for any loss, damage, injury or any other consequences resulting from the participant’s failure to comply with the rules and regulations as stipulated by EXPO.

6. EXPO will not allow the following behaviour to occur at any of the EXPO events:
   6.1. Physical harm to any person; this includes assault, sexual and/or physical abuse.
   6.2. Harassment, whether physical or verbal, oral or written.
   6.3. Conduct which threatens the mental health, physical health, or safety of any person.
   6.4. This includes drug or alcohol abuse and any form of destructive behaviour.
   6.5. Dishonesty, including plagiarism and cheating.
   6.6. Intentional disruption of any activity whether it be run by EXPO or by any other sponsor.
   6.7. Theft/illegal possession or damage to personal or EXPO property or services.
   6.8. Forgery, alteration, fabrication, or misuse of identification cards, records or misinterpretation of any kind.
6.9. Unauthorized entry, use, or occupation of EXPO facilities.
6.10. Disorderly conduct of any kind; including intoxication, indecent or obscene behaviour, libel, slander and illegal gambling.
6.11. Illegal purchase, sale, use, possession, or distribution of alcohol; drugs or controlled substances.
6.12. Failure to follow any instructions given by any EXPO official – especially those related to security or safety.
6.13. Unauthorized possession or use of any weapon including firearms, BB-guns, air rifles, explosive devices, fireworks, or any other dangerous, illegal or hazardous object or material.
6.14. Interference with or misuse of fire alarms, blue lights, elevators, or other safety or security equipment or programmes.
6.15. Loitering and/or playing around corridors, stairways.

7. Disciplinary action
7.1. Every RSFD is responsible for discipline and has the full authority and responsibility to correct the behaviour of participants when necessary.
7.2. Any corrective measure or disciplinary measure will correspond with and be appropriate to the offence.
7.3. All participants will abide by the disciplinary system that has been developed to assist and guide participant’s behaviour during any EXPO activity.
7.4. Should a matter be deemed severe in nature, the responsible RSFD may refer the matter to the national office for a decision.
7.5. The national office may convene a disciplinary hearing.
7.6. A decision taken at this hearing will be final and will be communicated to the offending party in writing.

8. Disciplinary sanctions

Depending on the nature and severity of the offence, one or more of the following disciplinary sanctions may apply:
8.1. Verbal warning (school informed of misdemeanour and disciplinary measure taken)
8.2. Written warning (copies sent to parents and school)
8.3. Withdrawal of participation for the current or forthcoming expo
8.4. Disallowed participation at the International Science Fair
8.5. Disallowed participation at any international expo
8.6. Disallowed participation at any future science expo
8.7. Withdrawal of any medals received
8.8. Withdrawal of special prizes received
APPENDIX B: PLANNING A SURVEY

The key to obtaining good data through a survey is to develop a good survey questionnaire. Whether you are conducting interviews or mailing out surveys, you will need to know how to design a good survey questionnaire.

What is a survey questionnaire?
Survey questionnaires present a set of questions to a participant who, through their responses will provide data to a researcher (learner conducting survey). Here we discuss some key elements to consider when designing a survey questionnaire, and then highlighting some tips and tricks for creating a good survey questionnaire.

Objectives
The key to developing a good survey questionnaire is to keep it short while ensuring that you capture all of the information that you need. Before you even begin to design your survey questionnaire, you should develop a set of objectives for your research and list out the information that you are trying to capture. This list of objectives and research goals will serve as your plan for the survey questionnaire.

Now that you know what you are looking for, you can begin to structure the questions that will help you capture the information. Once you have developed your survey questionnaire, go back to your objectives to determine if each of the questions is providing you with information that you need. Any question that is not providing necessary information should be removed. Test your questionnaire by asking someone who is not a participant in your study to complete. This is called a pilot study.

Types of Questions:
There are two different types of questions that can be used to collect information. The first is called a structured or fixed response question and the second is called non-structured or open question. It is important to understand when and how to use these questions when designing your survey.

Structured (fixed response)
Structured questions offer the respondent a closed set of responses from which to choose. Structured questions make data collection and analysis much simpler and they take less time to answer. Structured questions are best suited in the following situations: (1) when you have a thorough understanding of the responses so that you can appropriately develop the answer choices (2) when you are not trying to capture new ideas or thoughts from the respondent.
Examples of Structured Questions

<table>
<thead>
<tr>
<th>Do you have a driver's license?</th>
<th>Which subject do you enjoy the most at school?</th>
<th>How many hours a day do you spend doing homework?</th>
</tr>
</thead>
<tbody>
<tr>
<td>( ) Yes</td>
<td>( ) Mathematics</td>
<td>( ) 0 to 1 hour</td>
</tr>
<tr>
<td>( ) No</td>
<td>( ) Science</td>
<td>( ) 2 to 3 hours</td>
</tr>
<tr>
<td></td>
<td>( ) English</td>
<td>( ) 4 to 5 hours</td>
</tr>
<tr>
<td></td>
<td>( ) Afrikaans</td>
<td>( ) more than 5 hours</td>
</tr>
<tr>
<td></td>
<td>( ) History</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( ) Geography</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( ) Art / Music</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( ) Other</td>
<td></td>
</tr>
</tbody>
</table>

When writing the selection of responses for a structured question, you must ensure certain that the list covers all possible alternatives that the respondent might select AND that each of the answers is unique (ie they do not overlap). So for example, in the homework question above, we have included every option on the number of hours (from 0 to infinity). Also, you will notice that we were careful not to overlap the hours when defining the ranges by stating them as <0 to 1 hour> and <2 to 3 hours> rather than saying <0 to 1 hour> and <1 to 2 hours>.

Non-structured (open-ended)

Non-structured questions, or open-ended questions, are questions where there is no list of answer choices from which to choose. Respondents are simply asked to write their response to a question. Here is an example:

Example of a Non-Structured Question.
What do you like best about the school holidays?

Tips for creating a good survey questionnaire

• Clearly state your intentions with the research.
Many people are hesitant to answer questions about themselves and state their opinions. If you are developing your survey for a science fair project, people will probably be more willing to help if you clearly state your intentions. At the top of your survey, write a brief statement explaining why you are collecting the information and reassure each respondent that the information is entirely confidential and anonymous. If you need to know specifics about a person, respect their privacy by identifying them as subject1, subject2, etc...

• Include instructions with your survey questionnaire
What may seem obvious to you is probably not very obvious to someone else. To ensure that you collect valid survey results, make sure you include instructions on how to answer the survey questionnaire. There should be a short introductory set of instructions at the top of the survey questionnaire, and additional instructions for specific questions as needed.
Your overall instructions may be something like:
Please mark the appropriate box next to your answer choice with an “x” (X). Please answer all of the questions to the best of your ability.

- **Do not ask for personal information unless you need it.**
  Asking individuals to provide you with personal or demographic information (age, race, income level, etc...) may prevent some respondents from completing your survey questionnaire. Ethics also apply to surveys, e.g. do not ask for confidential information if it is not required. However, in many instances, this information is necessary for the research. If you need to ask for this type of information it is best to place the questions at the END of your survey questionnaire.

- **Keep the questions short and concise**
  The wording for survey questions should be short and concise. Each question should be clearly stated so that there is no misunderstanding about what is being asked. The best way to ensure your questions are well worded is to test them by having other people review and test your survey before you distribute it to the full sample.

- **Ask only one question at a time**
  This is a very common mistake in survey questionnaires and one that will impact the results of your data. When you are writing a question, you must make sure that you are only asking one question at a time in a sentence.

- **Make sure the questions are unbiased**
  When developing your survey questionnaire, you want to make certain that you are asking the questions in a neutral way, i.e. that you are not leading them toward a particular answer. This may seem simple, but when you are writing questions you will often find that the way you phrase the question may reflect your underlying opinion.

- **Ask questions that can be answered by your respondents**
  Make sure that the questions you are asking are questions that people will be able to answer. The most common mistake is to ask questions that most people simply cannot remember.

- **Order/group questions in sections**
  If you have more than six questions in your questionnaire, then you should make an effort to organize your questions so the respondents can answer them as quickly as possible. A good way to organize the questions is to group them together by subject. This way your respondents can focus their thoughts and answer a series of questions around these thoughts.

- **Present the questions in a clear and organised layout**
  A clear layout will make it much simpler for people to respond to the questions and for you to collect the data. Make sure that your method for marking answers is well explained and that your answer boxes are consistent throughout the questionnaire.

- **Test / pilot the survey questionnaire**
  Once you have developed your survey questionnaire, you should conduct a small test (5-10 people) to make sure that respondents clearly understand the questions you are asking and that you are capturing the information that you need for your study.

*Adapted from “Science Buddies”*
### APPENDIX C: CATEGORY DESCRIPTIONS

#### 1. AGRICULTURAL SCIENCES (AGR)

**The study of farming methods used to raise and take care of plants and animals (livestock and wildlife)**

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal Production</td>
<td>concerned with improving conditions, processes and production systems for livestock to increase yield for human consumption.</td>
</tr>
<tr>
<td>Aquaculture</td>
<td>cultivating fish, crustaceans, molluscs, algae under controlled conditions mostly for commercial purpose.</td>
</tr>
<tr>
<td>Crop Sciences</td>
<td>concerned with producing and using plants for food, fuel, etc. and includes plant breeding, horticulture and soil management, for example innovative crop solutions to increase productivity.</td>
</tr>
</tbody>
</table>

#### 2. ANIMAL SCIENCES (ANI)

**The study of animals**

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal Behaviour</td>
<td>is the study of animal behaviour with emphasis on the behavioural patterns that occur in natural environment.</td>
</tr>
<tr>
<td>Animal Genetics</td>
<td>is the study of genetic variation, genes and heredity in animals, specifically mechanisms of hereditary transmission and variation of inherited characteristics.</td>
</tr>
<tr>
<td>Animal Physiology</td>
<td>is the scientific study of the internal physical and chemical functions of animals.</td>
</tr>
<tr>
<td>Aquatic Animals</td>
<td>is the study of animals (vertebrate or invertebrates) that live in water for most or all of their lifetime.</td>
</tr>
<tr>
<td>Entomology</td>
<td>is the branch of zoology which is the scientific study of insects.</td>
</tr>
<tr>
<td>Wildlife Management</td>
<td>is the study of the conservation of wildlife, including endangered animals.</td>
</tr>
<tr>
<td>Zoology</td>
<td>is the scientific study of the behaviour, structure, physiology, taxonomy and distribution of animals.</td>
</tr>
</tbody>
</table>

