Planning a science project

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Based on IRIS handbook and presentation, by Narayan Iyer, IRIS SRC
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What is “research-based”?

Usually

- We don’t know the answer before starting out…..
- So we ask questions, make hypotheses, make observations/ do experiments to prove or disprove our hypotheses…

- No fixed end-point, can modify path of depending on what is done, and upon making interesting observations
- Novelty has to be there!

Select your topic

- Choose a topic that interests you - you'll have a lot more fun (and probably learn more)
- Check all the resources around you.
  - For eg. - If you are doing a project on Eucalyptus leaves, ensure that you have the Eucalyptus tree in the surrounding region where you live
- Literature survey helps define questions
  - Books
  - Wikipedia
  - www.scholar.google.com, www.scirus.com or www.pubmed.gov

Hypothesis and rough plan

- Hypothesis: a tentative theory that can be proved or disproved through further investigation and analysis.
  - Usually one hypothesis for each question you have.
  - You must do at least one experiment to test each hypothesis.

- Plan should include
  - The purpose of your experiment
  - The variable or the things that you are going to change during the experiment
  - Parameters which remain constant during the experiment
  - Positive and negative controls
  - Number of replicates, kind of analysis
  - Timetable

Data analysis and interpretation

- Carry out experiment and record data
  - Raw data in ink
  - There is no ‘wrong’ answer
  - Record observations that are not ‘planned’ (i.e. power outage, accidental jolt to table etc)
- Carry out planned data analysis
- Discuss data, analysis and conclusions
- Follow-up experiments if necessary
- Cost feasibility if relevant
- Report writing

How do I start?

- Choose a topic that will interests & challenge you
- Don’t be afraid to try something new – you will learn a lot in your journey
- Idea need not be complicated – simple idea succeeds
- Do background research – makes you realise the vast amount of research work undertaken
- Data suggests that good Mentoring by Teacher/Parent/Guide lead to higher quality
- If teachers see a potential in any student they can “assign” the students
- Problems are Opportunity

*Some contents taken from sciencebuddies.com

Common tips

Helpful hints

- Use available resources fully – *anyone* can be a guide
- Maintain a log book – record of the thought process, and original data is a must!
- Starting off with a hypothesis and proving it is incorrect is also good science
- Control experiments are often forgotten
- Appropriate measurements
- Solid conclusions – repeatability, practicality, knowledge of limitations of data

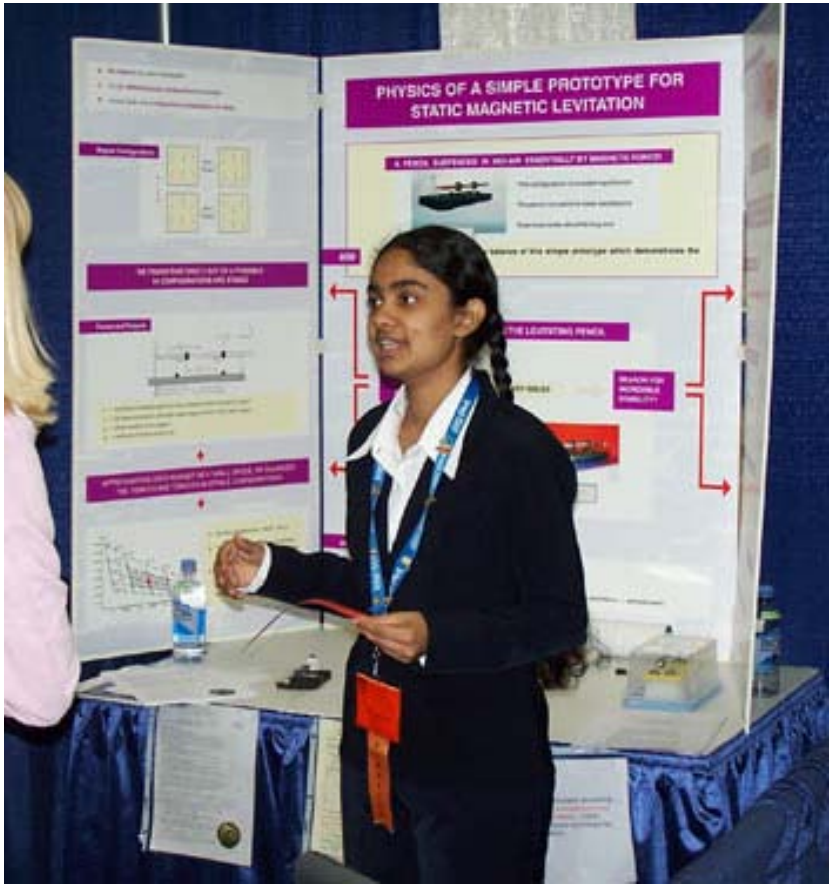
Example 1 : Simplicity

- A winning project does not always require expensive equipment, or a fancy laboratory to work in!

