How to Structure a Lab Report (and pass the science WASL)

Question:

- This should be a scientific question you intend to answer by way of your experiment.
- Not a Yes/No question
- Should use language like "how", "which", or "why"
- Example: "How does the angle at which a ramp is set up (its steepness) affect the time it takes for a toy car to reach the bottom of the ramp?"

Hypothesis:

- Includes your guess of what your results will be (prediction), and why you expect them (prediction reason).
- Can take the form of "I think _____ because _____" or equivalent. Example: "I think that a steeper ramp will shorten the time it takes for the car to reach the bottom, because gravity will influence it more."
- Don't just say "I think it will have an effect because…" – You need to specify what *kind* of effect you think it will have.

Materials:

- A detailed list of the items you're going to need: types of glassware, measuring tools, chemicals, etc. Note: You do not need to say how much of a particular item you are using (e.g. 50 mL of water), but if you do, you are not required to mention the measuring devices here – however, if you just say "water" (but not "50 mL of water") you *would* need to also say "graduated cylinder".
- Don't need to include things like pencils and paper, unless they are being used for something special.

Procedure:

- A numbered list of *logical* steps, not a giant paragraph, and each step starts with a verb – Doing this is not required on the WASL, but it helps the reader know what you had in mind, and *I* require it. On the WASL, the point for "Logical Steps" is given when the reader can tell what you did, *and* that what you did actually served to help you answer your question (If the procedure you write doesn't help you answer your question, then not only do they not award you the "logical steps" points, but you pretty much bomb the rest of your procedure – I'm not that cruel, but keep it in mind. For me, I might deduct the "logical steps" point, but I would award you your other earned procedure points so that at least you know what you *did* do right.)
- Experiments typically have 3 types of variables in them, and your procedure should make it obvious what you chose for each of them. The 3 types are defined as follows:

  Manipulated Variable (MV): (only 1)
  - The thing you're changing on purpose from test to test – identify it.
  - Is often found in the first part of the inquiry question: "How does the <u>angle at which a ramp is set up (its steepness)</u> (MV) affect the time it takes for a toy car to reach the bottom of the ramp?"
  - In math, this is often called the "independent variable", such as the X value on a graph.

  Responding Variable (RV): (only 1)
  - The thing you're measuring to determine if your manipulated variable made a difference (the <u>results</u> of your tests) – identify it.
  - Is often found in the second part of the inquiry question: "How does the angle at which a ramp is set up (its steepness) affect the <u>time</u> (RV) it takes for a toy car to reach the bottom of the ramp?"
  - In math this is often called the "dependent variable", because its value *depends* on what you put in initially; in graphing, Y is the dependent variable because you get it by choosing an X and plugging it into an equation.

  Controlled Variables (CV): (At least 3)
  - These are the things you need to be sure are kept the same from test to test, so you can be sure that it was in fact your one manipulated variable that made the difference in your results, not something else.
  - Only list things that might actually make a difference; it is unimportant, for example, to mention that all the cars were brown, but it *would be important* to mention that they were all the same size and had the same number of wheels. Using "identical" cars would be even better, because then you have controlled for *all* the possible ways in which the car itself affects how quickly it can go down a ramp.
  - You would want to list as many relevant controlled variables as you can think of, but your grade is only affected if you have less than 3. If you only list 1 or 2, your grade will be affected unless I personally can't think of any more either.
- I should be able to tell what you had in mind for Manipulated (MV), Responding (RV), and Controlled variables (CV) by reading your procedure, so I would like you to underline and label each of these variables as they appear.
  - **Sample Procedure:** "1. Set up a <u>meter-long ramp</u> (CV – now I know that the length of the ramp is the same in each test) at an angle 15 degrees from the floor; 2. Place the car at the <u>top</u> of the ramp (CV – now I know the car started in the same place each time); 3. Release the car and use a <u>stopwatch</u> to time how long it takes to reach the bottom of the ramp (CV – now I know the time was measured the same way each time); 4. Record this <u>time</u> (RV) in the data table; 5. Repeat steps 2-4 as Trials 2 and 3; 6. Repeat Steps 2-5 for a ramp at 30 degrees and 45 degrees from the floor."
- You need to mention (and do) repeated trials for each type of measurement (Step 5 from sample).
- You need to specifically say that you *recorded* the measurement, not just that you *took* the measurement. (Seems like a small difference, I know, but on the WASL they check for this. See Step 4 from sample.)
- *Don't* just say "Take and record <u>data</u>." You need to be specific about what kind of data you're taking – that's how we know what your RV was. Steps 3 and 4 from the sample make it clear what kind of data you're looking for.