#### 3. BIOMEDICAL and MEDICAL SCIENCES (BIO)

**Biomedical Sciences is the scientific understanding of how cells, organs and systems function and it is relevant to the understanding of human diseases and treatment. It is the application of science to knowledge, technology and interventions regarding healthcare and medicine.**

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diseases and Illnesses</td>
<td>refer to conditions of the living animal or plant or of one of its parts that impairs normal functioning, and is typically manifested through distinguishing signs and symptoms. Studies are concerned with infectious and communicable diseases, including the clinical aspects such as the use and effect of antimicrobial and antibiotic substances.</td>
</tr>
<tr>
<td>Field</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Food Science and Technology</td>
<td>is the study of the nature of foods, the causes of their deterioration, and the principles underlying food processing as well as the selection, preservation, processing, packaging and distribution of food. This includes nutrition and dietary needs.</td>
</tr>
<tr>
<td>Health Care</td>
<td>is the provision of services, the processes for the prevention of illnesses and injuries as well as the promotion and awareness of wellbeing.</td>
</tr>
<tr>
<td>Human Genetics</td>
<td>is the study of genes, genetic variation, and heredity in humans and how they are can cause certain diseases? An understanding of genetic diseases may influence treatment.</td>
</tr>
<tr>
<td>Human Physiology</td>
<td>is the study of physical and biochemical functioning of the human body and different organ systems. It includes understanding of cell physiology, immunology and organ systems.</td>
</tr>
<tr>
<td>Medical Science</td>
<td>is the science concerned with the diagnosis, treatment, and prevention of diseases and illnesses. This includes translational medicine, which is the discovery of new diagnostic tools and treatments, using a multi-disciplinary bench-to-bedside approach.</td>
</tr>
<tr>
<td>Microbiology</td>
<td>is the study of the structure, function, uses and modes of existence and the associated diseases of microscopic organisms such as eukaryotes (fungi and protists) and prokaryotes (bacteria and algae) and viruses. This includes the use of microorganisms for medical applications such as treatments. This sub-category focuses on:</td>
</tr>
<tr>
<td></td>
<td><strong>Bacteriology</strong> is the study of the biology of bacteria as well as the associated diseases. It includes the study of the biochemistry, physiology, molecular biology, ecology, evolution and clinical aspects of diseases caused by bacteria.</td>
</tr>
<tr>
<td></td>
<td><strong>Virology</strong> is the study of the biology of viruses as well as the associated diseases. It includes the study of the biochemistry, physiology, molecular biology, ecology, evolution and the clinical aspects of diseases caused by viruses.</td>
</tr>
<tr>
<td></td>
<td><strong>Mycology</strong> is the study of fungi as well as the associated diseases. It includes the study of the biochemistry, physiology, molecular biology, ecology, evolution and clinical aspects of fungal diseases.</td>
</tr>
<tr>
<td>Pharmacology</td>
<td>is the science of drugs, concerned with the uses, effects and modes of actions of drugs, on living tissues and systems and their effects on health and wellbeing, as well as the treatment of illnesses.</td>
</tr>
</tbody>
</table>
Sports Sciences is a multi-disciplinary field concerned with the understanding and enhancement of human performance in exercise and sport. It includes the knowledge, methods and applications of the sub-disciplines of human movement studies (i.e. exercise physiology, biomechanics, motor control and motor development, exercise and sport psychology), as well as how they interact.

Veterinary Sciences is concerned with animal pathology and healthcare, specifically with the prevention, diagnosis and treatment of diseases in animals (domesticated and wild).

4. CHEMISTRY AND BIOCHEMISTRY (CHB)

Chemistry is the branch of science concerned with the composition, structure and properties of substances and the transformations they undergo. Biochemistry is the branch of science that explores the chemical processes within, and related to, living organisms.

<table>
<thead>
<tr>
<th>Analytical Chemistry</th>
<th>is the study of the composition, separation, identification and quantification of chemical components of materials.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biochemistry</td>
<td>is a laboratory based science, which brings together biology and chemistry. It explores the chemical processes within and related to living organisms at a molecular level.</td>
</tr>
<tr>
<td>Inorganic Chemistry</td>
<td>is the study of the structure, synthesis, properties and reactions of all chemical elements and compounds, which includes metals and minerals, other than organic compounds.</td>
</tr>
<tr>
<td>Organic Chemistry</td>
<td>is the study of the structure, properties, composition, reactions, and synthesis of organic compounds, which by definition contain carbon.</td>
</tr>
<tr>
<td>Polymer Chemistry</td>
<td>is the study of the synthesis, characterisation and properties of monomers, polymer molecules or macromolecules whether natural or synthetic.</td>
</tr>
</tbody>
</table>

5. COMPUTER SCIENCES AND SOFTWARE DEVELOPMENT (COM)

Computer Science is the study of computational systems and information technology, specifically the theory, design, development, and application of these systems. This includes artificial intelligence, computer systems and networks, security, database systems, human-computer interaction, vision and graphics, numerical analysis, software systems and languages, bioinformatics and the theory of computing.

<table>
<thead>
<tr>
<th>Data Management</th>
<th>focuses on collecting, validating, storing, protecting, and processing data usually using databases.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Sciences</td>
<td>is the field that uses scientific methods, processes, algorithms and systems to extract knowledge and insights from data in various forms, including data mining. This requires data management (collection, validating, storing, protecting, and processing data) and data analysis.</td>
</tr>
</tbody>
</table>
## Networking

Networking is the use of computers and infrastructure to create networks and the study of how these networks' communicate. This includes the practice of transporting and exchanging data between nodes over a shared medium in an information system comprising of hardware and protocols (wired and wireless technology).

## Software Systems

Software Systems primarily focus on the interface between the hardware and users, the development of unique applications and the different programming languages used. Examples include programming applications for mobile devices, social media platforms, office suites, gaming applications, and educational software.

### 6. EARTH SCIENCES (EAR)

**Natural sciences related to planet earth.**

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmospheric Sciences</td>
<td>is the study of the dynamics and chemistry of the layers of gas that surround the Earth, for example, study of ozone depletion, greenhouse gases.</td>
</tr>
<tr>
<td>Climate Sciences</td>
<td>is the scientific study of climate, scientifically defined as weather conditions averaged over a period of time.</td>
</tr>
<tr>
<td>Geography</td>
<td>is the study of science that deals with the description, distribution, and interaction of the diverse physical, biological, and cultural features of the earth's surface.</td>
</tr>
<tr>
<td>Geology</td>
<td>involves studying the materials that make up the earth, such as rocks and the features and structures found on earth as well as the processes that act upon them.</td>
</tr>
<tr>
<td>Limnology</td>
<td>is the study of the physical, chemical and biological properties of fresh water.</td>
</tr>
<tr>
<td>Oceanography</td>
<td>is the study of the physical, chemical and biological properties of the ocean. For example, studying ocean currents, waves.</td>
</tr>
<tr>
<td>Soil Sciences</td>
<td>includes researching soil classification, formation, chemistry and also interactions with living things.</td>
</tr>
<tr>
<td>Water Sciences</td>
<td>looks at the distribution and quality of ground and surface water and includes management of water resources, and water security.</td>
</tr>
</tbody>
</table>
## 7. ENERGY (ENP)

**Study of energy systems and various aspects including productivity, generation using renewable and non-renewable sources, as well as the efficient and sustainable use of energy**

<table>
<thead>
<tr>
<th>Energy Productivity</th>
<th>is the total value gained from using a unit of energy and is concerned with new or improved processes and technologies at all stages of production. For example, acquiring and processing raw materials (coal, natural gas, nuclear, petroleum) storage, transmission and distribution of energy. Energy efficiency is the part of Energy Productivity focusing on minimising energy wastage, reducing costs, reducing energy consumption or some combination of these (e.g. using energy efficient light bulbs).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-renewable Energy</td>
<td>is the study and design of energy systems from non-renewable resources, such as fossil fuels (coal, petroleum, and natural gas).</td>
</tr>
<tr>
<td>Renewable Energy</td>
<td>is the study and design of energy systems using renewable resources (naturally replenished), for example sunlight, wind, rain, tides, waves, bio-energy, etc.</td>
</tr>
</tbody>
</table>

## 8. ENGINEERING (ENG)

**The use of scientific theories, mathematical methods and computer sciences to solve problems within society.**

<table>
<thead>
<tr>
<th>Biomedical Engineering</th>
<th>is the study, design, control and application of medicine, biology and technology for healthcare purposes such as prosthetics and diagnostic equipment.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical / Process Engineering</td>
<td>is the study, design, control, and application of systems and processes to convert input substances into desired output substances.</td>
</tr>
<tr>
<td>Civil &amp; Industrial Engineering</td>
<td>Civil Engineering is concerned with the planning, design, construction and maintenance of structures. Industrial engineering is about the optimisation and streamlining of complex processes, systems or organisations to reduce wastage of time, money and other resources and materials.</td>
</tr>
<tr>
<td>Electrical, Electronics and Embedded Systems</td>
<td>is the study, design, control and application of electricity, electronics, circuits, devices, microcontrollers and electromagnetism to solve problems.</td>
</tr>
<tr>
<td>Mechanical &amp; Aeronautical Engineering</td>
<td>Mechanical Engineering is the study, design, control and application of mechanics, specifically for machines such as engines. Aeronautical Engineering uses similar principles, specifically for aircrafts.</td>
</tr>
<tr>
<td>Mining &amp; Metallurgical Engineering</td>
<td>Mining engineering applies science and technology to the extraction of minerals from the earth. Metallurgical engineering deals with the processes used to extract metals from their ores, purify, alloy, and create useful objects from metals.</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>9. ENVIRONMENTAL STUDIES (EVS)</strong></td>
<td><strong>Deals with the components, process and preservation of nature and looks at human interactions with the environment, in interest to solve complex problems.</strong></td>
</tr>
<tr>
<td>Biological Control</td>
<td>is the intentional use of a specific organism or their metabolic by-products to limit the harmful impact of an invasive species.</td>
</tr>
<tr>
<td>Bioremediation</td>
<td>is the waste management technique that involves the use of organisms to remove or neutralise pollutants from a contaminated site.</td>
</tr>
<tr>
<td>Ecology</td>
<td>is the branch of biology that deals with the relations of organisms to one another and to their physical surroundings, including biodiversity.</td>
</tr>
<tr>
<td>Environmental Management</td>
<td>is the management of the interaction and impact of human activities on the natural environment.</td>
</tr>
<tr>
<td>Sustainable Development</td>
<td>is defined as a process of meeting human development goals while sustaining the ability of systems to continue to provide the natural resources and ecosystem services upon which the economy and society depends.</td>
</tr>
<tr>
<td>Sustainability</td>
<td>is the systematic approach to finding practical ways for saving water, energy, and materials, as well as reducing negative environmental impacts.</td>
</tr>
<tr>
<td><strong>10. MATHEMATICS (MAT)</strong></td>
<td>The study of quantities, structures, space and change. Statistics is the branch of mathematics that deals with the collection, analysis, interpretation, and presentation of numerical data. Probability is the mathematical representation of the likelihood of an event occurring.</td>
</tr>
<tr>
<td>Algebra</td>
<td>the study of the properties and relationships of abstract entities (such as complex numbers, matrices, sets, vectors, groups, rings, or fields), arithmetically using symbols e.g. $x, y, \pi$. These symbols represent numbers and quantities in formulae and equations in order to solve them.</td>
</tr>
<tr>
<td>Game Theory</td>
<td>is the branch of applied mathematics that provides the tools for the analysis of strategies for dealing with competitive situations where choices are required.</td>
</tr>
<tr>
<td>Geometry</td>
<td>the area of mathematics relating to the study of space. It involves the measurement (shape and size), properties, and relationships of points, figures, spaces, lines, angles, surfaces, and solids.</td>
</tr>
<tr>
<td>Number Theory</td>
<td>is the study of the set of whole numbers where the main goal is to discover interesting and unexpected relationships between sets of numbers, for example the Fibonacci Sequence</td>
</tr>
</tbody>
</table>
### 1. Statistics and Probability

