

Molecular Biology Through Discovery

Problem Set 1: Strategies of Life; Finding Articles

Part of every answer (now and always) should be the reasoning that led to it.

Part I: Strategies of Life

1.1. Which of the following are hydrophobic? Hydrophilic? Amphipathic?

- | | |
|----------------|---------------|
| A. vinegar | D. sugar |
| B. skin | E. wax |
| C. tooth paste | F. rabid dogs |

(The following problems require drawing. You might use Paint, PowerPoint or similar, or you can draw something and scan it somehow (last choice!). Establish your own graphical conventions or – why not? – use those that appear in the Notes.)

- 1.2. Consider that at an air-water interface, amphipathic molecules expose their hydrophobic surface to air. Draw a picture of what a soap bubble might look like at the molecular level, using a long-sticked popsicle to represent a molecule of soap.
- 1.3. Phospholipase A2 is an enzyme commonly found in snake venom that acts by cutting off one of the two fatty acids on phospholipids. Draw a picture that shows how extensive action of the enzyme might detrimentally affect the structure of a cell membrane (including its overall shape). At the scale of your model, how big would a cell be?

Part II: Introduction to the Course

The following resources may be helpful for answering the remaining questions:

- [How to Find Research Articles](#)
- [How to Find a Mentor](#)

Another suggestion: Read through all the remaining questions before starting to answer any of them.

1.4. Choose some topic that interests you and is related to molecular biology. Estimate how many articles have been written related to that topic, where the topic is the main focus of the article. The topic should be sufficiently broad that the number is greater than 6 but sufficiently narrow that the number does not exceed a couple of 100.

Here's an example of a bad topic: *DNA replication* (> 100,000 articles!)

Here's an example of a good topic: *Control of transcription during the development of facial characteristics in dogs*

Provide the topic, the number of articles, and the means by which you made the estimate, in sufficient detail that someone else could reproduce what you did and come up with the same number.

1.5. Find a review article concerning the topic you related in Question 5.

Provide a full reference* to the article and the means by which you found it.

1.6. You're looking for a research job, after having spent much of the past few years of your life studying mycobacteria. You want to stay with that field, but you fear that your choices are limited, as you feel compelled to live close by your ailing parents in Wilmington, DE (Delaware). You've

* All references (here and elsewhere) should contain the names of all the authors (unless there are more than 10, in which case list the first two... and the last), the year, the title, the journal, the volume, and the inclusive page numbers. Provide also a link to the article (or its abstract) that works outside of VCU. If you provide this information, any format is OK.

decided a good strategy is to find some organization in Wilmington that has published recently on work related to mycobacteria (define "recently" as within the last 15 years).

Provide references to one or more articles that fit your criteria, along with the name of the organization and the means by which you found all this information, in sufficient detail that someone else could reproduce what you did and come up with the same number.

- 1.7. Find a faculty member at VCU whose research fits into the area you defined in Question 4. Feel free to work backwards, changing your area of interest to fit the interests of a particular faculty member, but make sure that your answers to Questions 4, 5, and 7 are consistent with each other.

Provide references to one or more articles with the VCU faculty member as an author that demonstrates the connection with your area of interest. Also provide a brief explanation of why you chose this article and topic. What's so interesting?

Extra – in case you have the time and inclination

Suppose you are an editor at a respected scientific journal, and you are considering the following submission for publication:

*Mary had a little lamb, whose fleece was white as snow,
And everywhere that Mary went, the lamb was sure to go.
It followed her to school one day, which was against the rules.
It made the children laugh and play, to see a lamb in school.*

You're inclined to reject the manuscript out of hand. It is shorter than the usual submission to your journal, but the main objection is the lack of what you perceive to be the rigor required by a scientific article. Your heart softens, however, and you resolve to fulfill your calling as an editor by editing, rewriting the submission to meet your specifications. What follows is the first paragraph of what came of your effort, the **Results** section of an article in which *every assertion is connected to an observation*, either yours or someone else's, and *every observation is connected to the means by which it was produced*.

Cultural Impact of Human-Ovine Mutualism

Results

An adolescent human female (code-named "Mary") was tagged with a fluorescent protein for subsequent identification and then released. In random observations (n=7) over the course of a day, she was repeatedly observed within 2 meters of an animal with morphological characteristics typical of sheep [1]. The length of the animal's ischium (pelvis bone) to the scapula (shoulder bone) was measured repeatedly to be 18.7 cm, to be expected if the measurements were performed on a single specimen. This value places the animal in the smallest 5% of lambs in the 2010 U.S. lamb census [2].

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References

1. Reece WO (2009). Functional Anatomy and Physiology of Domesticated Animals. Fourth edition. Wiley-Blackwell, Danvers MA.
2. U.S. Bureau of Agronomic Statistics (2010). Morphological Assessment of Livestock. p.47. U.S. Government Printing Office, Washington DC.

Your task now is to complete the **Results** section of the manuscript, following the original as closely as possible but adhering to your high standards regarding evidence. Strangely, those high standards for some reason do not prevent you from making up any facts you may need and any references to justify those facts. So feel free.

Provide the Results and References sections.