Data Table:

- Has a title with the MV and RV clearly labeled. Example: "Ramp Steepness vs. Time"
- Shows units of measurement used (Examples: cm, inches, degrees Celsius, etc)
- An organized chart, showing *multiple trials* and *average values* calculated (only for number data – can't do averages of descriptive data).

Conclusions: *For an expanded explanation of Conclusions with good examples, see the .pdf entitled "Conclusive Paragraphs" posted under the "Science Resources" section of my website.*

- Your goal is to make this concise but informative: it shouldn't be really long, but it needs to contain the important information. For the WASL, we recommend a four-sentence structure that covers these areas:
- First sentence: The conclusion statement; summarizes the general findings of the investigation. Example: "Our findings suggest that the steeper the ramp was, the less time it took for the car to get to the bottom." *Do not be vague!* The sentence, "Our findings suggest that the steepness of the ramp made a difference in the speed of the car," is not specific enough to get full points on a WASL – you must be clear about *how* it made a difference. Note: It *can* also work to simply state whether or not your hypothesis was correct, but for this to work, your hypothesis needs to have been specific, too.
- Second sentence: References the lowest data point. Example: "At 45 degrees, the car made it down the ramp in an average of 5.4 seconds."
- Third sentence: References the highest data point. Example: "At 15 degrees, the car took an average of 12.7 seconds to get to the bottom."
    - Note 1: It does not matter what order you mention the high and low data points in.
    - Note 2: If averages are calculated, use those only – do not give individual trial data here. On the WASL only numerical data is used, but in class we will sometimes do labs where the data is a written description, in which case it is okay to talk about differences and similarities in what you saw from trial to trial.
    - Note 3: You must use the *extremes* of your data (specifically, the data for the extremes of your MV's conditions), in this case for 15 and 45 degrees. Comparing just the 15- and 30-degree sample data is not as compelling. (Nor should you to mention *all* the data, because I and the WASL folks want to see if you can identify the most compelling data, not just restate the entire data table – more is not always better.)
    - Note 4: Always include units of measurement, and never round data (say "12.7 seconds", not "about 13 seconds" when quoting it in the conclusion – it is okay to round when *taking* data (but not too much), but what it says in the conclusion must exactly match what you said in the data table.)
    - Note 5: Data is not always linear, even though it is in the example I've been using. With linear data, the high and low extremes of your results are the same two data points as the high and low extremes for your MV conditions. (Linear data is data that consistently goes up or down as your MV changes.) **You must always provide the results for high and low extremes of your MV conditions, even if those two extremes did not give the extremes of the RV results.**
- Fourth sentence: Compares highest and lowest data points, connecting them to the conclusion statement. Example: "The time the car took to get the bottom was 7.3 seconds <u>faster</u> at 45 degrees than it was at 15 degrees."
    - Note 1: Must use comparative language, such as "faster", "more", "less", "bigger", "warmer", "farther", "increased by" etc
    - Note 2: Finding the difference between the high and low RV data is a great way to make sure you score this point.
    - Note 3: If you have not given both high and low data points, you can't score any points for a comparison. What can you compare if you only listed one thing?

Scoring Rubrics: *Indicates things they also look for on the WASL

Attribute	Value Points
Question – You wrote it down, has obvious MV and RV	/2
***Hypothesis** – Prediction (I think…)	/1
- Prediction Reason (because…)	/1
***Materials**	/1
***Procedure**	
- *Controlled Variables obvious (mark as "CV")	/3
- *Manipulated Variable (only 1, mark as "MV")	/1
- *Responding Variable (only 1, mark as "RV")	/1
- *Repeated Trials	/1
- **Record* Measurements	/1
- *Logical Steps	/1
Data Table	
- Has columns labeled, including units	/1
- Shows multiple (at least 3) trials	/1
- Shows averages for # data	/1
***Conclusion**	
- Conclusive Statement	/1
- Supporting data for lowest manipulated variable	/1
- Supporting data for highest manipulated variable	/1
- Explanatory/Comparative Language	/1
GRAND TOTAL	/20

→ They don't make you write questions on the WASL, but every good scientist should know how to ask a good one.

→ This is only worth one point on the WASL, but I want to see 3 of them.

Also, variables are a "double whammy" on the WASL – not only do you need to include them in your own procedure, but they'll ask you to identify them in pre-written investigations.

→ On a WASL, they don't require you to write a data table unless you refer to it as part of a procedure (But *I* want to make sure you can make one).