

## How to Make a Concept Map

### LEARNING OBJECTIVES:

- Integrate concepts about multiple physiological systems in their application to an animal's ability to do something.
- Analyze physiological tradeoffs.
- Conceptually illustrate these physiological tradeoffs and relationships among physiological systems with a concept map.

### BACKGROUND:

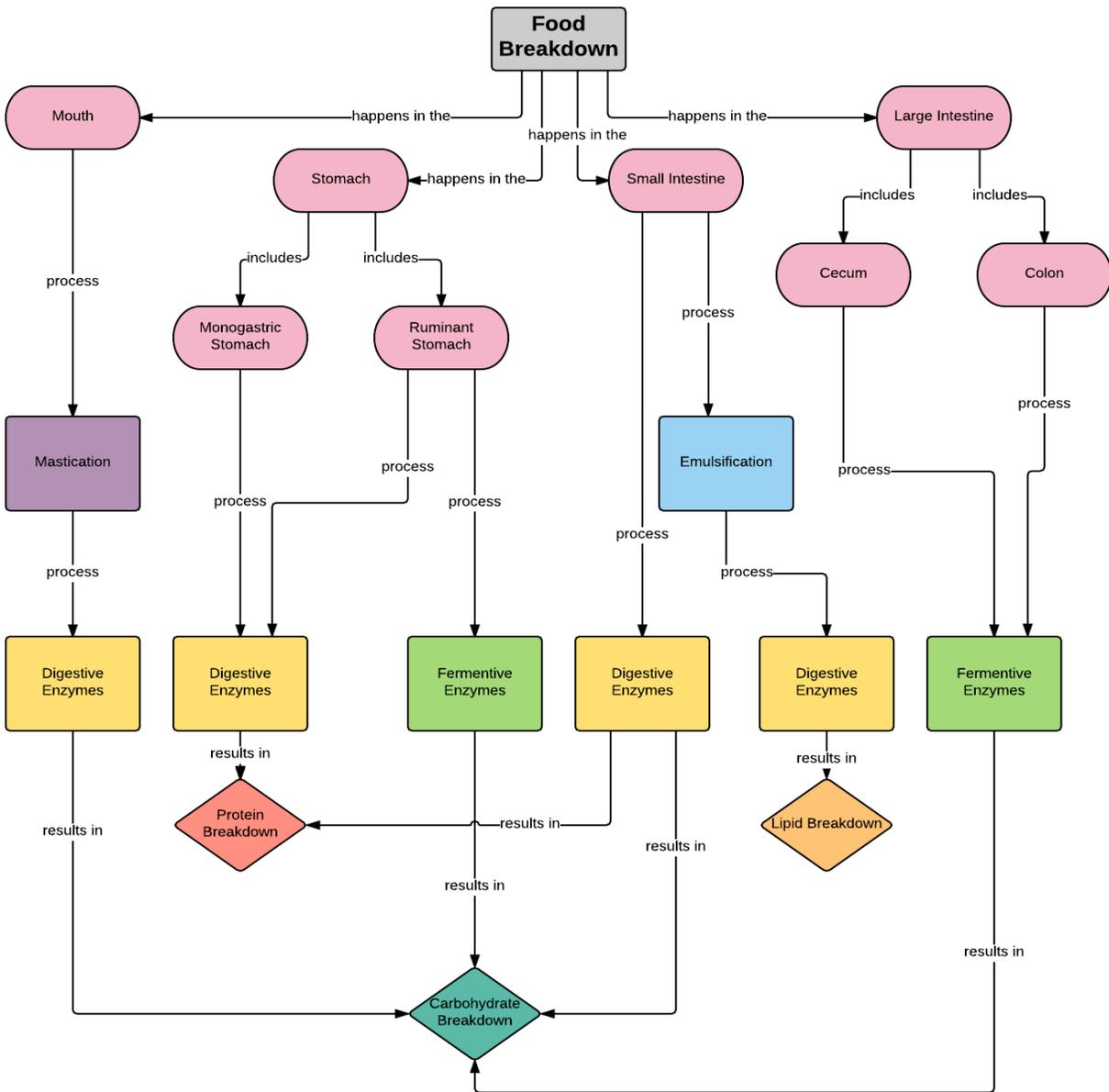
**Concept maps** are graphical tools for representing and organizing information in a way that shows relationships between ideas. They can help you organize your thoughts, study, and even brainstorm new ideas because they allow you to see how a variety of topics and processes are connected. Concept maps are typically made by placing a word or phrase in a box or oval and using arrows or lines to link it to other words and phrases, showing the relationship between these concepts. There are many different kinds of concept maps; some common concept map formats are the **hierarchy concept map**, the **spider concept map**, and the **flowchart concept map**.

### Hierarchy Concept Map:

The hierarchy concept map is organized with a main topic at the top, sub-topics branching downward from the main topic, and supporting details branching down from the sub-topics. This type of map is ideal for writing an essay, because it can help you generate supporting evidence and understand the primary and secondary details of the subject. It can also be used to categorizing information.

