Lab Report Instructions:

Format:

- Typed
- Double Space
- 12 point font size
- 1" margins
- Use spell check and proof read!!!
- Title page – should include name, date and title of report
- Staple both a copy of the rubric (can be found on the ocean Website) and your turnitin confirmation to the front of your report.

Sections you should include in your report:

- Title
  - A clear and concise sentence that fully explains the topic of the report
- Abstract
  - A brief summary of the experiment and its results
  - 1st sentence = Intro/Background
  - 2nd sentence = Hypothesis
  - 3rd and 4th sentences = Materials (briefly say what you did, such as – made a 10X dilution of milk, made serial dilutions, and plated them onto 6 plates with final dilution factors of 100X, 1000X, 10,000X, ect.)
  - 5th sentence = Results ... What did you find out?
  - 6th sentence = Conclusion ... Why do you think sentence 5 happened?
- Introduction
  - What is known about the topic (use your primary sources).
  - Hypothesis
    - Not a question but a statement of what you think will happen.
- Materials and Methods
  - How did you conduct the experiment? Step by step instructions.
  - You may list materials but methods should be in paragraph form.
  - Should explain in detail your experiment so that anyone could repeat it.
- Results
  - What happened? Don’t explain your data, just write out exactly what data you recorded.
  - Include tables and/or graphs (make sure they have a title, figure #, correct units and any necessary explanations). Someone should not need to read the paper to understand them!
- Discussion
  - What do you think your results mean?
  - Discuss your results in this section – Why did you see what you did?
  - Discuss evidence to support or falsify your hypothesis (use your data and information from your primary sources).
  - You can never actually prove your hypothesis.... either your evidence supports or refutes it.
- Literature Cited (This is it’s own page with Literature Cited centered at the top)
  - Anything that is not an obvious, commonly known fact must be cited within the text and on the literature cited page.
HOW TO WRITE LAB REPORTS FOR BIOLOGY

General Comments:

Unless otherwise told by your instructor, laboratory reports are to be an INDIVIDUAL effort. You may discuss the lab and the data, but do not look at anyone’s report (rough draft or final version). You should not even outline the report together. Many students have received a severe penalty for plagiarizing lab reports from their lab partner or from someone else.

You should think of your lab report as a Research Report. It should be written as if you were going to submit it to a scholarly journal for publication. Therefore, it should follow a very precise format and should be written for a general audience, NOT just your lab instructor.

Laboratory reports should be typed and double spaced using a 1-inch margin. Follow the instructions outlined in the Lab Report Instruction Sheet. Submit the report in class and electronically through turnitin.com by the due date. Excuses such as “the computer was down” or “my printer ran out of ink” or “I forgot to submit it online but I have my hard copy” are not acceptable!!!!

Although there are minor variations in the format of scientific reports, almost all of them conform to the basic principles set out below. You should follow this format for your lab report.

Format of a Research (Lab) Report:

Your report should follow similar guidelines that are used in scholarly journals. Thus it will contain the following sections:

- Abstract
- Introduction
- Materials and Methods
- Results
- Discussion
- Literature Cited

For a good example of a research paper, see the attached sample paper (fictitious): “The effects of jumpamine chloride ……”.
Writing Style:

Your report will be read critically, not only for scientific content and logic, but also for your ability to express yourself in this form of writing. The text should be organized into logical paragraphs and sentences. Each paragraph should start with a topic sentence which introduces the information in the paragraph.

Be sure to proof-read. Since most word processing applications have spell check, there is no excuse for misspelled words.

When you are writing about methods and results, be sure to use past tense because you have completed the experiments by the time you begin writing.

Scientific binomials (genus and specific epithet) are Greek or Latin, and are therefore always underlined or italicized.

Scientific writing should be clear and concise. Don’t use five words when two will do. Work on clarity and organization in your presentation.

EXAMPLES:

- To long: “The effect of obesity on heart rate was the purpose of the experiment.”
- Better: “We investigated the effect of obesity on heart rate.”
- Unclear: “We obtained an aquarium and then we put fish in it.”
- Better: “All experiments were performed in a 10 gallon aquarium.”

ABSTRACT

This section should be a brief summary of the experiment and its results. You should briefly describe your introduction and state your hypothesis. The Methods should be described in a condensed form. This section is not intended to provide enough detail to allow for repetition of your experiment. You should indicate what the results of your experiment were and why you think you observed these results.

INTRODUCTION

This section may be as short as a few paragraphs or as long as a few pages. It serves to introduce your experiment. Start with general statements and become more specific.

