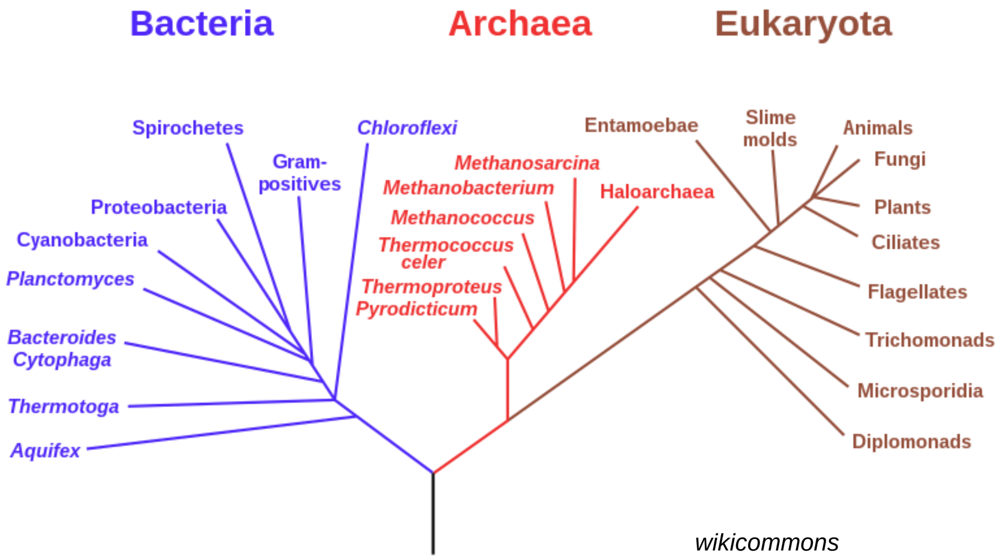
# Welcome to Biology 121-224
# Genetics, Evolution & Ecology

Ian McAllister, Pacific Wild

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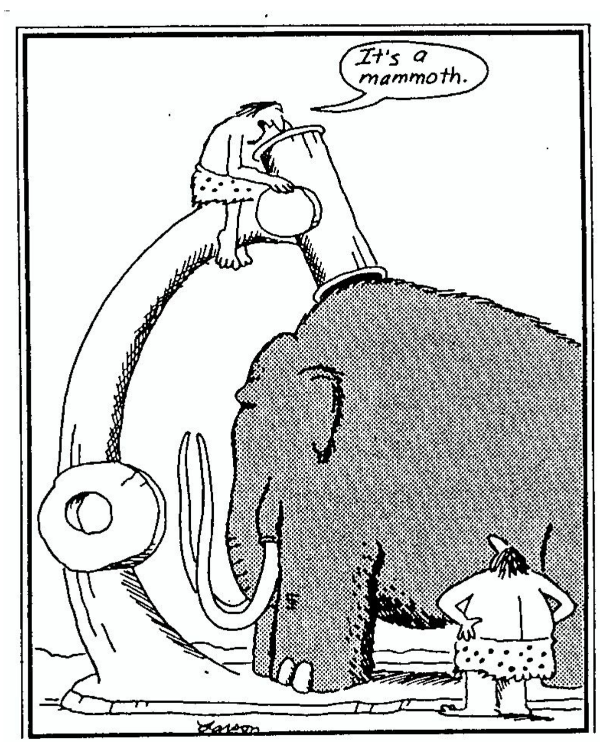
# Biology 121

- I think this is an awesome class! ☺
- Cover basic concepts in genetics, evolution and ecology (in that order), such as:

  - how genetic information is transmitted across generations
  - how genetic diversity and variation arises
  - how evolutionary mechanisms result in changes in populations and species over time.
  - how species interact with each other and their environment.

# Main Goals

– to provide you with foundational knowledge necessary for upper year biology courses;
– Hopefully, add to your appreciation of the natural world (especially snakes ☺); and
– to help you appreciate how biologists understand the world.



Early microscope

Testing whether or not animals "kiss."

# Overview of today’s class

- Welcome & Introductions
- Course Overview / Administration details
- Tips & Tricks to success #1  - Writing a scientific explanation
- Small activity on describing results

#1 reason for lost marks on 121 exams – incomplete explanations.

#2 misreading questions

# Land Acknowledgement

With thanks, I respectfully acknowledge that I live and work on the traditional, ancestral, and unceded lands of the hən̓q̓əmin̓əm̓ speaking xʷməθkʷəy̓əm (Musqueam), the Stó:lō, Sḵwx̱wú7mesh Úxwumixw in Sḵwx̱wú7mesh (Squamish), and Tsleil-Waututh nations of the Coast Salish peoples.

https://students.ubc.ca/ubclife/welcome-musqueam-territory

# iClicker Question: On a squirrel scale - how was your winter break?

A. 1

B. 5

C. 6

D. 8

E. Other #

# Introductions

Introduce yourself to the people around you☺

Example question:

If you could be any organism, real or fictional, what would you be?  Why?

