Independent Research
Topic Selection and Research Proposal

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In this class, you are required to do an original experimental research project.

Your Research Question must be:

- Original: no one has published an answer to this particular question, and no one knows the answer. It doesn't have to be important, just original in its particular form.
- Be stated in the form: How does A affect B?

Your Research Proposal must include:

- Research Question
- List of Materials Needed: Include all materials you will use. Make a note of any equipment or materials you will provide yourself
- Diagram of Proposed Experimental Setup
- Summary of Proposed Procedure

The Investigation

Once your research proposal has been approved, you will conduct the investigation. You will be expected to test your proposed procedure, identifying and resolving any unexpected issues. You must gather data that, when analyzed, will lead to a valid and reliable answer to your research question.

Reporting on your Research

After the completion of the investigation, you will be required to write a complete scientific research report which: grounds your research in the context of current theory, clearly describes the procedure, shows the data and analysis processes, and presents the results and conclusions with an evaluation of their validity and reliability. More details on the research report can be found on the IB Scientific Writing Guide. Students whose research yields interesting, valid findings may be invited to publish a paper on their research in the International Scholastic Journal of Science.

Developing a Good Research Topic

I would suggest you spend some time looking at what scientists have done in the past. You cannot duplicate their research, but if you can modify or extend their research, or improve on their method to increase our level of confidence in their results, then it is good science. And often reading about what others are doing stimulates interesting ideas of your own.

It is also good to just look at interesting phenomenon and find out how they work, you might focus on things that you are personally interested in. Take some time to look at some of the things that happen in the world around you, and try to figure out how you can study them scientifically.

Places to look for ideas

- International Scholastic Journal of Science: Look at old papers and how you might further our understanding in that field. (http://www.isjos.org)
- Physics @ ISB: Lists of former ISB students' work. (http://www2.isb.ac.th/physics_isb/physisb/students/ iblabs/newdex/newindex.htm
- The Annals of Improbable Research: Awarders of the *Ig*Nobel Prize. (http://www.improbable.com/)
- Myth Busters: TV series that looks at unusual phenomenon. Lots of fun ideas.
- Youtube- keywords: physics phenomenon, weird, cool, fun

Research Ideas

- Sports: anything-tennis, football, badminton, boxing, rugby, running, etc
- Sound: wine glasses, Tibetan signing bowls, bells
- Whistles and Blowing Bottles: Resonance and Helmholtz Resonance
- Music: Characteristics of different musical instruments under different conditions.
- Projectiles entering water: deceleration, cavity formation
- Double Pendulums on a horizontal string
- Euler's Disc-Look at various effects (spin height, rate, adding small weight) under different conditions
- Bouncing Balls under different conditions: there's so much we don't know about the details of specific cases.
- Tin Can Telephones
- Turbulators or Dimples and Air resistance
- Edge effect of balls falling/moving through narrow tubes
- Water-filled Basketballs: pumped either partially or fully with water (pump it up while the ball and pump are both submerged). Fun and weird behaviors here.
- Water resistance on falling particles in different liquids
- Water drops on Lotus Leaves
- Soap Bubbles-formation, falling, pressure
- Pulling apart inter-leafed phone books
- Waves on water or Bungy cords
- Bubble rings and air cannon vortices
- Characteristics of a balloon. Pressure, ageing, popping
- Thumping melons
- Oobleck (Cornstarch and water): Fascinating stuff
- The Coanda effect
- Friction: affects so many behaviors in ways that are little understood and that we have so little data on.
- Wind and wave/ripple formation in water/sand

Equipment and sensors at ISB that might help you think of topics to investigate

Sound and Waves

- Microphone with FFT capability
- Underwater microphone
- Aquariums
- Very Long Aquarium
- PVC Tubes of different length and diameter
- Wine glasses of various shapes and sizes
- Range of speakers
- Tuning forks
- Decibel Meter
- Set of glass plates of varying shapes and sizes….study resonance?
- Range of hollow plastic balls of different sizes (resonance?)
- Long Bungy Cords
- Springs

Light

- Light meters
- Pyrometer
- Laser pointers
- LED's of different color
- Polarizing Film
- Diffraction Gratings
- Mirrors and Lenses
- Triangular shaped containers (for index of refraction studies?)
- Spectrophotometer
- Light Sensor
- Polarimeter

Thermal Physics

- Temperature Sensors
- Thermocouple (High-temp thermometer)
- Infrared Thermometer (measures temp of a surface from a distance)
- Dry-ice
- Liquid Nitrogen

Mechanics (Force & Accel)

- Accelerometers
- Force Meters
- Force Plates (can be jumped on)
- Pressure Sensor
- Sets of balls of different sizes, densities, and materials…steel and marble (stone)
- Plastic Beads
- Styrofoam Balls
- Assorted sizes of small glass spheres ranging from .1 to 6 mm
- Water rocket launchers
- Slingshots

Video equipment

- Camera-Super Macro (close-up)
- Video-Standard speed
- Video-High speed (up to 1200 frames per second)
- Web-cam (adjustable frame rate to any value, can be used for slow changes)
- Shock-resistant camera (can be used in collisions)
- Underwater camera

Electricity & Magnetism

- Voltage and Current meters
- Very strong magnets
- High-Current Power Source
- Tesla Coil
- Van de Graaf generator
- Strong magnets
- Magnetic Field Sensor
- Rheoscopic Fluid
- Ferrofluid
- Electric Motors, DC (ranging from hi-speed to very low speed)
- House Fan
- Motors and Propellers for toy airplanes
- Solar Cells
- Hall Effect Apparatus
- Electromagnets (can be studied in themselves, or used to cleanly release a steel ball with no spin)
- Superconductor

Miscellaneous

- Clear plastic tubes of different diameter
- Vacuum Pump and Vacuum Jar
- Air Blower (form column of blowing air)
- Anemometer-measures wind speed
- Air compressor with pressure gauge
- Winged Seeds
- Soap Bubble Blower
- Euclid's Disc
- Airsoft BB gun
- Air Cannon
- Apparatus to make bubble rings under water
- Geiger Counters
- Radioactive Sources