The first part of the introduction should set the context for your experiment by briefly providing background information. You should present what information is known from previous studies, then state what additional information your experiment may provide. You should utilize information from your primary sources (scholarly research articles) for this component. Be sure to give proper citations when you state facts or ideas from any outside sources.
EXAMPLE: The larch is an evergreen that loses its leaves in the fall (Jones, 1921).

See other examples of citations in "The effects of jumapine chloride....".

In the second part of the introduction you should describe the specific questions you chose to study. State what you did in a general way, e.g., "We investigated the effect of obesity on heart rate by comparing heart rates of fat and thin people after they climbed stairs", but do not give away the specific details of your Methods or Results. Specifically state your hypothesis at the end of the Introduction.

MATERIALS and METHODS

The materials – all of them – should be listed in bulleted form or written out in paragraph form. It is important for all materials to be listed so that ANYONE can read your report and repeat it.

The experiment has been completed by the time you write your report, so use past tense. This section includes a brief outline of the methods used in the experiments. Do not simply copy from your laboratory manual.

The purpose of this section is to allow other experimenters to duplicate the methods you used, so it should be detailed enough so that someone else could read your report and repeat the experiment. However, you should NOT include trivial details such as "we used test tubes that were 10cm long," or "the test fish were kept in a beaker before the experiment began."

It is important to quantify your treatments whenever possible; for example, how many milligrams of caffeine did each person ingest, or how long did you wait between administering salt and measuring blood pressure?

Good Example:

We exposed cells to 0, 15, 30, or 45 seconds of ultraviolet irradiation. Cells from each irradiation treatment were diluted to $10^3$ and $10^5$ of their original concentration. One mL of each of these dilutions was plated on nutrient agar and incubated overnight. The number of colonies was counted the next day.

Bad Example:

Our lab bench received cells from treatment #1, and these were serially diluted, so that there were 2 different concentrations of bacteria to count on the Petri dishes. Lab bench 2
received cells from treatment 2. These were also serially diluted, resulting in 2 different concentrations of bacteria to count.

Problems with the bad example, which contains nearly the same number of words but much less information:

- Trivial information is included (Our lab bench received...)
- "Treatment #1" is a poorly identified variable. The reader will probably have to refer back to a previous page to find out what this treatment is.
- Important details are left out, such as the number of seconds the cells were irradiated, the dilution factors, and the temperature at which the cells were grown.

RESULTS

The results section always starts with normal paragraph (text) format, NOT with tables or figures. You MUST first direct the reader's attention to EACH table and figure before they appear, indicate what they show, and summarize the important data in each.

Good Example of How to Begin the Results:

Results
The mean IQ of Union biology students was found to be higher than the mean IQ of Harvard students and of students from many colleges, as seen in Figure 1.

As with all writing the results should be organized into coherent logically organized paragraphs and sentences.

Data is reported in 3 ways:

- Text or paragraph form, if there are just a few numbers to report.
- Figure: a graph, picture, or diagram
  ***** A figure will have a detailed legend at the bottom ******

- Table: something that contains only numbers, and has a detailed legend at the top.

See examples of figures in, "The effects of jumpamine...."

Report ALL data, even if it was unexpected or if it did not support your hypothesis.

**Do not discuss the implications of the results in this section, nor attempt to explain why various results occurred.**
RAW DATA is NOT normally reported in the Results. Readers are usually interested only in SUMMARIZED DATA, such as means, standard deviations, totals, averages, etc. However, since this is not really going to be submitted for publication, you should include any raw data and lengthy calculations so your instructor can detect any errors you may have made.

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**DISCUSSION**

*This is usually the most important part of your paper.* This is your chance to be original, cleverly interpret the results you obtained and draw general conclusions from them. Information in the discussion should go from the specific to the general. This is a typical order of topics which might occur in the Discussion:

**major conclusions** (don't list this as a subheading)

Begin the discussion by briefly stating the major conclusions from the results. Explain what the results mean. Discuss whether the results SUPPORT or do NOT support your original hypothesis(es). Your experiment is really very limited in scope, so DO NOT claim that you have "proven" or "disproven" a hypothesis; you perhaps obtained some small bit of evidence to support a hypothesis, or you provided some evidence which contradicts a hypothesis.

**expand on your results**

In next paragraph(s) expand your discussion of these results. You might wish to compare them to results from other studies, which you should cite properly.

**introduce some new ideas**

As the discussion continues it is important to offer some original ideas and interpretations. For example, discuss the implications or your results for the biology of the organism(s). For example, why did the behaviors you observe evolve? You may wish to suggest new experiments which would shed further light on the questions raised by your results.

**improvements in experimental design**

Your best guess is that the results reflect reality. Students often feel that their discussion should consist mainly of an analysis of all the things that went wrong with the experiment. We strongly discourage this approach. Naturally all experiments have some weaknesses, but for the purposes of this exercise assume
that your results are reasonable. It is OK to get negative results (no significant differences). You may, however, suggest additional experiments using different methods that may improve our understanding of the topic.