1. Brainstorm a list of important ideas related to your topic.
2. Choose the concept from your brainstormed list that is most essential to all of the others (i.e. the one from which all of the others stem). This may be obvious, or it may require a little thought. Remember, if it's a hierarchical map, then the key word/phrase should be the one that connects all of the others. Put this word/phrase in a box or oval at the top of your map.
3. Choose the second tier of the second most important words/phrases from your brainstormed list and write them below your key word/phrase, each in their own box or oval.
4. Add lines to connect the concepts, and explain the relationship between the concepts in a word or two. The relationships can vary; one concept can be part of another, it can be crucial to another concept, it can be used to produce another concept, or there can be a variety of other relationships.
5. Continue this process down the tiers until you have included all of the concepts on your brainstormed list.

6. Example:

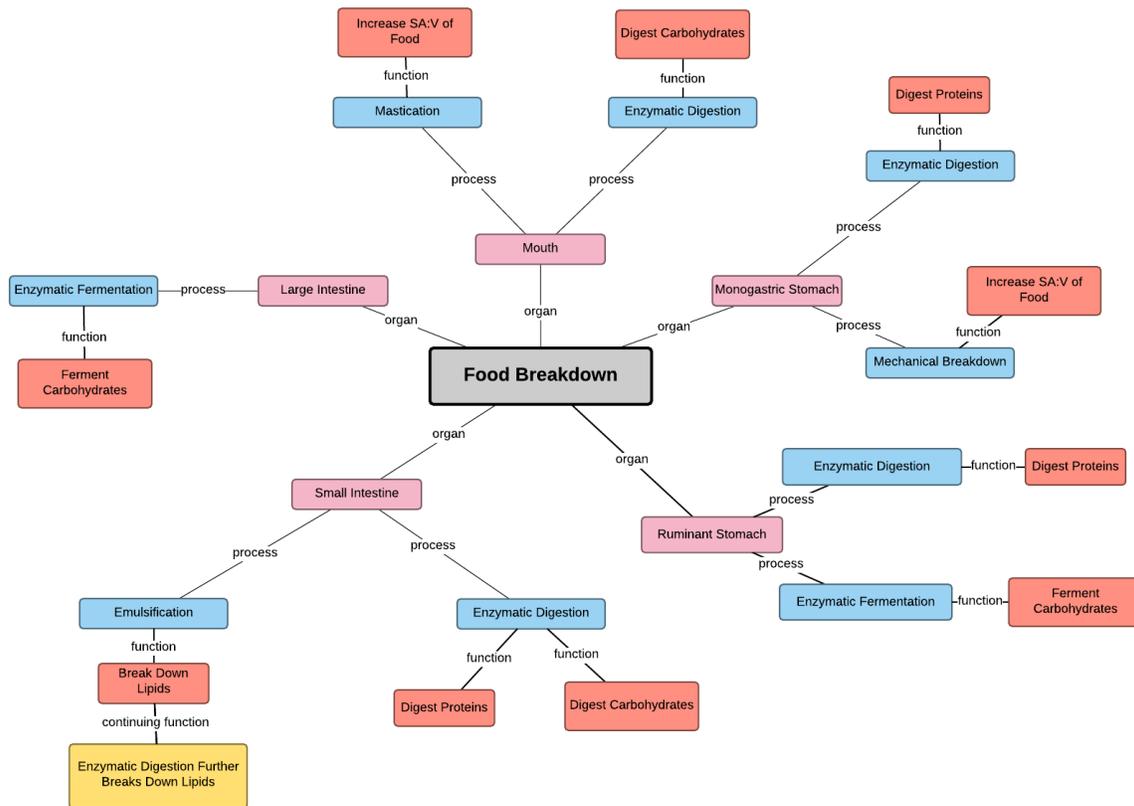


Spider Concept Map:

The spider concept map is organized with a main topic in the center, sub-topics branching outward from the main topic, and supporting details branching off the sub-topics. This format will actually make the map resemble a spider. This type of map is very useful for helping you see which topics are richer than others, because you'll see that you can "branch off" more concepts from larger topics. It can be useful when there is a high level of interconnectedness across multiple concepts.

1. Brainstorm a list of important ideas related to your topic.
2. Choose the concept from your brainstormed list that is most essential to all of the others (i.e. the one from which all of the others stem). Put this word/phrase in a box or oval in the center of your map.

- Write the subtopics around the main topic. You can write them in smaller circles and connect the circles to the main topic.
- Add lines to connect the concepts, and explain the relationship between the concepts in a word or two.
- Continue this process outward until you have included all of the concepts on your brainstormed list.
- Example:



**Flowchart Concept Map:**

The flowchart concept map allows you to examine a process and see the multiple options for getting it done. The flowchart can be linear and can just flow from one concept to the next, but it can also have multiple elements for examining a variety of outcomes. The starting point can be a process or a problem that needs a solution. This type of map is very useful for decision making and process analysis.

