DP Physics Year 2
Summer work

During the summer before your senior year, you are expected to pick an IA topic and begin writing your IA. The topic of your IA needs to fall within the scope of this class. Once you have your topic, you'll have to narrow your focus to a single research question. Then write the procedure for an experiment that will test and answer that research question. Once you've done that, return to the background information and explain the relevant physics concepts and equations that apply to your experiment.

On the first day of class for the 2022-2023 school year, I expect the following to be turned in:

1. Topic (note: this is not the research question)
2. Personal connection to the topic
3. 2-3 credible sources for background information (cited in MLA format)
4. Derivation of your mathematical model
5. Variables (IV, DV, CV, how you're measuring them, how you're manipulating IV, how you're controlling CVs)
6. Research question
7. Prediction / hypothesis
8. Written IA Background
9. Written IA Methodology

Use the rest of this document to help you pick your topic, RQ, and then write your background and procedure.

If you have any questions while you're working on this over the summer, please don't hesitate to reach out to me either on Schoology or by email at lesch@cdspatriots.org.

See you in the fall!
Mrs. Esch

Physics Internal Assessment Proposal

You will begin the process of completing your Internal Assessment by investigating a topic that interests you.

1. **Decide on a Topic** (note: this is NOT a research question)
    - Look over previous units and this year's units (see Year 1 & 2 topics on syllabus AND consult your textbook).
    - Decide on a few topics that might interest you. Note: If you choose a Year 2 topic, it may require additional research as you haven't learned it yet)
    - Remember: Internal Assessment questions MUST be within the scope of this course. Feel free to ask your instructor if any doubt).
    - Once you've decided on the topic, imagine a physical situation that you'd like to explore (ex. a bird flying, riding a rollercoaster, etc.)
2. **Personal Connection**
    - A portion of your IA grade is based on "Personal Engagement." Explain why this topic interests you. Do you have a personal anecdote? Is there a real-world application? Why do you care? Why should the reader care?
3. **Find Quality Resources**
    - Find 2-3 quality (credible!) sources on this topic.
    - Highlight interesting information, experiments, or equations. If there is not much to highlight, it is not a good source option!
4. **Focus in on a Mathematical Model**
    - Within your topic of study, look at the Data Booklet & textbooks to find 4-5 relevant equations for your situation.
    - Consider various types of investigations that may be possible (hands-on vs. database vs. simulation) (see Allowable Types of Investigations below)
    - Choose a combination of equations (ex. 1/2 mv2=mgh+W) that interests you most. You may want to return to Step 2 to identify an equation that fits with your Personal Connection.
    - Once you decide on your equation, you may want to return to Step 3 to find more focused resources.
5. **Decide on Variables and Research Question**
    - Define each variable in your chosen equation.
    - What are the standard units for each variable?
    - What instrument would you use to measure each variable? (if applicable)
    - Choose two variables to investigate – one for your IV, the other for your DV
    - All remaining variables will be your control variables
    - Write a research question of the form "How does the [IV] affect the [DV]?
6. **Predictions**
    - Manipulate your equation so that it's of the form DV=[constant]*IV
    - What pattern do you expect?
    - Will you need to linearize, if so how?
    - What is your expected slope?
    - What is your expected y-intercept?

Allowable Types of Investigations

The IA criteria allow for and indeed encourage a wide range of investigation types.

IA Criteria as given by the IB	Teacher Clarifications
Hands-on investigations – This includes many traditional experiments. Investigations are not restricted to syllabus content, and the concepts and skills required need only be in line with the level of the course the student is taking.	Choose an IV /DV and then select values of control variables that make those measurements easier and able to take on a wide range of values. Usually involves comparing to a known value / constant / empirically determined engineering properties.
Modeling and spreadsheet investigations – Here the student may process primary or secondary data and analyse it with a computer model. Spreadsheets and graphing software can be used in all investigation types. In some cases, real data can be compared to ideal or theoretical data by using a spreadsheet.	More advanced: Typically involves using a mathematical model to make a prediction of how a variable will change over time as a result of certain choices in parameter. Uncertainty comes from computer rounding and step sizes used in calculation. Examples: Predict temperature change for a simple climate model. Predict motion including velocity-dependent forces like drag.
Database investigations – Here the student would access online databases for scientific information. They would design a method to answer their research question using the database, and perhaps graph or model their results. Teachers with large classes may encourage students to take this approach.	You should investigate several sources for information, and choose the best, but you must understand/explain how others collected this data, and explain/propagate uncertainties. Usually good for interesting, complex data. Could involve comparing to professional results using the same data. **Examples:** astronomical data for orbits, brightnesses, velocities; particle accelerator data, nuclear / quantum data