Statistics is concerned with collecting, organising, analysing, interpreting and presenting data. Probability is the study of chance i.e. calculating the likelihood or “odds” of something happening in the future, and can be expressed as a fraction, decimal or percent.

### 1. PLANT SCIENCES (PLA)

**The study of plants.**

<table>
<thead>
<tr>
<th>Aquatic Plants</th>
<th>is the study of plants that grow in an aquatic environment (freshwater or saltwater), whether rooted or floating, including the study of algae (Phycology).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botany</td>
<td>is the scientific study of the behaviour, structure, physiology, taxonomy, distribution of plants, and plant pathology.</td>
</tr>
<tr>
<td>Plant Genetics</td>
<td>is the study of genetic variation, genes and heredity in plants, specifically mechanisms of hereditary transmission and variation of inherited characteristics. How plant genetics affect characteristics / morphology of the plant.</td>
</tr>
<tr>
<td>Plant Pathology</td>
<td>is the study of the organisms and environmental conditions that cause disease in plants, the mechanisms by which this occurs, the interactions between these causal agents and the plant (effects on plant growth, yield and quality), and the methods of managing or controlling plant disease.</td>
</tr>
<tr>
<td>Plant Physiology</td>
<td>is the study of the physical, chemical and biological functioning of plants.</td>
</tr>
</tbody>
</table>

### 1. PHYSICS, ASTRONOMY AND SPACE SCIENCES (PHY)

**Physics is the study of matter, energy, motion and forces. Astronomy and Space Sciences is the study of the universe and beyond, including its origins and the properties of objects in space.**

<table>
<thead>
<tr>
<th>Astronomy and Space Sciences</th>
<th>is the study of the Universe and beyond, including its origins and the properties of objects in space.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material Sciences</td>
<td>is the scientific study of the properties and applications of materials of construction or manufacture (such as ceramics, metals, polymers, and composites).</td>
</tr>
<tr>
<td>Matter and Materials</td>
<td>is the study of the property of the different phases of matter and their macroscopic properties which includes topics such as superconductivity, semi-conductors, thin films and complex fluids.</td>
</tr>
<tr>
<td>Mechanics</td>
<td>is the branch of science that explains how masses behave when subjected to the effects of force and displacement. It includes Kinematics, Projectiles, Velocity and acceleration, Newton’s Laws, Collisions, Rotational Motion and Fluid Mechanics.</td>
</tr>
<tr>
<td>Mechatronics and Robotics</td>
<td>integrates electronics, control and mechanics in the study and design of electromechanical systems, such as robots, to solve problems.</td>
</tr>
<tr>
<td>Field</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Optics</td>
<td>is the study of a part of the electromagnetic spectrum (specifically the infrared, visible, and ultraviolet light) as well as the devices used to measure, detect and produce this spectrum, for example photometers and lasers.</td>
</tr>
<tr>
<td>Theoretical Physics</td>
<td>is the description of natural phenomena in mathematical form.</td>
</tr>
<tr>
<td><strong>13. SOCIAL SCIENCES (SOC)</strong></td>
<td></td>
</tr>
<tr>
<td><em>A branch of science that deals with the study of humans; their behaviour, interpersonal relationships, institutions and functioning within society.</em></td>
<td></td>
</tr>
<tr>
<td>Anthropology</td>
<td>is the study of people, their evolutionary history; as well as how they behave and adapt to different environments; communicate and socialise with one another.</td>
</tr>
<tr>
<td><strong>Education Studies.</strong></td>
<td><em>Education</em> is the process of facilitating learning, or the acquisition of knowledge, skills, values, beliefs, and habits. <em>Education Studies</em> looks at ways to promote the analytical, critical and logical aspects of learning, leading to overall growth and development of an individual. Educational methods include e-learning, inquiry based learning, discovery learning, storytelling, discussion etc. Studies include a focus on the various teaching and learning pedagogies. Research in this field includes the types, uses and efficacy of various educational resources including manipulatives such as geoboards, blocks to illustrate shape and space, tangrams etc.</td>
</tr>
<tr>
<td>Human Behaviour</td>
<td>relates to how humans act and interact based on factors such as culture, tradition, values, and attitudes, etc. It looks at human interpersonal relationships and interactions.</td>
</tr>
<tr>
<td><strong>Ekistics</strong></td>
<td><em>Ekistics</em> is the study of the various types of human settlements, including regional, city, community planning and dwelling design. This study draws from the vast areas of geography, ecology, human psychology, anthropology, culture, and aesthetics. Settlements can be as small as one house or large as a megacity.</td>
</tr>
<tr>
<td>Psychology</td>
<td>is the study of the mind and our behaviour. It integrates science, theory, and practice in order to understand, predict and relieve problems whilst promoting adaption, and personal development. There are a number of fields of psychology such as Clinical psychology, Child psychology and Developmental psychology, Cognitive psychology, Social psychology and Educational psychology.</td>
</tr>
</tbody>
</table>
APPENDIX D: PLAGIARISM FORM

DEFINITION OF PLAGIARISM

Plagiarism is the act of presenting someone else’s work or ideas as your own; without their consent; by incorporating it into your work without full acknowledgement. This includes all published and unpublished material whether in printed or electronic; in the form of text, computer codes, illustrations, photographs, graphs; from books, the world wide web; journals; data; lectures etc.

I/We declare that,

• I/we know what plagiarism is and what constitutes plagiarism,
• this research study is my own work,
• in this research study, other people's work is acknowledged and all sources of information is referenced.

Signed,

PRINT NAME/S
1. ________________________________________________________________
2. ________________________________________________________________

SIGNATURE/S:
1. ________________________________________________________________
2. ________________________________________________________________

Date: ____________________________ Region: ______________________________

This Plagiarism declaration document must be signed and presented at the Science Fair, as a compulsory requirement of the Official Document File.
APPENDIX E: RESEARCH PLAN

Do you have a mentor/supervisor/teacher/resource person to guide and support you?
In which of the four project types listed below, does your research project fit?
Select one of the four project types listed below.

Complete the appropriate Research Plan Template contained in this document, below.

Delete all other Templates, including this page.

1. Scientific Investigations /Experimental
   • Scientific Investigative projects follow the scientific method to test a hypothesis, usually through observations and experimentation. This involves collecting and analysing data to reach a conclusion.

2. Engineering Type Projects and Computer Science Projects
   • For these types of projects, a design process is followed according to criteria, to build and test-redesign-retest a prototype/product/solution e.g. a device or a computer code.

3. Social Sciences Projects
   • Social Sciences research involves an objective and systematic method of exploring and analysing human behaviour, social issues and other phenomena. It involves collecting qualitative and/or quantitative data.

4. Mathematics/Theoretical Projects
   • Mathematics projects explore quantity, structure, space and change. Starting with an observation, problem or question, make conjectures/hypotheses, prove your claim using new or existing methods, make valid deductions and test your ideas theoretically. Your reasoning and arguments must be logical.
Scientific Investigations/Experimental

NAME: ________________________________________________________

PROVISIONAL PROJECT TOPIC: _________________________________

PROVISIONAL EXPO CATEGORY: _______________________________

Delete all guidelines under the following headings once you have completed your Research Plan

Introduction
• Introduce the topic. What concepts/definitions will you be using?
• Briefly mention your background reading/literature review here.
• What are the benefits/significance of doing this research/who will benefit? Why are you doing this research?
• What research has already been done? How will your research be different/new/innovative?

Problem Statement: What problem/issue will you be addressing? Write the research question(s) or problem statement.

Aim: What is the aim/objective of this research project?

Hypothesis: Is a statement or claim about something that can be tested scientifically. Your research will test the hypothesis to accept/reject it or see whether it is correct/incorrect. Your hypothesis must be clear, simple and testable.

Variables: List the independent, dependent and the controlled/fixed variables

Method
1. Materials:
• List the materials and equipment you will use

2. Procedure:
• A step-by-step description of how you will use the materials/equipment to answer your research question/solve the problem/test the hypothesis
• How will you collect and record the data? How will you analyse the data?
• How will you ensure safety when conducting the experiments (research involving hazardous materials and procedures must be done in a laboratory under adult supervision)?
Time Frames:
- This is your project work plan. Write down the dates when you will be doing each of the steps above, including the Literature Review.
- State the dates when you will periodically report to your teacher/mentor on your progress and seek guidance. Finally, state when you will write up your Project Report and complete the Poster.

References:
- List a minimum of three references (e.g. science journal articles, books, internet sites) that you used to get information about your topic using the “Harvard” Referencing method.

Remember to:
Read Eskom Expo’s guidelines on Project Approval and Ethics (what research is not allowed) and Plagiarism.
Sign the Plagiarism Form.
Keep a Journal/Data Book to record all your thoughts, observations, data, and rough work.

Teacher’s/Mentor’s comments and suggestions:

Teacher’s/Mentor’s name, signature and date:
Engineering/ Computer Science

NAME: ________________________________________________________

PROVISIONAL PROJECT TOPIC: _________________________________

PROVISIONAL EXPO CATEGORY: _______________________________

Delete all guidelines under the following headings once you have completed your Research Plan

Introduction
- Introduce the topic. What concepts/definitions will you be using?
- Briefly mention your background reading/literature review here. What are the benefits/significance of doing this research/who will benefit? Why are you doing this research?
- What research has already been done? How will your design be different/new/innovative?