- Start with a problem or topic. Put this word/phrase in a box or oval at the top of your map.
- Brainstorm causes or solutions (depending on your focus) for the problem or subsets of your topic. Write them below your key word/phrase, each in their own box or oval.
- Add lines to connect each stage to the stage above it, and explain the relationship between the concepts in a word or two.
- Continue this process downward until your flowchart is complete.

5. Example:



MIGRATION CONCEPT MAP ASSIGNMENT:

Together with your assigned group, use your shared PowerPoint slide through OneDrive to design a concept map about the physiology of animal migration. You can diagram the topic as a whole or you can choose a subtopic within it, but you must include aspects of the nervous system, sensory systems, motor systems and metabolism in your concept map. Choose any of the concept map formats above to best illustrate the relationships among your chosen concepts. Include a *minimum* of 25 concepts and 40 connecting lines (with relationships among connections explained) in your map. Use lecture notes and the textbook as your primary resources.

## Writing a Thesis, Outline and Argument Map

Today you will work in groups of three. Each of you should have brought in your thesis and paper outline.

### Part 1: Checking Your Organization With Your Outline

With each of your group members' outlines, answer these questions:

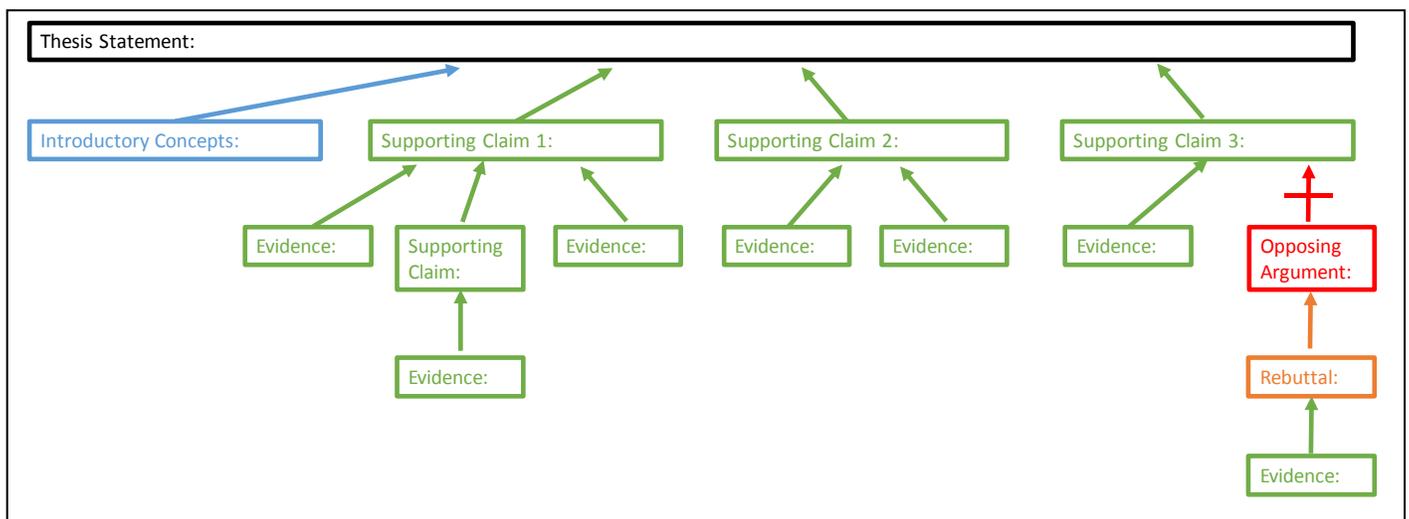
1. Identify and underline the thesis. Does this thesis follow approach 1 (support a particular theory/hypothesis), approach 2 (explore a range of theories/hypotheses to explain the same phenomenon), or approach 3 (develop a novel theory/hypothesis)? Does the topic present something of interest? Why or why not? Is the topic too broad or too narrow?
2. Is the main analysis section organized chronologically, thematically or methodologically? Do you think this is the best organization for this particular topic? Why or why not?
3. For the given thesis, what topics need to be included in the Introduction? Are they all included?
4. Does the main analysis section include all of the topics you would expect to address this thesis? Does the main analysis section include topics that do not directly relate to the thesis?
5. Does the main analysis section address rebuttals of the thesis? Does it do this effectively? Why or why not? Can you think of any additional rebuttals the author should address?
6. Does the outline include a conclusion and references?

Once everyone in the group has jotted down notes on their answers to all of these questions on each of the outlines, discuss your feedback on each one with your group. When the group discusses your outline, take good notes on their feedback and incorporate it into an updated outline that you will bring to the next Writing Workshop.

### Part 2: Creating an Argument Map of Your Paper

An argument map is a graphical representation that exposes the structure of the argument. Mapping your argument can provide a useful method for ensuring that it is strongly supported, based on valid assumptions, and logical. Use your updated outline to construct a detailed argument map, citing references to support each claim. You can find a template on D2L.