LITERATURE CITED

In this section you will list any literature which you have cited in the text. List ONLY those references which you have specifically cited. References are listed in alphabetical order, by the first letter of the first author's last name.

See correct format in the sample paper, "The effects of Jumpamine Chloride...."

FREQUENT PROBLEMS IN SCIENTIFIC WRITING

The following are a few hints to better scientific writing. Read them carefully.

- Underline or italicize scientific names. The genus should be capitalized and the species name lower case (unless it's a proper name). The word "species" is both singular and plural; there is no word specie'. The plural for "genus" is "genera"

- Be concise by eliminating unnecessary words. Some examples:

  In his paper on spiders, Jones stated that spiders can't fly (Jones, 1950).
  In order to conduct the experiment we used 10 test fish.

  The bold faced words in the above examples can all be eliminated.

- Use the standard scientific citation format:

  Smith (1987) found...
  Eagles eat turtles (Smith, 1987) ...

- The cited articles should be listed in alphabetical order at the end of the paper under "Literature Cited."

- In general, DON'T use quotes. Instead, paraphrase the author and cite him/her. Quotes interrupt the flow of your text. Only quote if the precise wording is absolutely critical. If you must quote, incorporate 2-3 lines into the text. Longer quotes should be isolated by single spacing and wider margins.

- If an entire paragraph comes from a certain author, cite once at the end of that paragraph, not after every thought or sentence.
Citation Instructions:

The order of the references should be alphabetical by the first author. In general the format should be:

Primary Literature/Journal Article:

Book/Lab Manual:
Authors/Editors (in order in book). (year published). Book Title. Publisher. City Published.

Authors are listed by Lastname, F.I., where F.I. refers to the first initials.

You must also cite these references in the body of the text where information from this reference is used. The format for the citation is: Lastname (YEAR) when the authors name is used in the sentence or (Lastname, YEAR) when the names are not used in the sentence. YEAR refers to the year the article or book was published.

It is of vital importance that you properly reference and cite any information or ideas that are not your own. To not use proper references and citation is a form of academic dishonesty and plagiarism and will be treated as such following school guidelines.

Table Format:

Table #. Table Title.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Something (cm)</th>
<th>Something else (s)</th>
<th>Yet another thing (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>C</td>
<td>8</td>
<td>13</td>
<td>21</td>
</tr>
</tbody>
</table>

Be sure the table has a number – so it can be referenced in your text. Also, give your tables a title – it should be descriptive and self explanatory.

The table should be completely understandable even without the rest of the lab report.

Include the proper units – put them in parentheses above the data (so you don’t have to write out cm, s, m, bacteria/g, g, mL, etc. every time you write a number into your chart.)
The effects of jumpamine chloride on jumping performance in two species of frogs of the genus *Rana*

Leo Lizardgazer, 1997.

**Note:** Your report should also include an abstract before the introduction.

**Introduction**

Jumpamine chloride (JCI-) is a natural waste product of muscle metabolism in many species of frogs. Phrogsucker et al. (1957) first reported that up to 60% of this chemical is reabsorbed from the bladder before excretion. This result lead to a number of studies attempting to identify the advantage of reabsorption of this product. One recent study showed that injection of JCI- into the bloodstream increased muscle mass in the grass frog *Rana pipiens* (Hylaflex and Smith, 1988). Anurheight (1990) was the first to demonstrate an actual improvement in performance capability, by showing that swimming performance in *Xenopus laevis* was improved by adding JCI- to the diet.

The present study was carried out in order to see if JCI- had any direct effects on jumping performance in frogs of the genus *Rana*. We hypothesized that the increased muscle mass shown in earlier studies (Hylaflex and Smith, 1988) would result in improved jumping distance. Such a result would suggest the biological function of JCI-reabsorption. We also investigated the influence of temperature in modifying JCI- levels, which then induced changes in jumping performance. Demonstrating temperature effects would shed light on the underlying mechanism involved in the changes in muscle induced by JCI-. Based on earlier studies we hypothesized that JCI- acts by increasing the activity of a number of enzymes associated with muscle contraction. If this is the case, we hypothesize that jumping distance will improve exponentially with temperature over a certain temperature range.

We tested the effects of JCI- on jumping performance by injecting the drug into the bloodstream and measuring average jumping distance under specific conditions. We looked at temperature effects by carrying out the same experiments at a range of different ambient temperatures. We conducted the study on two different species to see if the effects observed were species-specific or more general in nature.