Need or Problem Defined: What need/problem will you be addressing/fulfilling with your design or invention? Who is your target user?

Aim: What is the overall aim/objective of this research project?

Engineering Goals or Design Goals or Algorithms: What is/are the primary goal(s) you want to achieve with your prototype/design/solution? Your goals will help you to “test” the functionality of your design/solution.

Method
1. Materials:
   - List the materials and equipment you will use

2. Procedure:
   - Design Criteria:
     - These are the specific requirements of your design/solution/program
     - Examples of these are costing, availability of supplies, power output, weight, storage/construction space, timeframe/time available for design and testing, performance goals/tasks, durability, style/appearance factors etc.
   - A step-by-step description of how the materials/equipment will be used to build your prototype/solution and achieve your Engineering/Design Goals and Algorithms. The procedure must also take into account the design criteria outlined above.
   - How will you test the prototype/solution and record the results?
   - How will you ensure safety when building and testing the prototype/solution? Research involving hazardous materials and procedures must be done in a laboratory under adult supervision.
3. Preliminary Designs:
   • Include labelled diagrams (include scale, measurements with units) of the first prototype/solution and descriptions of the design ideas.

Time Frames:
   • This is your project work plan. Write down the dates when you will be doing each of the steps above
   • State the dates when you will periodically report to your teacher/mentor on your progress and seek guidance.
   • When you will write up your Project Report and complete the Poster?

References:
   • List a minimum of three references (e.g. science journal articles, books, internet sites) that you used to get information about your topic using the “Harvard” Referencing method.

Remember to:
Read Eskom Expo’s guidelines on Project Approval and Ethics (what research is not allowed) and Plagiarism.
Sign the Plagiarism Form. Keep a Journal/Data Book to record all your thoughts, observations, data, and rough work.

Teacher’s/Mentor’s comments and suggestions:

Teacher’s/Mentor’s name, signature and date:
Introduction
• Introduce the topic. What concepts/definitions will you be using?
• Briefly mention your background reading/literature review here.
• What are the benefits/significance of doing this research/who will benefit? Why are you doing this research?
• What research has already been done? How will your research be different/new/add new knowledge?

Problem Statement: What problem(s)/issue will you be addressing/exploring?

Aim: What is the aim/objective of this research project?

Research Question(s): The Research Question(s) help focus the study and guides the methodology. It must be clear, concise, and answerable by your research (must not be a Yes or No answer).

Hypothesis: Is a clear, concise statement or claim about something, that can be tested scientifically. Your research will test the hypothesis to accept/reject it or see whether it is correct/incorrect.

Variables: If your study involves cause and effects, list the independent, dependent and the controlled/fixed variables. Variables must be measurable.

Method
• What is the overall design of your research e.g. Case Study, Descriptive Study, Experimental (cause and effect)?
• How will you collect your data e.g. through observations, interviews?
• What instruments will you use to collect the data e.g. Survey Form, Questionnaire
• Will you be using different instruments to answer the same questions, to cross-check if your data is reliable?
• Describe the sample: how many participants will be studied (sample size)? Who is your target group and is it representative of the larger population? Where are they located? What age groups, gender etc. will be studied? How will you select the sample? Will it be random or deliberate? How will you analyse and represent the data? Will you use statistics, descriptions with tables, graphs

Ethics
• How will you ensure that your research is ethical?
• Did you get permission to conduct the study e.g. from the Principal?
• You need to inform the participants, in writing about what the study entails, why you are doing it, and when and how the information will be used.
• The participants need to sign a letter stating that they give you consent to do the study.
• How will you ensure confidentiality e.g. delete/block out names, contact details and other personal information?

Time Frames (Project work plan)
• The dates when you will: be doing each of the steps above and periodically report to your teacher/mentor on your progress. Finally, state when you will write up your Project Report and complete the Poster.

References:
• List a minimum of three references (e.g. science journal articles, books, internet sites) that you used to get information about your topic using the “Harvard” Referencing method.

Remember to:
Read Eskom Expo’s guidelines on Project Approval and Ethics (what research is not allowed) and Plagiarism. Sign the Plagiarism Form. Keep a Journal/Data Book to record all your thoughts, observations, data, and rough work.

Teacher’s/Mentor’s comments and suggestions:

Teacher’s/Mentor’s name, signature and date:
Mathematics/Theoretical

NAME: ________________________________________________________

PROVISIONAL PROJECT TOPIC: ________________________________

PROVISIONAL EXPO CATEGORY: _______________________________

Delete all guidelines under the following headings once you have completed your Research Plan

Introduction
Introduce the topic. What concepts/definitions will you be using?
• Briefly mention your background reading/literature review here.
• What are the benefits/significance of doing this research/who will benefit? Why are you doing this research?
• What research has already been done? How will your research be different/new/innovative?

Problem Statement: What problem/issue will you be addressing? Write the problem statement

Research Question(s): The Research Question(s) help focus the study and guides the methodology. It must be clear, concise, and answerable by your research (must not be a Yes or No answer)

Aim: What is the aim/objective of this research project?

Hypothesis/Conjecture: Is a statement or claim about something that can be tested scientifically. Your research will test the hypothesis to accept/reject it or see whether it is correct/incorrect. Your hypothesis must be clear, simple and testable.

Definitions and Concepts:
Define terminology and concepts you will be using

Method
• Provide a description of how you will use your observations/existing information/existing methods etc. to argue or prove your hypothesis/conjecture and answer the Research Question
• Which theorems/proofs/method will you be using?
• How will you minimise errors?
• How will you test your solution e.g. through working out examples?
Time Frames:

- This is your project work plan. Write down the dates when you will be doing each of the steps above, including a Literature Review.
- State the dates when you will periodically report to your teacher/mentor on your progress and seek guidance. Finally, state when you will write up your Project Report and complete the Poster.

References:

- List a minimum of three references (e.g. science journal articles, books, internet sites) that you used to get information about your topic using the “Harvard” Referencing method.

Remember to:
Read Eskom Expo’s guidelines on Project Approval and Ethics (what research is not allowed) and Plagiarism. Sign the Plagiarism Form. Keep a Journal/Data Book to record all your thoughts, observations, data, and rough work.

Teacher’s/Mentor’s comments and suggestions:

Teacher’s/Mentor’s name, signature and date:
APPENDIX F: PROJECT REPORT GUIDELINES

Pages should have 2.5-cm margins. It is preferable to use 12-point Sans-serif fonts that are easy on the eyes, i.e. Gill Sans MT, Times New Roman. Use 1.5-line spacing. Include page numbers on the bottom centre or right corner of each page. Spelling, grammar usage and punctuation should conform to the Oxford English Dictionary for UK English (not US English).

Paragraphs are useful tools for separating and organising your ideas. Different ideas should be split into separate paragraphs and common ideas should be grouped in the same paragraph. Your paragraph should have a topic sentence which gives the reader an indication of what to expect in that paragraph. If you present two hypotheses/engineering goals in the Introduction, then you should deal with those hypotheses/goals in the same order in the Methods, Results, and Discussion sections.

REMEMBER: Plagiarism is cheating by claiming someone else’s work as your own. Don’t do it!

A guide/template on how to write a project report to bring to the Eskom Expo Science Fair. It gives detailed instructions, that you need to read and follow. Ask your teacher if you do not understand any part of this section of the report guide.

All reports must have a cover page (see next page)
Delete all guidelines under each heading once you have completed your Project Report

PROJECT TITLE: ...

SUBTITLE (if applicable) ...

First Name(s):
Surname:
Category:
Province and Region:
School:
Grade:

(Cover page: All projects reports must have a cover page with the above details)
Scientific Investigations/Experimental

Writing Style/ Format

Abbreviations
Use abbreviations sparingly and only if they will save substantial redundancy throughout your project report. Adding abbreviations (particularly abbreviations that are common in your choice of category) can make your writing more concise, but overuse simply adds confusion. Be sure to define abbreviations in full at first use by writing out the term in full, and then placing the abbreviation in parentheses; e.g., basal metabolic rate (BMR), body temperature ($T_b$). Do not begin a sentence with an abbreviation.

Scientific names of organisms
All organisms have common and scientific names and must be both named at first mention e.g. “African Lion (Panthera leo) specialising on marine diet…” You then choose which one to use and be consistent throughout the report. If you choose to use the scientific name, at first mention, the scientific name of the species must be written in full, and italicised and when mentioned subsequently you must use the first letter of the genus followed by a full stop, followed by species name e.g. “Behavioural characteristics of P. leo make…” Never start a sentence with an abbreviated scientific name. The genus name always starts with a capital letter and species name is in small letters. If you are discussing organisms of more than one genera which share a common initial letter, you need to always write the full names to avoid confusion e.g. “Panthera leo and Puma concolor exhibit similar…”

Plant names also follow the binomial nomenclature, however, in plants, you can also get subspecies (subsp.) and within subspecies, we get varis (var.). For example, the umbrella thorn acacia (Vachellia tortilis) has four subspecies, and these must be written like this: Vachellia tortilis subsp. heteracantha; Vachellia tortilis subsp. raddiana; Vachellia tortilis subsp. spirocarpa; Vachellia tortilis subsp. tortilis – notice ‘subsp.’ is not italicised. There are two varieties of Vachellia tortilis subsp. raddiana and these must be written like this: Vachellia tortilis subsp. raddiana var. pubescens; Vachellia tortilis subsp. raddiana var. raddiana – notice ‘var.’ is also not italicised.

Numbers
Write out numbers smaller than 10 in letters and use numerals for numbers 10 and more. However, use numerals only when numbers are being compared e.g., “We captured 3, 7, 14, and 17 bats on subsequent nights” or if the numerals are accompanied by units of measurement e.g. “3 kg, 9 cm”. In addition, do not start a sentence with a number:

Tables and figures
Tables must have a title (above the table) and figures must be accompanied by a caption (below the figure). Both tables and figures must be referred to in the
text. Thus, provide a brief description of the data and the column headings, and be sure to explain any abbreviations you use. When planning your figures, begin by deciding what the figure should look like. Normally, one places the independent variable (i.e., perceived to be causing the relationship) on the X-axis and the dependent or response variable (i.e., perceived to be affected by the independent variable) on the Y-axis.