Template:



Sarah Jane Alger - Biology

Please upload your outline to the “Final Outline” dropbox and your argument map to the “Argument Map Draft” dropbox before the next class. For the next Writing Workshop, you should bring in: (1) your updated thesis and outline, (2) your argument map, and (3) your working references page.

## How to Critically Read Scientific Literature

### OVERVIEW:

All of the scientific knowledge that is used to invent everyday devices, inform public policy, develop medical treatments, grow our food, and enlighten our decisions ultimately comes from primary scientific research. Throughout this course, you will be asked to thoughtfully discuss, explain, and integrate scientific papers. This can be a daunting activity, especially if you do not have much practice reading primary research papers. This lab is designed to teach you an approach that will maximize your comprehension of primary research papers in a reasonable amount of time.

### LEARNING OBJECTIVES:

- Explain how scientific knowledge is generated.
- Compare and contrast primary literature, secondary literature, tertiary literature and popular science (pop-science) writing.
- Define independent variable, dependent variable, treatment groups, control groups, and controls.
- Read a primary literature article and identify the hypothesis, biological rationale, methods, results, and conclusions.
- Critically evaluate and discuss scientific evidence.

### BACKGROUND:

Scientific literature comes in four basic forms: primary literature, secondary literature, tertiary literature and pop-science. The papers you will be reading for this course are mostly **primary literature**: papers that report original research and have been peer reviewed prior to publication. **Peer review** is a critical component to the scientific process in which other scientists with relevant expertise evaluate the scientific credibility of a paper to ensure that it consists of sound and reliable information and interpretation. **Secondary literature** (often called **review papers**) consists of peer reviewed papers and academic books that review, integrate, and summarize the primary literature for a professional scientific audience. **Tertiary literature** includes textbooks, encyclopedias, and other sources that review, integrate, and summarize large volumes of both primary and secondary literature for a scientific audience. Tertiary literature is not peer reviewed, but is generally reviewed by editors. **Pop-science writing** is also not peer reviewed and it includes books, magazine articles, newspaper articles, blog posts, and other sources that provide scientific information to the lay public.

The burden of assessing published material lies with you, the reader. After completing a critical reading of a journal article, you should be able to paraphrase the significance of the paper in 3 or 4 sentences. You should also be able to both praise and criticize several points of the paper. **Critical evaluation** does not necessarily mean a negative evaluation; rather, it should recognize both the strengths and weaknesses of the paper. Keep in mind that the authors don't have all of the answers or all of the time and money needed to discover them; and they sometimes make mistakes. Learn to evaluate their work as you would that of your peers.

Primary literature can be very intimidating; it uses so much jargon, methods, and statistical details that we're not familiar with, we sometimes feel like we are tasked with interpreting a paper in another language... and in a sense, that is exactly what we're doing. You are not alone in this struggle; even scientists get stumped on unknown elements of every paper they read. But like learning a foreign language, the key to reading and understanding primary scientific literature is immersion. I don't expect you to comprehend every detail of the papers you read for this class, but I do expect you to develop a solid understanding to the answers to each of these questions (which will be referred to as "**the four questions**" throughout this course):

- 1) What was/were the authors' hypothesis/hypotheses? What previous evidence caused them to believe this would be true (i.e. identify the biological rationale)?
- 2) Briefly, what were the methods? Identify the independent and dependent variables and the treatment and control groups. List the techniques used.
- 3) What were the major results and how did they relate to the hypothesis/hypotheses?
- 4) What were the authors' conclusions and do you believe them? Why or why not? What additional evidence would strengthen your belief?

The effective strategies for reading a primary literature paper are very different from those we use for reading other types of literature. For one thing, primary literature papers need to be read *at least twice*. The purpose of the first pass is to help you generate expectations of what the paper will attempt to convince you of. The second pass is a thorough reading and critical evaluation of the paper. For another thing, primary research papers are most effectively read *out of order*. Here are some guidelines:

#### First Pass:

The goal of the first pass is to gain a general understanding of what the authors did, what their results were and how they interpreted the results. Tolerate confusion or ambiguity during your first read. Try not to expect the complexities of the paper to be clarified immediately. Your confusion can generate excellent questions that may be answered during your second read, or if not, provide material for discussion or further investigation. For your first pass, you should take notes for each of the following steps:

1. Read the **Title**. It should summarize the work of the article and help you to clarify your expectations of the paper.
2. Read the authors' **names** and **affiliations**. Where and with whom are they working? What is their expertise?
3. Identify the paper's major conclusions using only the **Title** and **Abstract**. Keep the theme(s) in mind while reading the entire paper.
4. Study the **figures and tables**, including the legends. The data are the backbone of the paper and you need to understand them. From this first pass with the figures, you should be able to identify the **independent variables** (the variables manipulated by the researchers), **dependent variables** (the variables measured that are supposedly affected by the independent variables), **treatment and control groups**, and major **results** of their study.