  ISEF 2006: Physics Grand Awards 2nd Prize winning project of Hamsa Padmanabhan

Simple projects: levitating pencil

- What did Hamsa do?
  - Exquisitely detailed analysis of the physics of a simple arrangement of magnets on a pencil, demonstrating the basics of static magnetic levitation
  - All the “experiment” needed was a pencil, some ring magnets, thermocole etc., (but it was followed up with some very rigorous mathematical analysis!)



Example 2 : Engineering Innovation

- Innovative Engineering Design – must work out all the nitty-gritty details and have final working product

  ISEF 2006: Engineering Grand Award winning project of Apurv Mishra

Innovative Engineering Design

- Apurv Mishra, ISEF 2006
- Designed a sensitive device to pick up small movements of the muscles above the eyebrow
- This enables patients who cannot speak, or do not have limbs to communicate
- Made a variation that would enable them to use a computer mouse!
- “Engineering” – not just science – actual prototype fabricated and tested on patients

Specific issues for engineering-type projects

- ENGINEERING design – why this length, why this voltage, why this particular chip used…
- Rigorous testing under field conditions – feasible/practical
- Thorough checking of alternative solutions, prior work
- Cost?

Example 3 : Traditional Knowledge

- “Ancient wisdom” re-analysed
- Traditional Indian medicine (Ayurveda) or cultural references to a lot of natural remedies, procedures etc. which have not been analyzed using a modern “scientific method”

- ISEF projects:
  - Custard apple seed/leaves
  - Coconut flower extract
  - Spices
  - Kusha grass
  - Papaya leaf

Termite resistant grass mats

- Vaishnavi Vishwanathan, ISEF 2007
  - Detailed analysis of termicidal properties of “kusha” grass (desmostachia bipinnata)
  - Analysis of various extraction techniques, attempts at identifying active component, control experiments

Specific issues for TK projects

For “traditional knowledge” projects

- thorough checking of prior work – recently lots of work thanks to new patent regimes
  - Many plants etc. studied comprehensively
- Why does it work? – often a synergistic combination of many factors, isolation of single ingredient can be close to impossible
- Comparison with “alternative” (incl. cost)
- Access to labs – beyond a point, need sophisticated standardized equipment
- Statistics

Example 4 : Local Relevance

- “Appropriate Technology” – typically low-cost solutions using easily available resources to solve local problems
- Might appear “crude” or elementary but these projects are often the most useful ones
- ISEF projects:
  - Foot operated 2-wheeler
  - Artificial limbs
  - Modified wheelchairs
  - Currency identifier

Modified wheelchair

- Mukund Tiwari, ISEF 2006
  - Modified a wheelchair to provide forelimb exercise for cerebral palsy patients
  - A cost effective solution that filled a need in his local environment
  - Used available contacts effectively

Problems that Intel folks see…

- Abstract – Lot of pages; sometimes the message is lost – Express your idea in 250 words
- Not enough data provided, it is not clear if it is a mere idea or some work has been done
- Not enough novelty – bring out your novelty upfront
- Copied material – judges hate it! & reject immediately
- If you have a prototype done – say a working prototype done!
- State your specific reference – don't hide! Don't say referred google or yahoo – state the exact internet site URL
- If you don't have complete data points – don't make any conclusion – state that it is in progress

Resources

- www.ScienceBuddies.org*
- www.ScienceClub.org
- http://www.societyforscience.org/isef/
- YouTube – search for science project videos

*Has Topic selection wizard for project selection

Judging rules

- **POTENTIAL MAXIMUM SCORE CHART**

	Individual	**Team**
1. Creative Ability	30 points	25 points
2a.Scientific Thought / 2b.Engineering Goals	30 points	25 points
3. Thoroughness	15 points	12 points
4. Skill	15 points	12 points
5. Clarity	10 points	10 points
6. Teamwork	——	16 points
Total Possible Score	100 points	100 points

What is IRIS?

- A National Science & Engineering Fair for school students that focuses on “Research Based” projects
- Std 5th – 8th classified as category I
- Std 9th to 12th classified as category II
- Jointly conducted by Intel, CII, DST
- Affiliated to ISEF International Fair

When does it happen?

- It happens yearly in late November/early Dec
- City is chosen by consensus
- Abstracts are generally due by September End

How it works?

- IRIS Scientific Review Committee meets on a need basis
- Shortlists the abstracts (pre-screening)
- Students get accept letters
- Students participate in the National Fair
  - *Student + One Guide's stay provided and travel re-imbursed*
- Judging of projects (Judged from various scientific community - local and out station) followed by deliberation
- Category wise winners and special awards announced
- Out of the selected National winners 6 projects go to ISEF international fair (4 individuals and two team projects)
- Coaching camp for ISEF projects

Subject Categories…

- 10 subject categories for submission of entries
  - Animal Science/Zoology, Plant Science/Botany, Biochemistry
  - Environmental Science
  - Physics, Chemistry, Mathematics, Earth and Space Science
  - Engineering, Computer Science

India’s Performance at ISEF

Year	Awards (G+S)	Total
2008	4+4	8
2007	2+5	7
2006	4+3	7
2005	1+2	3
2004	7+2	9
2003	4+0	4

Why ZERO from Pune at the National Fairs or ISEF?!!

Scene from the fair

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