If both variables are continuous (e.g., measurements, counts, time), a line graph is appropriate.
If the X-axis is categorical (e.g., male/female, juvenile/yearling/adult, low/medium/high treatments of an experiment), then a bar graph is appropriate.
Each graph should have values along the X and Y axes, clear labels for each axis (with units), and a complete description below it.

Introduction
In the introduction, just present a brief overview, sufficient to establish the need for your research. This tells the reader what the report is about. It sets the project in its broader context, identifies and explains the motivation of the project. It ranges between two to four pages. Never put your findings or decisions in the Introduction.

Literature Review
Briefly review relevant literature (e.g., journal articles, books, technical reports, etc.) to orientate the reader. You present an overview of what is known about the research project. In doing so, you will read previous and recent research done around your project and write what is most relevant to it. As you near the end of the literature review (i.e., at the beginning of the last paragraph), identify the important gap that you are trying to fill. You need to build up to why you are doing this research project.

Problem Statement
Based on the gaps/knowledge you found in the literature review, clearly write either a problem statement or phenomena. Give a basic statement of the problem or explain the importance of the phenomena.

Aim
State your aim clearly and concisely.

Research Question or Hypothesis
Clearly state the research question you want to answer or your hypothesis.
**Method**
The method section describes what you did, why you did it and how you did it. This section must explicitly explain how you went about testing the hypothesis, solving the problem or understanding the phenomena. Describe your methods in enough detail so someone else could replicate your project. In other words, anyone should be able to follow your methods to verify or refute what you found. Briefly explain the rationale for the measures you made. This section is written in the past tense.

**Variables**
List your variables.

**Materials**
List the materials and apparatus you used for your project. Don’t mention brand names.

**Experimental design**
In this section, you need to describe your experimental design. Include descriptions of all treatments and variables and provide the number of replicates you used. Identify each treatment using a descriptive name (e.g. Temperature at 35°C), rather than generic names or numbers (e.g., Treatment 1). Make sure that the experimental conditions are adequately described. Tables are often useful for describing the experimental design and flow diagrams for sequential protocols. Among the details to be included in this section, most important are the quantitative aspects of your study (e.g., masses, volumes, incubation times, concentrations in lab experiments, etc.). Avoid using brand names when doing your project. Instead, use generic names e.g. the sugar levels between brand 1 and 2 were compared.

**Results**
The overall purpose is to describe patterns, not to explain or interpret them. Think of the Results section as telling a story about what you found when conducting your tests. Start with a basic summary of the data, not statistical results. For example, - We caught a total of 50 rodents over 10 trap days for an overall trapping rate of 25%. Of these 50 rodents, 19 were females and 31 were male. You might also provide basic natural history data relevant to your study, how they might have changed over time, or how they differed between treatments/study areas. You need to set the context within which the data was collected. That will help the reader to understand the data more fully.

Results should be presented in a way that it aligns with the hypothesis/research questions. Begin by thinking about what information the reader will need to assess whether you achieved your aim or not. It should be presented in a form that is easy to read, which usually means putting it in a graph or a table.
Discussion
The discussion interprets patterns you found. Explain why you found what you found, backing it up with relevant literature. This is done by reviewing and comparing literature. Literature used must be cited and referenced (see referencing guide, Appendix J). How are they similar or different? Why might there be differences between your research and others?
It explains what the patterns mean (i.e., why you found the results you did). The discussion is an important part of your project and must be substantive.

Limitations and errors
Briefly describe any errors in your testing that may have influenced your overall results. What were the limiting factors?

Recommendations for Future Research
Make concrete suggestions about how this project could be extended.

Conclusion
Clearly state your conclusion and importantly, be sure to address the importance of your work. Write your conclusions to address one all-important question: - So what? What is the overall importance of the results? Why should anyone care? You must refer to the hypothesis and to the most important results and you must state whether your hypothesis is supported or rejected.

Acknowledgments
Any person who made a direct contribution to the study should be acknowledged. If applicable, funding sources should be mentioned.

References
Referencing is a way to validate that you have done further reading, learning and comprehension by using relevant sources. Eskom Expo for Young Scientists uses the Harvard format for referencing. Formatting has to be consistent throughout the report.

Appendix
An appendix is placed at the end of your report, because the full version is either inappropriate or too detailed for the body of the report. There may be more than one appendix, in which case the series is called the appendices. When you mention the content in your appendix, you must name it in the text, e.g. Appendix 5.
Engineering/Computer Science

Writing Style/ Format

Abbreviations
Use abbreviations sparingly and only if they will save substantial redundancy throughout your project report. Adding abbreviations (particularly abbreviations that are common in your choice of category) can make your writing more concise, but overuse simply adds confusion. If you are to use acronyms in your report, you need to tabulate the list of the acronyms along with the full names, at the beginning of the report. Do not begin a sentence with an abbreviation.

Tables and Figures
Tables and figures form part of what you say in the paragraph(s). They are accessories to the text. You cannot just put a table or figure anywhere and always refer to them in text e.g. “Viscosity decreases with increasing temperature as shown in Figure 1…” Whenever you refer to tables and figures in the paragraph(s), you need to be clear about what you are determining from them and why. Both should be able to stand alone and make sense to the reader. Tables and figures should have an appropriate title/captions and labels with correct units.

Titles and captions
Tables have a title at the top and figures have captions at the bottom which describes the purpose for which it has been presented (e.g. “Table 1: Measurements of the width of the cylinder” and “Figure 1: The viscosity of oil at different temperatures”). Table and figures are usually referenced by a number and should be numbered in sequence, e.g. Table 1, Table 2… Figure 1, Figure 2, etc.

Labelling of graphs
Label your axes so that the reader knows what scale points are plotted on the graph and specify units for quantities.

Introduction
In the introduction, just present a brief overview, sufficient to establish the need for your project. It sets the project in its broader context, identifies and explains the need/ motivation for the project. It ranges between two to four pages. Never put your results or conclusion in the Introduction.

Literature Review
Briefly review relevant literature (e.g. journal articles, books, technical reports, etc.) to orientate the reader. You present an overview of what is known about the research project. In doing so, you will read previous and recent research done around your project report and write what is most relevant to it.
As you near the end of the literature review (i.e., at the beginning of the last paragraph), identify the important gap that you are trying to fill. You need to build up to why you are doing this research project.

**Problem Statement**
Based on the gaps/knowledge you found in the literature review, you lead up to the need. Based on the need you identified, state the problem statement/phenomena, as clearly as possible.

**Aim**
Clearly and concisely state your aim.

**Engineering goals or Design goals**
Clearly state the engineering goal/design goal. These are linked to solving the problem and filling the knowledge gap identified.

**Method**
The method section describes **what** you did, **why** you did it and **how** you did it. This section must explicitly explain how you went about testing the engineering/Design goals, to solve the problem. Describe your methods in enough detail that someone else could replicate your project. In other words, anyone should be able to duplicate your methods to verify or refute what you found. Briefly explain the rationale for the measures you made. This section is written in the past tense.

**Materials**
List the apparatus that you used for your project.

**Procedure**
In this section, you describe the series of repeatable steps that you took in creating and testing a functional prototype/process/solution.
**Engineering Method**
Engineering projects include multiple designs, you build, test, find new problems, make changes and test again (design-test-redesign-retest) before you can settle for a final design. For a clear transition between the designs, you need to mention the earlier designs (minimum two) and evaluations of the prototypes/processes that you did to eventually get to the final one. However, the full details of the initial prototype must be in the appendix. In this section, we are interested in the final design details. The final prototype/final process with the most desirable features, fewest negative characteristics and stays within the limitations of the need you identified.

**Planning**
The prototype/process design must be appropriately presented in this section. This can be done visually through drawings/flow diagrams (These can include circuit diagrams, system drawings, technical plans, drawing blueprints, etc.) and must include all the necessary measurement units. Mention the name of the program used for the visual representations.

**Creating**
A detailed step by step description of how you built your prototype/developed a process

**Testing and Evaluating**
Testing is the way a prototype/process under development is evaluated for correctness and robustness and is proved to meet the stated goals. It is done at each stage of creation and has characteristics unique to the level of the test being performed.
This section includes the quantitative aspects of your project. The prototype/process components are compared against requirements and specifications through tests. The results from these tests can be represented graphically or in a table. The results are then evaluated to assess the progress of design/process (performance, supportability, etc.)

*If your project involves programming, the code must be in the appendix.*
**Computer Science Method**

When computing data, you need to mention the type of programming language you will be using for the different interfaces and the parameters/fields that will help in fulfilling the need. Flow diagrams are useful for describing computational designs.

**Developing**

A step by step description of how you are developing a model to meet a certain need. The computational language used must be appropriate for what you want to achieve; taking into consideration the parameters/arguments/features that will determine whether the solution will meet basic requirements.

**Testing**

Testing is the way a model/solution under development is evaluated for correctness and robustness and is proved to meet the design goal. It is done at each stage of development and has characteristics unique (parameters/arguments/features) to the level of the test being performed.

The parameters/arguments/features are very important in the testing of your program/solution. If any modifications are made on the parameters/arguments/features, provide details on how they were changed and how this affected the solution. This can be presented in a table/graph. It is necessary to analyse and choose from two or more alternative approaches to test and evaluate the feasibility of your program/solution.

**Results**

The overall purpose is to describe patterns, not to explain or interpret them. Think of the Results section as telling a story about what you found when conducting your tests. You need to set the context within which the data was collected. That will help the reader to understand the data more fully.

Results should be presented in a way that it aligns with the engineering/design goals. Begin by thinking about what information the reader will need to assess whether you achieved your aim or not. It should be presented in a form that is easy to read, which usually means putting it in a graph or a table.

**Discussion**

The discussion interprets patterns you found. Explain why you found what you found, backing it up with relevant literature. This is done by reviewing and comparing literature. Literature used must be cited and referenced (see referencing guide, Appendix J). How are they similar or different? Why might there be differences between your project and others?
It explains what the patterns mean (i.e., why you found the results you did). Emphasize the strengths rather than the weaknesses of your prototype/solution.

**Limitations and errors**
Briefly discuss all the things that affected your measurement but which you could not control because of certain constraints. This includes sources of errors you have identified and how it affected your results.

**Recommendations for Future Research**
Make concrete suggestions about how this project could be extended.

**Conclusion**
Clearly state your conclusion, and briefly summarise your evidence for each conclusion. Most importantly, be sure to address the significance of your work. Write your Conclusion to address one all-important question: -So what? What is the overall importance of the results? Why should anyone care? State whether or not your engineering/design goal.

**Acknowledgments**
Any person who made a direct contribution to the project should be acknowledged. If applicable, funding sources should be mentioned.