5. Skim the **Introduction** to learn about the general subject, past work in this field, and how the study will fit into the big picture of biology. It should be very clear what the objectives were, what their paper will tell you, and why it is important. At this point you should have an idea of the authors' **hypothesis**, their reasons for believing this hypothesis may be true (i.e. the **biological rationale**), and their general approach to test it.
6. Skim the **Methods**, which describes the **study system** (organisms, locations, time period), **experimental design** (the groups compared and their treatments, what was measured), and **techniques** used (both for collecting data and analyzing data). At this point you don't need a thorough understanding of every detail of what they did, but you should be able to describe each of these three elements with a simple sentence.
7. Skim the **Results** and match up your understanding of the figures and tables with your understanding of the text. At this point you should be able to summarize the main conclusions.
8. Skim the **Discussion**. This is where the results are interpreted, related to relevant theory, and put into context of the questions and big picture. The authors should explain the results and how their analysis relates back to the hypotheses and questions. There should also be a description of how the work has advanced our understanding of the subject. Unsubstantiated speculation should be avoided, but authors will often discuss new hypotheses generated from the present work and alternative interpretations of the results.

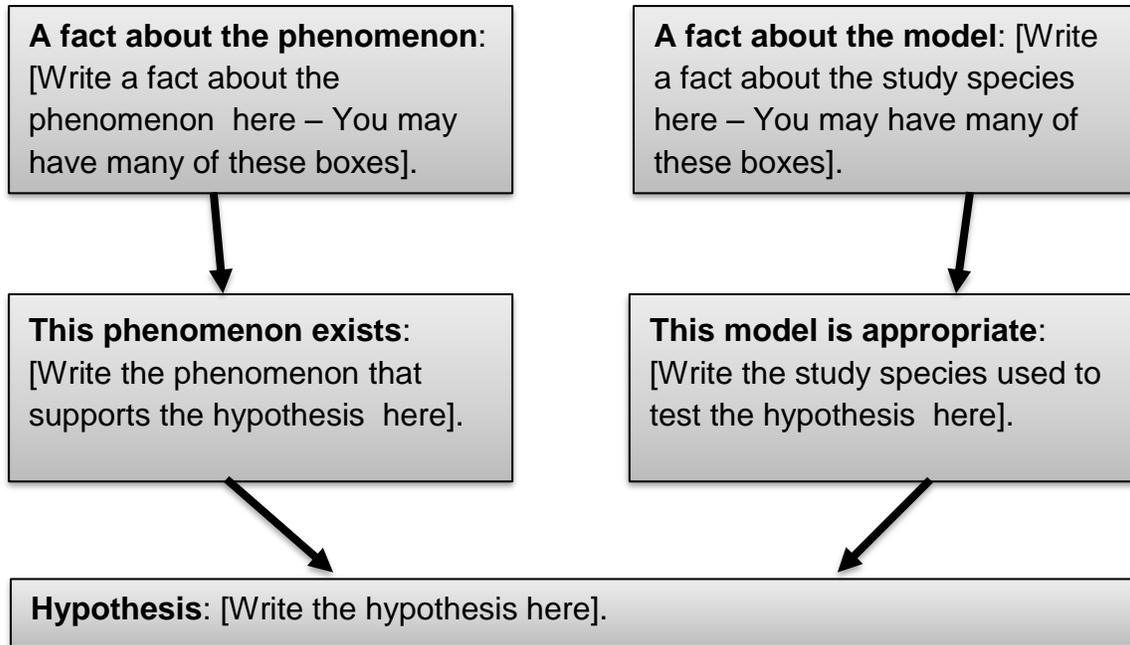
Second Pass:

The goal of the second pass is to deepen your understanding of the paper, address any questions or misunderstandings you may have had during the first pass, and to critically evaluate what the authors did, what their results were and how they interpreted the results. You should add to and alter your first pass notes during each of the following steps:

1. Reread the **Title**. Does it match your understanding of the paper?
2. Read the **Abstract** carefully. It is a summary of the questions, general approach used, results, interpretation, and conclusions. Abstracts can be difficult to read because an entire publication must be summarized in an understandable way in only about 200 words.
3. Read the **Introduction** carefully and create a **biological rationale map**.
  - a. On a sheet of paper, identify the hypothesis and write it in a box at the bottom of the sheet.
  - b. In animal physiology research, the biological rationale generally has two components of the argument: (1) this physiological phenomenon exists (or these physiological phenomena exist), and (2) this model system has attributes that make it appropriate to study this physiological phenomenon in. Each of these main components of the biological rationale is a *claim*. Identify these two main components of the biological rationale and put each in boxes with an arrow pointing to the hypothesis box.

- c. For each of the components of the biological rationale, find the facts that support it (these are *supporting claims*) and add them each in their own box, with an arrow pointing to the point it contributes to.
- d. Once you have created the biological rationale map, consider: Is the logic that guides the researchers to their hypothesis sound? Are there other hypotheses that could explain the same phenomena?