Computer-simulation investigations – Investigations may involve computer simulations. Here, students can obtain information or data that will be processed to discover something that goes beyond the simulation's routine. Students can also combine a hands-on investigation with a computer model and compare the results. Students may also combine real data with a mathematical model.	You should be able to set at least one variable as a control variable in addition to your IV/DV. Explain why you set that control variable at the value you did. You must investigate SEVERAL simulations and justify why you chose this one. It MUST allow you to estimate and propagate uncertainties. Examples: Shooting charged particles into electric/magnetic fields, making measurements of phenomena too fast for hands-on data.
Hybrid investigations – It is understood that students might perform any combination of the above investigation types. The types are not exclusive categories but rather illustrate the wide range of acceptable investigation types.	Examples: Using a database to look up specific heat capacities of materials, then testing them using hands-on data. Using database data as input to a modeling/spreadsheet calculation, as for nuclear reaction rates or radioactive decay. Collecting hands-on data to compare to the results of a simulation.

Physics IA Background Checklist

Use this checklist to know what should be included in the background and methodology.

Research question

- ☐ Did you identify an appropriate topic?
- ☐ Did you state a relevant, specific, and fully focused research question clearly, where the dependent and independent variables, and perhaps method, are included?
- ☐ Did your research question set the framework for the entire individual investigation and is consistently carried through?
- ☐ Did you state and describe the correct independent variable with the correct range of values it will take?
- ☐ Did you state and describe the correct dependent variable with the correct units?
- ☐ Where appropriate, did you predict a quantitative relationship between the IV and DV?
- ☐ Did you state and describe the relevant control variables together with why and how they are controlled or monitored?

Background information

- ☐ Did you give detailed, relevant, and appropriate physics and mathematical background theory (including mathematical derivations of formulae and explanation of symbols, where appropriate)?
- ☐ Did your information enhance the understanding of the investigation and puts it into a physical science context?
- ☐ Did you include a hypothesis or physical model (quantitative or qualitative), when possible and appropriate?
- ☐ Did you outline any assumptions, limitations, or simplifications in any physical models that you discuss?

Safety, ethical, environmental issues

- ☐ Does your plan show awareness of safety, ethical, or environmental issues related to the methodology?
  - For example, risk assessment, use of materials, instruments, or apparatus, and any issues related to storage and disposal of chemicals or materials.

Methodology

- ☐ Did you include details about apparatus, materials, and instrumentation (including absolute uncertainty in a single measurement and sensitivity range)?
- ☐ Did you include a complete description of any materials or substances and the dimensions and composition of any solids?
- ☐ Did you give a clear, detailed, and logical sequence of reproducible steps?
- ☐ Did you describe the rationale or justification of relevant steps in the setup of the apparatus?
- ☐ Did you describe how your methodology minimizes random uncertainties?
- ☐ Did you describe any calibration of instruments and check for systematic errors?
- ☐ Did you present a labeled diagram or photo of your apparatus?
- ☐ Did you include circuit diagrams, free body diagrams, or ray diagrams where appropriate?
- ☐ Did you explain choices with regard to the methodology, apparatus, or instrumentation selected?
- ☐ Did you explore alternative methods and outline why they are less suitable?

Describing sufficient data

- ☐ Do you plan to collect a sufficient number of reliable and relevant raw data points over a wide data range?
- ☐ Do you plan to collect a more raw data at certain points, like at the extremes of the range or inflexion points?
- ☐ Do you plan to collect a suitable number of repeated and average readings?
- ☐ Do you plan to collect relevant qualitative data (observations)?

- [ ] Does your method take into account and minimizes likely random and systematic errors in the raw data?
- [ ] Do you ensure that your data collection is relevant to the initial research question?
- [ ] Do you plan to collect raw data that records units and random uncertainties, as well as being recorded to an appropriate precision?
- [ ] Do you plan to record physical conditions, such as temperature and pressure, if these affect the value of your DV?