**References**
Referencing is a way to validate that you have done further reading, learning and comprehension by using relevant sources. Eskom Expo for Young Scientists uses the Harvard format for referencing. Formatting has to be consistent throughout the report.

**Appendix**
An appendix is placed at the end of your report, because the full version is either inappropriate or too detailed for the body of the report. There may be more than one appendix, in which case the series is called the appendices. Examples of material suitable for an appendix are a new computer program specifically designed for the research, an unpublished test and its validation, or a list of stimulus materials.
Social Sciences

Writing Style/ Format

Abbreviations
Use abbreviations sparingly and only if they will save substantial redundancy throughout your project report. Adding abbreviations (particularly abbreviations that are common in your choice of category) can make your writing more concise, but overuse simply adds confusion. Be sure to define abbreviations in full at first use by writing out the term in full, and then placing the abbreviation in parentheses; e.g., Schedule for Affective Disorders and Schizophrenia (SADS). Do not begin a sentence with an abbreviation.

Tables and Figures
Tables must have a title (above the table) and figures must be accompanied by a caption (below the figure). Both tables and figures must be referred to in the text. Thus, provide a brief description of the data and the column headings, and be sure to explain any abbreviations you use.

When planning your figures, begin by deciding what the figure should look like. Normally, one places the independent variable (i.e., perceived to be causing the relationship) on the X-axis and the dependent or response variable (i.e., perceived to be affected by the independent variable) on the Y-axis.

If both variables are continuous (e.g., measurements, counts, time) a line graph is appropriate.

If the X-axis is categorical (e.g., male/female, young/old, etc.), then a bar graph is appropriate.

Each graph should have values along the X and Y axes, clear labels for each axis (with units), and a complete description.

Introduction
In the introduction, just present a brief overview, sufficient to establish the need for your project. It sets the project in its broader context, identifies and explains the motivation for the project. It ranges between two to four pages. Never put your results or conclusion in the Introduction.

Literature Review
Briefly review relevant literature (e.g. journal articles, books, technical reports, etc.) to orientate the reader. You present an overview of what is known about the research project. In doing so, you will read previous and recent research done around your project report and write what is most relevant to it. As you near the end of the literature review (i.e., at the beginning of the last paragraph), identify the important gap that you are trying to fill. You need to build up to why you are doing this research project.
Problem Statement or Phenomena
Based on the gaps/ knowledge you found in the literature review, clearly write either a problem statement or phenomena. Give a basic statement of the problem or explain the importance of the phenomena.

Aim
Clearly and concisely state your aim.

Research Question or Hypothesis
Clearly state the research question you want to answer or the hypothesis.

Method
The method section describes what you did, why you did it and how you did it. This section must explicitly explain how you went about testing the research question/ hypothesis, to solve the problem. Describe your methods in enough detail that someone else could replicate your project. In other words, anyone should be able to duplicate your methods to verify or refute what you found. Briefly explain the reasons for the data you collected.

Participants
This section indicates the number of participants that took part, and an indication of their gender, age, and other demographics that may be relevant to the project. Include information on how they were recruited to participate in the project.

Instruments/ Sources
List all the instruments/ sources used for your project. This section is included only if you have the participants filling out questionnaires, or completed tests. Include any observation/interview, schedules and tests (Pre- and Post-, Behavioural and Psychometric). If you use existing data, provide details on where you found it, and give details on how you got permission to use the information.

Procedure
Describe the procedure used. What were the variables (if any)? How were they manipulated? – between or within participants? Describe the procedure in terms of what the participants did, rather than what you did e.g. “the participants, read a set of instructions, completed a block of four practice trials and completed two questionnaires.” Items/questions in data collection method must be related to the aim. Remember to always maintain objectivity. This ensures that you minimise errors and bias.

A sample of the questions asked on the tests/questionnaire must be put in the Appendix section. Also, explain how you maintain confidentiality when reporting on the participants: Identifiers e.g. names, photographs, personal details of participants; must not be used.
Results
The overall purpose of this section is to describe patterns, not to explain or interpret them. Think of the Results section as telling a story about what you found in your questionnaire or interviews. You need to set the context within which the data were collected. That will help the reader to understand more fully the data and analyses specific to your hypothesis/research question.

Results should be presented in a way that it aligns with the hypothesis/research question. Begin by thinking about what information the reader will need to assess whether you achieved your aim or not. It should be presented in a form that is easy to read, which usually means putting it in a graph or a table.

Discussion
The discussion interprets patterns you found, you analyse your results here. Explain why you found what you found, backing it up with relevant literature. This is done by reviewing and comparing literature. Literature used must be cited and referenced (see referencing guide, Appendix J). How are they similar or different? Why might there be differences between your project and others? It explains what the patterns mean (i.e., why you found the results you did). The discussion must be linked to the hypothesis/research question.

Limitations and errors
Briefly describe any errors that affected your measurement but which you cannot do anything about, given certain constraints. This includes sources of errors in your methods that bias your results.

Recommendations for Future Research
Make concrete suggestions about how this project could be extended.

Conclusion
Clearly state your results and importantly, be sure to address the importance of your work. Write your conclusions to address one all-important question: - So what? What is the overall importance of your results? Why should anyone care? You must refer to the hypothesis/question and to the most important results and you must state whether your hypothesis is supported or rejected, or your research question has been answered.

Acknowledgments
Any person who made a direct contribution to the study should be acknowledged. If applicable, funding sources should be mentioned.
References
Referencing is a way to validate that you have done further reading, learning and comprehension by using relevant sources. Eskom Expo for Young Scientists uses the Harvard format for referencing. Formatting has to be consistent throughout the report.

Appendix
An appendix is placed at the end of your report, the full version is either inappropriate or too detailed for the body of the report. There may be more than one appendix, in which case the series is called the appendices. Examples of material suitable for an appendix are a new computer program specifically designed for the research, an unpublished test and its validation, or a list of stimulus materials.
Mathematics/Theoretical

Format and Style

Abbreviations
Use abbreviations sparingly and only if they will save substantial redundancy throughout your project report. Adding abbreviations (particularly abbreviations that are common in your choice of category) can make your writing more concise, but overuse simply adds confusion. Be sure to define abbreviations in full at first use by writing out the term in full, and then placing the abbreviation in parentheses; e.g., arithmetic progression (A.P.). Do not begin a sentence with an abbreviation.

Notations and Numbers
Use standard scientific notation. Think about which subscripts and superscripts would be best to use in the report. Numbers should be written in scientific notation.

1. Numbers whose absolute value is greater than or equal to 0.1 and less than 100 may be written without exponent. e.g. 0.5268
   10.31
2. Numbers whose absolute value falls outside the range less than 0.1 and greater than 100 should be written with an exponent e.g. -1.97x10^5 1.97x10^-11

Most numbers in the theory are associated with units. It is important that the units are shown next to the number written in the correct notation. For example, the average magnitude of the acceleration due to gravity at the surface of the earth is 9.80 m/s^2 or 9.80 m.s^-2. Do not begin a sentence with a number.

Variables and Equations
Variables in text and in equations are often represented by symbols. The symbols must be italicised, however; units and numbers are in normal font. Vectors are in bold font or with arrows above them, and matrices are in bold. Clearly define all variables when they are first used.

Equations should be treated as part of the text. If you use equations taken from a source, reference the source. If the equation is not to be numbered and is small, it can be included in a sentence, it may be placed in the text just like a word (e.g., The energy of a photon is given by $E = \hbar \nu$, where $E$ is the photon energy, $\hbar$ is Planck’s constant and $\nu$ is the frequency of the light).

It is required to number equations that are going to be used continuously. Grammatically, the equation is treated as if it is part of the text. Which is why there
are punctuations such as a comma or full stop at the end of a displayed equation. Use of an equation editor is strongly encouraged e.g.:

\[(x + a)^n = \sum_{k=0}^{n} \binom{n}{k} x^k a^{n-k}\]  

Eq. 1

Refer to all numbered equations in the report and refer to them in text, if you will not be referring to an equation, do not number it.

**Theorems or Corollaries**
Number theorems and corollaries by section. Subdividing the report into title sections enables readers to more easily locate them in the report. For example, “In Theorem 8.1, it was proved…,” – it’ll be easy to for the reader/judge to locate the theorem under that section.

**Tables and Figures**
Tables and figures form part of what you say in the paragraph(s). They are accessories to the text. You cannot just put a table or figure, always refer to them in text e.g. “Viscosity decreases with increasing temperature as shown in Figure 1…”. Whenever you refer to tables and figures in the paragraph(s), you need to be clear about what you are determining from them and why. Both should be able to stand alone and make sense to the reader. Tables and figures should have appropriate title/captions and labels with correct units.

**Titles and captions**
Tables have a title at the top and figures have captions at the bottom which describes the purpose for which it has been presented (e.g. “Table 1: Measurements of the width of the cylinder” and “Figure 1: The viscosity of oil in mm²/s at different temperatures”). Table and figures are usually referenced by a number and should be numbered in sequence, e.g. Table 1, Table 2… Figure 1, Figure 2, etc.

**Labelling of graphs**
Label your axes so that the reader knows what scale points are plotted on the graph and specify units for quantities.

**Introduction**
In the introduction, just present a brief overview, sufficient to establish the need for your project. It sets the project in its broader context, identifies and explains the motivation for the project. It ranges between two to four pages. Never put your results or conclusion in the Introduction.

**Literature Review**
Briefly review relevant literature (e.g. journal articles, books, technical reports, etc.) to orientate the reader. You present an overview of what is known about the research project. In doing so, you will read previous and recent research done around your project report and write what is most relevant to it.
As you near the end of the literature review (i.e., at the beginning of the last paragraph), identify the important gap that you are trying to fill. You need to build up to why you are doing this research project.

**Problem Statement or Phenomena**
Based on the gaps/knowledge you found in the literature review, you lead up to the need. Based on the need you identified, state the problem statement/phenomena, as clearly as possible.

**Aim**
State your aim and it should always be concise.

**Hypothesis or Research question**
Clearly state the hypothesis or the research question you want to answer.

**Method**
The method section must explicitly explain how you went about solving the problem or understanding the phenomena. It describes the mathematical/theoretical techniques you used and thus must be written in the past tense.

**Variables**
State the variables of your research project.

**Procedure**
Explain which procedure you followed, why you chose it and gives a clear step-by-step description of how the procedure was carried out. Give enough detail in this section so that someone else could be able to replicate what you did, in order to verify or refute what you found. For theoretical work describe the theory with basic equations and indicate how such equations are solved. Details of long derivations should be put in the appendix. You need to mention the type of programming software you used e.g. MATLAB, R, Statistica, Wolfram Mathematica, etc. and the variables that will be influencing your data.