### A Basic Biological Rationale Map Format:



4. Read the **Methods** carefully. You should consider whether the design and methodology accurately addressed their hypothesis. What could they have done differently to improve the strength of their conclusions?
5. The **Results** should adequately, objectively, and accurately describe the data presented in the paper, in prose and in figures and tables. Pay attention to the data, tables, and graphs. Do they clearly, succinctly, and attractively present the results of the paper? Compare your impression of them with the author's interpretation. (For the purposes of this class, assume that the statistical analyses were appropriate and performed correctly. If you have a strong background in statistics, you are welcome to question the analyses, but if not, don't waste time worrying about the stats.)
6. Read the **Discussion** carefully. Are the conclusions justified by the data? Were the original questions answered? Does the interpretation of the data seem objective and accurate? What are the implications of the results for general issues and understanding in this field? Are there further studies suggested by this work that might help to clarify things?

7. Use your notes to write summary answers to the four questions, including a biological rationale map:

**“The four questions”:**

- 1) What was/were the authors’ hypothesis/hypotheses? What previous evidence caused them to believe this would be true (i.e. identify the biological rationale)? Answer this question in the form of a biological rationale map.
- 2) Briefly, what were the methods? Identify the independent and dependent variables and the treatment and control groups. List the techniques used.
- 3) What were the major results and how did they relate to the hypothesis/hypotheses?
- 4) What were the authors’ conclusions and do you believe them? Why or why not? What additional evidence would strengthen your belief?

Habits of Critical Readers:

1. *Read without distraction.* Critical reading is best done when you are focused and comfortable, but not too comfortable. This might be at a library study cubicle, a coffee shop, or wherever you find you work well and are alert.
2. *Keep good notes* and organize the notes for easy future referencing.
3. *Make comments.* Highlight or underline the parts that you think are important. Write notes in the margin. Use a question mark to note things that you don’t understand.
4. *Look up unfamiliar words* as you encounter them (especially if they are used multiple times). Re-write them in your own words if necessary, and use that definition when you encounter them later in the paper.
5. *Don’t get bogged down.* A scientific paper should tell a story and the plot is more important than the details. Skip difficult parts to avoid losing the story line. Come back to them later to see if you can reason them out. If you can’t, come talk to me or ask about them in class.

LAB ASSIGNMENT:

Today you will practice the First Pass steps on an actual primary literature paper. Unlike most reading experiences you will not do this alone, but as a group. Here are the instructions:

1. Introduce yourself to the other folks at your table.
2. Using the assigned article, go through each of the steps outlined in “First Pass” out loud as a group. For each step, there should be a period of quiet while everyone is reading and processing and jotting notes, followed by an audible discussion.’
3. Complete the In-Lab Assignment questions, write your name and your lab partners’ names on it and turn in one copy for your group.
4. To clean up, return the copied articles to the front desk.

**CRITICAL READING**  
**PRE-LAB ASSIGNMENT**

NAME: \_\_\_\_\_

These questions will help you compare and contrast forms of scientific writing, create a biological rationale map, and identify the major components of an experiment from scientific writing.

1. Indicate which types of scientific writing (by the following numbers) have the following attributes: (\*Note: answers may be used more than once).

1= primary literature, 2= secondary literature, 3=tertiary literature, 4=pop-science

- a. Found in academic journals \_\_\_\_\_
- b. Has a Results section \_\_\_\_\_
- c. Peer reviewed \_\_\_\_\_

2. Rank the types of scientific writing (by the following numbers) in terms of credibility:

\_\_\_\_\_ > \_\_\_\_\_ > \_\_\_\_\_ > \_\_\_\_\_

3. Rank the types of scientific writing (by the following numbers) in terms of readability:

\_\_\_\_\_ > \_\_\_\_\_ > \_\_\_\_\_ > \_\_\_\_\_

What follows is the entire Introduction section from the paper, Fuxjager, M.J., Mast, G., Becker, E.A. and Marler, C.A. (2009). The 'home advantage' is necessary for a full winner effect and changes in post-encounter testosterone. *Hormones and Behavior*, 56: 214-219. (Note: Numbers in brackets denote references cited in the original paper). Read it and then answer the following questions about the corresponding biological rationale map.

Winning aggressive disputes can enhance an individual's ability to win future contests. This example of plasticity in winning ability is called the winner effect [22], and it occurs in species of fish [3, 10], mammals [37], birds [12], and invertebrates [20, 47].

Whereas most studies of winner effects address how the experience of winning itself can modify the chances of future victory [22] few experiments investigate how the context of a fight might also influence the winner effect's formation and expression. This fact is surprising given the extensive literature demonstrating that contextual factors associated with aggressive male-male encounters have potent effects on animal aggression [2, 24].