**Materials and Methods** (notice that Materials are not included – you will need to include them).

**Effects on jump distance:**

Ten specimens of *Rana pipiens* were given 1.0 ml. of 10% JCI solution Ten control frogs were given injections of 1.0 ml of a salt solution. All frogs were maintained at 25°C for 1 day in 1 inch of water. At this time each frog was placed on an open floor and
induced to jump 2 times by slapping the ground behind the frog. The jump distance was defined as the sum of two jumps. The same procedure was repeated using *Rana iwanna*.

The effects of temperature:

Each of the JCl-treated frogs was placed in a temperature controlled tank, ranging from 0 to 90°C in intervals of 10°C. One control frog was placed in the tank with each treated frog. The frogs were left in the temperature controlled tanks for 24 h, and then tested, as above, for jumping performance. Each frog was tested 10 times.

Results

The effects of JCl on jumping distance depended on the species tested. These results are summarized in Figure 1. It is clear from this figure that JCl had a striking impact on *Rana pipiens*, but had little or no effect on *Rana iwanna*. The mean 2-jump distances (at 25°C) for *Rana pipiens* were 2.3 m (sd=1.5) for controls and 4.2 m (sd=1.2) for JCl-treated. The mean distance was significantly longer for the treated frogs (t-test, O.005<P). *Rana iwanna* the mean for untreated frogs was 2.6 m (sd=1.5), and for the treated frogs, 2.5 m (sd=2.0). The difference in means was not significant (t-test, p=0.11).

The relationship between temperature and jump distance is shown for *Rana pipiens* in figure 2. The same relationship for *Rana pipiens* is shown in figure 3. It is clear from Fig. 2 that for *R. pipiens* jump distance increases linearly with temperature. For *R. iwanna* temperature also affects jump distance in an approximately linear fashion, but does not begin to have an effect until the temperature exceeds 30°C.
Figure 1. The effect of JCI injection in two species of frogs at 25°C. Bars indicate mean 2-jump distances. Shaded bars are *R. pipiens* and open bars are *R. ursina*. Error bars indicate 1 standard deviation from the mean (n=10).

Figure 2. The effects of temperature on mean jumping distance for *Rana pipiens* (n=10). Distance s are the sum of two jumps. Error bars indicate standard deviation (±1s).
Discussion

JCI- has the clear effect of increasing jump distance in both frog species (see figures 1, 2 and 3). These results support our original hypothesis that JCI- would improve jumping performance. The effect on jumping distance is clearly temperature-dependent. However, there are differences between the species in how this effect appears. For example, in R. iwanna no increase in performance occurs until the temperature exceeds 30°C. This explains why no significant difference in jumping distance was observed at room temperature (Fig. 1).

The nature of the relationship between temperature increase and JCI- effects on jumping distance was not consistent with our original hypothesis regarding the molecular mechanism of action of JCI-. We had proposed that its effect might be an enhancement of activity of certain enzymes. This led us to predict an exponential performance increase with temperature. The linear increase we observed is not consistent with the proposed mechanism. It suggests that JCI- may be directly acting on the mechanical properties of the muscles themselves. Such a mechanism has been proposed for the action of the hormone gogetemall in the tree lizard Philanthropus fabricus (Herbrain and Phutz, 1992). This suggests an interesting line of study for future experiments in which JCI- would be administered to isolated muscle preparations and its direct effects on contractile elements observed directly.

The observation that weight loss occurs when frogs are exposed to higher temperatures also suggests an effect of JCI- on the overall metabolism of frogs. We are currently carrying out a study to test the direct effects of JCI- on metabolic rate.
The results described above are important for understanding the role of JCl- in the natural biology of these frogs. In Rana pipiens reabsorption of JCl- will clearly lead to increased jumping ability which can be expected to improve its survival chances. Moreover this advantage will occur at temperatures during which it is normally active (20-40 °C). The comparison with R. iwanna is interesting however. R. iwanna is not normally active above 30°C. Nonetheless R. iwanna absorbs JCl- from its bladder. This strongly suggests that improved jumping performance alone cannot account for the evolution of the general tendency of frogs to reabsorb this substance. It would be very interesting to compare the relative amount of reabsorption in frogs active at temperatures where the effects on jumping performance occur versus those where it does not.

The results presented here also have serious implications for the use of JCl- in frog jumping contests. Twainson (1990) expressed concern that the increased occurrence of doping with this drug in frog jumping contests may have dire consequences for the sport. Here we clearly show that this drug has the potential to influence the outcomes. The seriousness of the effect on the results clearly depends on the temperature at which contests are held, as well as the species involved. Moreover we have recently found that use of JCl- compromises the health of our frogs. Our results support the conclusions of Twainson (1990), and suggest that government regulation and drug testing may be in order.
Literature Cited