**Results**
The overall purpose of this section is to describe patterns, not to explain or interpret them. Think of the Results section as telling a story about what you found when conducting your experiments or theoretical calculations. You need to set the context within which the data were collected. That will help the reader to understand more fully the data and analyses specific to your hypothesis/research question.

Results should be presented in a way that it aligns with the hypothesis/research question. Begin by thinking about what information the reader will need to assess whether you achieved your aim or not. It should be presented in a form that is easy to read, which usually means putting it in a graph or a table.
Discussion
The discussion interprets patterns you found. Explain why you found what you found, backing it up with relevant literature. This is done by reviewing and comparing literature. Literature used must be cited and referenced (see referencing guide, Appendix J). How are they similar or different? Why might there be differences between your project and others? It explains what the patterns mean (i.e., why you found the results you did). What assumptions did you make?

Limitations and errors
Briefly discuss all the things that affect your measurement but which you cannot do anything about, given certain constraints. This includes sources of errors in your assumptions/calculations that bias your results.

Recommendations for Future Research
Make concrete suggestions about how this project could be extended.

Conclusion
Clearly state your conclusion and importantly, be sure to address the importance of your work. Write your conclusions to address one all-important question: - So what? What is the overall importance of your results? Why should anyone care? You must refer to the hypothesis/question and to the most important results and you must state whether your hypothesis is supported or rejected.

Acknowledgments
Any person who made a direct contribution to the project should be acknowledged. If applicable, funding sources should be mentioned.

References
Referencing is a way to validate that you have done further reading, learning and comprehension by using relevant sources. Eskom Expo for Young Scientists uses the Harvard format for referencing. Formatting has to be consistent throughout the report.

Appendix
An appendix is placed at the end of your report, the full version is either inappropriate or too detailed for the body of the report. There may be more than one appendix, in which case the series is called the appendices. Examples of material suitable for an appendix are a new computer program specifically designed for the research, or an unpublished test and its validation.
APPENDIX G: ABSTRACT

Name:  
School Name:  
Grade:  
Region:  
Project Title:  

An abstract is a summary of your project report that you write after you have completed your research AND have written your project report. Your abstract must be clearly written and concise and does not include references/tables/graphs/images. Your explanations must follow a logical sequence. Do not cite references or refer to figures or tables in the Abstract. Write full sentences and not point form. Your Abstract must be displayed at the beginning of your Report File as well as in your Official Documents File. It is written in the third person and in past tense.

This is a Template and a guide to help you write the content. It has compulsory headings, which must be used in your abstract. Abstract must be less than 250 words.

Purpose
Begin by identifying the aim of your research. In many cases, you might begin by stating the question you sought out to investigate and your variables/functions/mathematical relationships. State the Hypothesis (if applicable). For Engineering Projects, what were the Engineering Goals and design criteria?

Method
Briefly describe procedure used. Mention and explain the numerical approaches/equations/assumptions/proofs you used to approach the research question and how you did it (Mathematics) or the engineering/computer science study method used in testing the engineering goal/algorithm (Engineering and Computer Science Projects), that you used to solve the problem. Don’t list materials used but rather mention them while explaining your method. For Social Sciences projects: Describe the participants in the study. State how many participants took part and how they were selected, and the instruments you used to answer the research question.

Results
Give a brief summary of the main results, the ones that align with your aim.

Conclusion
Provide the main conclusion, was the hypothesis accepted/rejected? Was the research question answered. What might your results indicate and what directions does it point to for future research?

Delete all information except the headings in this Template
APPENDIX H: BINDING AGREEMENT

AGREEMENT ENTERED INTO BETWEEN ESKOM EXPO FOR YOUNG SCIENTISTS AND THE FINALIST

The finalist is defined as a school learner who voluntarily enters and exhibits his/her research project at a Science Fair managed by the Eskom Expo for Young Scientists, a registered Non-profit Organisation or appointed third party within the education system.

AGREEMENT

1. I agree to adhere to the Eskom Expo for Young Scientist’s Code of Conduct, which is available at www.exposcience.co.za.
2. I hereby enter into an agreement with Eskom Expo for Young Scientists for the duration of two years, following the International Science Fair competition that I may participate in, whereby Eskom Expo for Young Scientists and Eskom, have the authority to use my project and photographs of myself for publicity purposes, including written materials and social media. I will make myself available and cooperate when contacted, interviewed, photographed and videotaped by the media before, during and after the Science Fair.
3. In order to protect the finalist, no form of media coverage e.g. television, radio, magazines, newspapers, scientific journals, including school media releases etc. will be allowed without the written permission of the Eskom Expo for Young Scientists.
4. The name, Eskom Expo for Young Scientists, must be promoted in all media coverage in any form of presentation.
5. Attendance is mandatory at all ISF events – judging, public day, special awards and prize giving ceremonies. If I am not present at any of these events, Eskom Expo and special awards sponsors have the right to withdraw their medals, special prizes and selection for international participation.
6. In the event that I participate in the International Science Fair, I will be in my own room, allocated by Eskom Expo, no later than 23:00 or as directed by the delegation leader.
7. If I am not present at my project during judging, then I will not be judged. This is also applicable to public viewing and special judging/international selection.
8. The Chief Judge’s decision is final and no discussion or correspondence will be entered into concerning the results.
9. If I am selected or wish to enter any other form of science related activities/competitions nationally and internationally, I undertake to inform Eskom Expo.
10. As part of my commitment to Eskom Expo, I agree to assist with activities
of the organisation, where possible.

I I. I agree that I must not delete or change any part of this document as it will disqualify me from any further participation in any activity managed by Eskom Expo for Young Scientists.

TERMS

As the parent/guardian of the finalist, I acknowledge that I have read, understood and endorse the above agreement on behalf of the finalist, and I accept the following terms:

1. Should I remove the finalist from the care of the delegation leader without permission, or intervene in any way whatsoever during the science fair event, the finalist then terminates all ties with Eskom Expo for Young Scientists.

2. I accept that I shall thereafter become liable for all expenses incurred by the organisation relating to my child’s/ward’s participation in any Science Fair managed by the Eskom Expo for Young Scientists.

In the event of a breach of any of the terms of this agreement, all monies owing to the Eskom Expo for Young Scientists must be paid within fourteen (14) days upon receipt of a written letter of demand.

Signed at ________________________________ on ______day of 20_____

Finalist
Name:_________________________________

Signature: ______________________________

Parent/Guardian
Name:_________________________________

Signature: ______________________________
APPENDIX I: PROJECT APPROVAL FORM

PROJECT NUMBER: ______________________
CATEGORY: ____________________________
NAME (S) OF STUDENT(S): _______________________________________

I. Instructions
Set up your project according to Eskom Expo Guide Book rules. A member of the Project Approval Committee will approve your project. Once approved: sign this Form, get this Form stamped at the Front Desk. Finally place Form in the Plastic Jacket at the front of your table.

II. Inspection by Project Approval Committee (Please tick √ and write instruction if necessary)

<table>
<thead>
<tr>
<th>SECTION 1: WRITTEN INFORMATION</th>
<th>Approved</th>
<th>Not Approved/ Not available</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Project title same as in ISF programme</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2.1 Poster is displayed on Eskom Expo Board</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2.2 Poster meets A4 rule</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3 Acknowledgement for all photographs given: “Photos taken by finalist or urls given below each photo”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.4 No Regional information at ISF including Judging Sheets; Certificates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Files/folders/books (3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5.1 Report File is on table</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5.2 Journal/ Project Data Book is on table</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5.3 ISF Official Documents File on table and contains the following in this order:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Abstract displayed on table</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Research Plan signed by teacher</td>
<td></td>
<td></td>
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<tr>
<td>• Plagiarism Form</td>
<td></td>
<td></td>
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<tr>
<td>• Binding Agreement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Permission Letters for surveys / scientist supervision (if applicable)</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>SECTION 2: SAFETY</th>
<th>Not applicable/ Approved</th>
<th>Not Approved</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Electrical items comply with safety rules (wiring, no overload, all unplugged)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2 No models on floor</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### SECTION 3: ETHICAL VIOLATIONS

<table>
<thead>
<tr>
<th>Remove the following immediately</th>
<th>No Violation</th>
<th>Violation</th>
<th>Action needed (if there is a violation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 Brand names or branded products e.g. Coca Cola, Facebook, Raspberry Pi, JoJo tank, Duracell, Aquelle, Microsoft, KFC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2 Living organisms including animals, plants, fungi, bacteria</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.3 Human or animal parts e.g. hair, nails, foetuses, organs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.4 Agar plates or other growth mediums</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3.5 Dangerous chemicals e.g. medicines, drugs, acids, paints</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.6 Flammable substances e.g. petrol, oil, paraffin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.7 Wood (unless treated)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.8 Hazardous substances or devices e.g. weapons, knives</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.9 Inappropriate photographs e.g. photos of operations, nudity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.10 Unsealed water or food (must be in a transparent container and additionally sealed with tape)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### III. APPROVAL

**A. PROJECT APPROVED: No Further Action is Necessary**

If the Project is APPROVED with no problems, tick here: __________________

Approved by:  Name (print): _______________________Signature: ____________________

**B. PROJECT NOT APPROVED: Further Action is Necessary**

Issued by:  

Name (print): _______________________Signature: ____________________

Brief description of Violation: ________________________________________

Forbidden Item(s):  ______________________________________________

Accepted by Venue Manager (name and signature):

_______________________________________________________________

**C. FINAL PROJECT APPROVAL AFTER CORRECTION OF VIOLATION**

Approved by:  Name (print): _______________________Signature: ____________________

**D. FINALIST SIGNATURE(S) (Sign, get Stamp & place in plastic jacket on table, throughout Expo)**

I/we understand that the initial Project Approval check has been completed but additional reviews may occur during judging. I/we undertake to obey the instructions of the Project Approval Committee, for example, **forbidden items will not be returned to the project after final approval**

Finalist signature: _________________ Date:_______________________

Finalist signature: _________________ Date:_______________________
APPENDIX J: REFERENCING GUIDE

Referencing is very important as it acknowledges the person or people who are the rightful owners of the information you use in your project report. It is a way to validate that you have done further reading and you give credit for the various sources used when writing a report. The sources (books, articles, websites, etc.) that are used for your project report has to always be referenced.