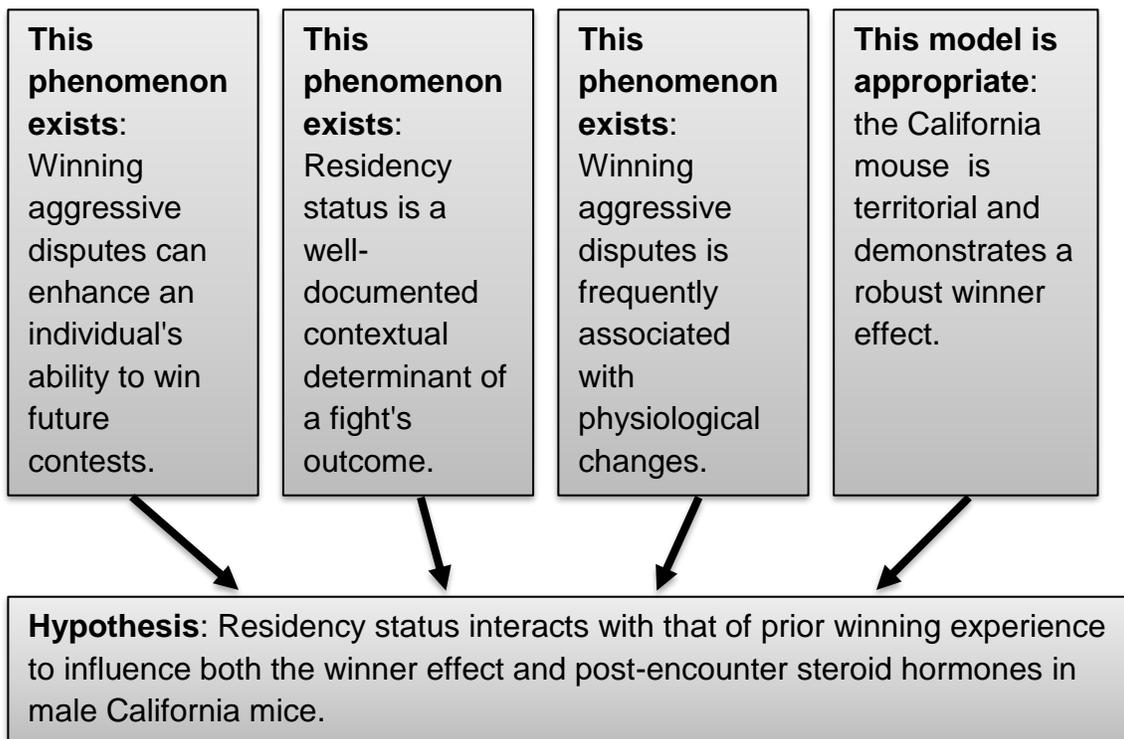
Residency status is a well-documented contextual determinant of a fight's outcome. In many species, including humans, individuals are more likely to win disputes that occur within their territory or home range [15, 27, 31, 36, 46], a phenomenon called either a 'home advantage' [9] or a 'residence effect' [25]. Although only a few experiments investigate whether residency status influences the winner effect [4, 20], in these studies, animals that had won a prior aggressive interaction were selected as focal individuals.

This methodology results in focal individuals that are intrinsically better fighters [5] and thus introduces a confounding variable (intrinsic fighting ability) into the experiment that blurs any effect residency status might have on the winner effect [5, 10, 22].

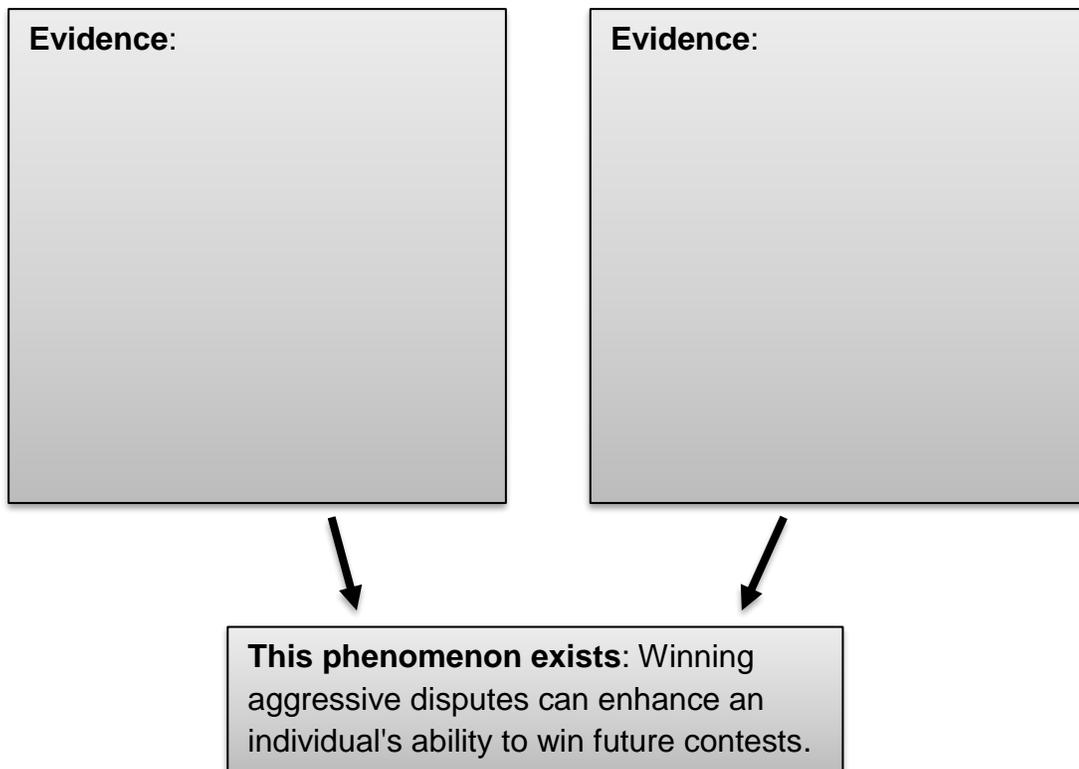
Additionally, winning an aggressive contest is frequently associated with physiological changes. For instance, steroid hormones like testosterone (T) and progesterone (P) sometimes change following an aggressive encounter (reviewed in [11, 18]), a concept expanded upon by the so-called 'Challenge Hypothesis' [49]. Researchers have hypothesized that such post-encounter hormonal titers modulate plasticity in future winning ability [11, 34, 37, 45] and/or territorial site preference [29]. Interestingly, recent studies have shown that a fight's social context can influence the expression of post-encounter T pulses [19, 35], suggesting that other sources of contextual information associated with a given antagonistic contest, such as residency status, might have similar effects. Little is known about the factors that generate inter-individual variation in contest-related T spikes, but this topic has recently generated a great deal of interest [48].

This study investigates how the effect of residency status interacts with that of prior winning experience to influence not only the winner effect, but also post-encounter steroid hormones. We used the monogamous and territorial California mouse (*Peromyscus californicus*) because this species demonstrates a robust winner effect [37] and experiences a post-encounter T surge that changes future fighting behavior. Also in this species, P is thought to affect aggression [11, 45], yet the exact mechanism through which this occurs remains unclear. Thus, we subjected male mice to aggressive contests against opponents with a slight competitive edge and manipulated whether the focal individual had a 'home advantage' during the encounter and/or winning experience before the encounter. We measured each focal animal's plasma T and P after the contest to determine if these hormones change as a result of residency and winning experience working in concert or independently. We also measure corticosterone (Cort) to assess if encounters in the unfamiliar cages were more stressful than those in the home cage.

### Biological Rationale Map:



4. Underline and label the hypothesis in the introduction. Where was it located?
  
5. Underline the sentences/phrases in the introduction relevant to the claims in the corresponding biological rationale map. Where were they located?
  
6. Underline the sentences/phrases in the introduction that support the claim in the biological rationale map that "Winning aggressive disputes can enhance an individual's ability to win future contests". Where were they located?
  
7. Add part of a third tier to this biological rationale map, by adding supporting claims that cite evidence that supports the claim below.





**CRITICAL READING**  
**IN-LAB ASSIGNMENT**

NAME: \_\_\_\_\_

LAB PARTNER(S): \_\_\_\_\_

\_\_\_\_\_

These questions will help you practice skills to critically read primary research papers more effectively and efficiently.

1. Map the biological rationale of the assigned paper below. Your map must include a box for the hypothesis, at least one box for the phenomenon, at least one box for the model system, and at least three boxes of evidence that support the main claims.





**Participants of Critical Thinking FEG Luncheon Meeting on Friday, November 17, 2017**

#	First Name:	Last Name:	Department:
1	Sarah Jane	Alger	Biology
2	Elia	Armacanqui-Tipacti	World Languages and Literatures
3	Lindsay	Bernhagen	CITL
4	Kym	Buchanan	Education
5	Sydney	Bueno	Education
6	Dave	Dettman	Library
7	Ashley	Driver	Biology
8	Cary	Elza	Communication
9	Jennifer	Hess	Continuing Education
10	Corey	Huck	HPHD
11	Jennifer	Huffman	Library
12	Todd	Huspeni	Academic Affairs
13	Vera	Klekovkina	World Languages and Literatures
14	Dejan	Kuzmanovic	English
15	Nikki	Logan	Education
16	Nancy	LoPatin-Lummis	University College/History and International Studies
17	Lynn	Ludwig	English
18	Shanny	Luft	Philosophy
19	Elizabeth	Martin	Business
20	Michele	Miller	Campus Activities & Student Engagement
21	Ismaila	Odogba	Geography/Geology
22	Sarah	Orlofske	Biology
23	Neil	Prendergast	History and International Studies
24	Eduardo	Rodriguez	Business & Economics
25	Sean	Salstrom	Art and Design
26	Nancy	Shefferly	Biology
27	Krista	Slemmons	Biology
28	Dona	Warren	Philosophy
29	Emily	Wisinski	Tutoring-Learning Center
30	Christopher	Yahnke	Biology
31	Amy	Zlimen	Sociology & Social Work

11/14/2017