Why reference
Provide references to:
- Acknowledge intellectual owners of the information you used in your report
- Support/ proof for claims made in your report
- Give credibility to the work you have done
- Help the reader/judge to locate sources used
- Show judges that you have read substantially
- Avoid plagiarism

When to reference
Provide references when you:
- Write someone's ideas as your own
- Summarise someone's ideas
- Use data / information from a source
- Use tables, pictures, figures, diagrams or graphs from a source

How to reference
There are a few standard referencing styles, however, at Eskom Expo for Young Scientists when referencing your work, you need to make use of the Harvard format. This guide provides more detail with regards to specific examples of how you might use the Harvard style of referencing in your research plan/ research report. There are two types of referencing (i) in-text referencing, found in the main body of your project report and (ii) Reference list or Bibliography, found at the end of your project report.

In-text referencing
In-text referencing is used when directly quoting for example, “Water is a basic necessity” (Miya, 1980) or rewording an idea from a source, for example, Research done by Miya (1980) proves that water is a basic necessity. They are mostly used, but not limited to the Introduction and the Discussion sections.
**Reference List**
The reference list contains the full citations of all the in-text references you mentioned within your report and is located at the end of your project. A reference list should include any documentation that is not one’s own. All sources should be arranged alphabetically according to the surname of the first author.

## I. Books

<table>
<thead>
<tr>
<th>In-text reference</th>
<th>Reference List</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only author’s surname (s) and write the year in brackets OR both the author’s surname (s) and the year in brackets, separated by a comma,</td>
<td>Author surname, Initials. Year. <em>Title of Book</em>. Edition (if not the first edition). City of Publication: Publisher</td>
</tr>
<tr>
<td><strong>Books:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>One or two author(s)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Three or more authors</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Referencing of a chapter in a book</strong></td>
<td></td>
</tr>
<tr>
<td>It is very important that you add a page number when referencing a chapter in a book.</td>
<td></td>
</tr>
<tr>
<td>Only author’s surname (s) and write the year in brackets OR both the author’s surname (s) and the year in brackets, separated by a comma,</td>
<td>Author surname, Initials. Year. Chapter title. In Editors (Ed.) <em>Book Title</em>. City of publication: Publisher: (Page).</td>
</tr>
</tbody>
</table>
## Multiple books by the same author

<table>
<thead>
<tr>
<th>Author/Year</th>
<th>Title and Details</th>
</tr>
</thead>
</table>

## Articles:

### In-text reference

**Only author's surname and write the year in brackets OR author's surname and the year in brackets, separated by a comma,**

### Reference List

**Journal Articles:**

- **Author known – one/ two author(s)**

- **Author known – more than two authors**
  - Govender et al. (2006) / (Govender et al., 2006)

### Two/ more articles by the same author(s), in a single year

Assign letter suffixes (a, b, c, d, etc.) to the year and arrange the titles alphabetically.


**Theses and Dissertations**


**Magazine/ Newspaper Articles:**

**Daily Newspaper / Monthly Magazine articles (Hardcopy)**

Masipa (2019) / (Masipa, 2019)


**Online Newspaper Articles: with author**

Malsang (2019) / (Malsang, 2019)


**Online Newspaper: no author**

(“Teen dagga usa”, 2019)

### 3. Images/Visual Mediums

<table>
<thead>
<tr>
<th>In-text reference</th>
<th>Reference List</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using acronyms: It is usual practice to specify the full name of an organisation the first time it is used, followed by its abbreviated name in brackets. After this it is acceptable to use the acronym only.</td>
<td></td>
</tr>
</tbody>
</table>

#### Images

**If you are the photographer**

Do not include in the Reference list. Under the photograph, write Figure and a number. In your writing, refer to the photograph by figure number, e.g. Figure 1 illustrates…

#### With Author

<table>
<thead>
<tr>
<th>Burden (2016) / (Burden, 2016)</th>
<th>Burden, A. 2016. <em>Fountain pen on black lined paper</em> [Image]. Available at: [<a href="https://unsplash.com/photos/y02jEX_B0Q0">https://unsplash.com/photos/y02jEX_B0Q0</a>] [Viewed 21 June 2019].</th>
</tr>
</thead>
</table>

**No Author**

|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

#### Illustrations and Diagrams

|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

#### Blogs

|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

#### Online Videos (YouTube)

|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

#### Email
<table>
<thead>
<tr>
<th>Only author’s surname(s) and write the year in brackets OR both the author’s surname(s) and the year in brackets, separated by a comma,</th>
<th>Sender’s Last name, First initial. Year: Subject Line of Email. [email].</th>
</tr>
</thead>
</table>

### Social Media

<table>
<thead>
<tr>
<th>Only author’s surname (s) and write the year in brackets OR both the author’s surname (s) and the year in brackets, separated by a comma,</th>
<th>Author’s surname, Initial. Year: Title of page [Social media format]. Day/month/year written. Available from: URL. [Accessed: Day/month/year]</th>
</tr>
</thead>
</table>

### Acts


### Policy Documents: White/ Green Papers


### Media Release


### Treaties, Declaration & Charters

Note: Charter or treaties signed by a country, international governmental organisation or groups of countries are listed under the name of the organisation or country.

### Quotes

**Short quotes**

If your quotation is fairly brief - up to two lines, say - you should place it in quotation marks within your own paragraph. Author’s surname, year and page number are shown in brackets immediately following the quotation.

**Long quotes**

Longer quotes should: be preceded by a colon, be indented from the main text, not have quotation marks and cite the author, year and page number. **Note** that the author details are right-justified, and only the year and page number are in parentheses.

### Useful Links

[Harvard Style (Beginners, Intermediate and Advanced Tutorials)](https://example.com)
## GLOSSARY

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Aim</strong></td>
<td>Purpose for doing your research project, emphasises what is to be accomplished. Usually stated ‘the aim of this project is… to develop, to establish, to build, to understand…’</td>
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<tr>
<td><strong>Algorithm</strong></td>
<td>An unambiguous process or set of rules to be followed in calculations or other problem-solving operations.</td>
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<tr>
<td><strong>Arguments</strong></td>
<td>In computer science: a value that is passed between programs or functions and are variables that contain data or codes. In mathematics: an input to a function, usually the independent variable, e.g. ( f(x;y) = x^2 + y^2; ) ( x ) and ( y ) are arguments.</td>
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<tr>
<td><strong>Branded products</strong></td>
<td>These show the name of an item e.g. BMW and these names should not be visible in any Eskom Expo report or poster and should be replaced by Brand A etc.</td>
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<tr>
<td><strong>Conclusion</strong></td>
<td>Relates to the hypothesis/engineering goal and either agrees or disagrees with the hypothesis and must include key results.</td>
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<tr>
<td><strong>Discussion of results</strong></td>
<td>Patterns and trends are noted and explained, anomalies/ unusual results are discussed, limitations noted and clarified. Relevant literature is mentioned.</td>
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<tr>
<td><strong>Engineering goals</strong></td>
<td>These are the beginning of the design processes that an engineer does when he/she identifies a problem or need and then creates or develops a solution.</td>
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<td><strong>Errors and limitations</strong></td>
<td>What went wrong that you can change next time and what could you have done if you had more time or resources?</td>
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<tr>
<td><strong>Hypothesis</strong></td>
<td>A testable prediction about what is going to happen in your project. It answers to the problem statement/ research question and provides guidance for investigation.</td>
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<tr>
<td><strong>Mentor</strong></td>
<td>A person who assists you as you develop your project and gives you professional help (e.g. scientist or a teacher)</td>
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<tr>
<td><strong>Observation</strong></td>
<td>Something interesting (a phenomenon) that you have noticed e.g. Elephants prefer to eat leaves off trees.</td>
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<tr>
<td><strong>Problem Statement</strong></td>
<td>This is what you want to know about the phenomenon e.g. why do elephants prefer to eat tree leaves?</td>
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<tr>
<td><strong>Procedure</strong></td>
<td>A series of actions followed to get a desired result.</td>
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<tr>
<td><strong>Proof</strong></td>
<td>In mathematics: an argument which convinces other people that something is true.</td>
</tr>
<tr>
<td><strong>References</strong></td>
<td>ALL the books, magazine and newspaper articles and Internet pages that you consulted while doing the project and referenced in the correct way.</td>
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<tr>
<td><strong>Reliability</strong></td>
<td>Implies consistency and stability of tests done. There should be evidence of repeated testing and increasing sample size. If you measure leaf sizes of plants exposed to the same conditions, you should roughly get the same results every time.</td>
</tr>
<tr>
<td><strong>Research Question</strong></td>
<td>The research question is based on what you want to answer and the reason why you are asking this question. What is the main question that will be answered by your research.</td>
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<tr>
<td><strong>Sampling</strong></td>
<td>A process where a subset of a larger group is chosen/selected to perform tests; There are different types of sampling methods.</td>
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<tr>
<td><strong>Scientific Notation</strong></td>
<td>A way of writing very large or very small numbers, e.g. 650,000,000 can be written in scientific notation as $6.5 \times 10^8$.</td>
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<tr>
<td><strong>Solution</strong></td>
<td>A means of solving a problem or the result of a problem-solving process.</td>
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<td><strong>Trials</strong></td>
<td>Replication of the entire experiment to increase reliability.</td>
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<tr>
<td><strong>Triangulation</strong></td>
<td>Is the use of more than one approach to researching a question, done to increase accuracy and reliability.</td>
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<tr>
<td><strong>Validity</strong></td>
<td>Means a test/instrument is accurately measuring what it is supposed to measure.</td>
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<tr>
<td><strong>Variables</strong></td>
<td>Factor that can change value during and between experiments. Your investigation depends on measurable items, factors or conditions that can change due circumstances of your experiment or test. These are regarded as variables and include; controlled/fixed, independent and dependent variables.</td>
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<tr>
<td><strong>Independent</strong></td>
<td>A factor(s) that is systematically changed in order to see what effect the changes have in an experiment.</td>
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<tr>
<td><strong>Dependent</strong></td>
<td>A factor(s) that is measured or observed to see how it responds to changes made to the independent variable.</td>
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<tr>
<td><strong>Controlled</strong></td>
<td>Factor(s) that remains the same throughout the experiment in order to isolate the relationship between the independent and dependent variables.</td>
</tr>
<tr>
<td><strong>Constants</strong></td>
<td>Values that do not change either during or between experiments, e.g. standard gravitational force ( g = 9.80665 \text{ m/s}^2 ), Pi ( \pi = 3.14 ), etc.</td>
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<tr>
<td><strong>Vector</strong></td>
<td>A quantity having direction as well as magnitude, especially as determining the position of one point in space relative to another.</td>
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