3-minutes


# Rory Macklin (he/him)


Research Interests: avian evolution and speciation, paleobiology, community science!


**macklin@zoology.ubc.ca**

# Nadia Páez, Ph.D. student, Zoology program

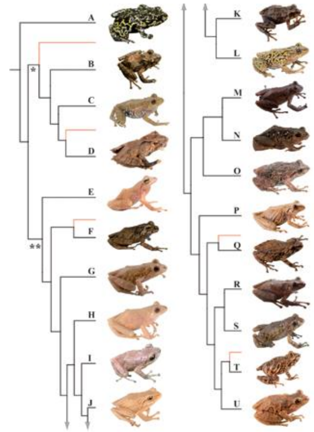
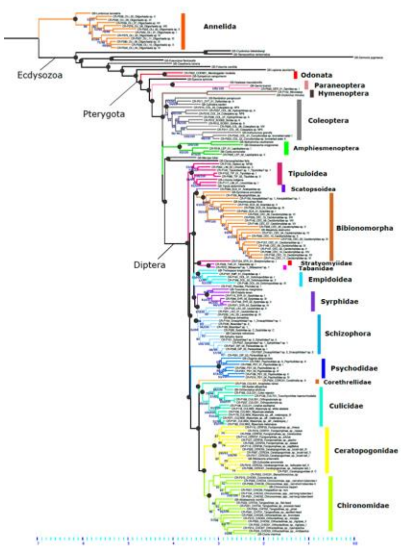
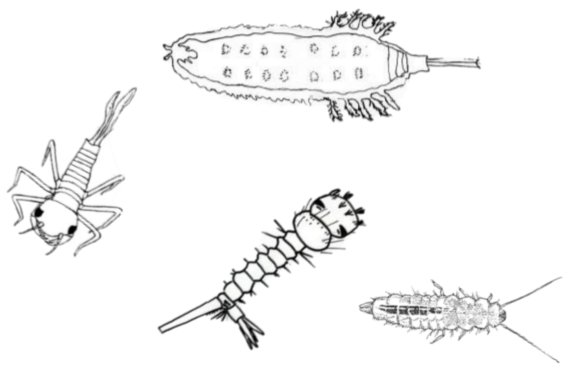




**Figure 4.** Morphological variation within *Pristimantis*, subgenus *Huicundomantis*. **A** *Pristimantis philipi*. Pristimantis cryptomelas group (*): **B** *Pristimantis gagliardoi* **C** *Pristimantis muscosus* **D** *Pristimantis cryptomelas*. *Pristimantis phoxocephalus* group (**): **E** *Pristimantis torresi* sp. nov. **F** *Pristimantis hampatusami* **G** *Pristimantis jimenezi* sp. nov. **H** *Pristimantis phoxocephalus* **I** *Pristimantis totoroi* sp. nov. **J** *Pristimantis atratus* **K** *Pristimantis chomskyi* sp. nov. **L** *Pristimantis multicolor* sp. nov. **M** *Pristimantis* sp. (CCS2) **N** *Pristimantis gloria* sp. nov. **O** *Pristimantis luteae* sp. nov. **P** *Pristimantis tinguichaca* **Q** *Pristimantis verrucolatus* sp. nov. **R** *Pristimantis* sp. (UCS1) **S** *Pristimantis teslai* sp. nov. **T** *Pristimantis versicolor* **U** *Pristimantis atillo* sp. nov.



**Ruby Burns** ***(they/them)***

*Peer Tutor*

I’m a fourth year biology undergrad from Mississauga (Ontario). I love all things marine biology, and am researching kelp settlement for my Honours thesis!  When not nerding out over seaweed, I love to play music, crochet, and explore the beautiful biodiversity right here in Vancouver. This’ll be my fourth time helping with this course, and I’m super excited for this term!

# **Lynn Norman** – Instructor (please call me Lynn)

- I have been teaching at UBC since December 2001 (likely before you were born)
- Until recently I was a Biology 140 lab instructor

# iClicker Question - Which of the following fact(s) about me is FALSE?

| | | |
|---|---|---|
| A. I have bicycled around New Zealand | B. I have been diving under the ice | C. I have been within 1 metre of a wild black bear |
| D. I have never played a video game | I have gone powder skiing in the Rockies by moonlight | E. I tried to get 400 live jumping spiders on a commercial flight |

# For the Alliance!

# My “old” research:

*Thamnophis* spp.  Garter Snakes (3 species)

http://www.macleans.ca/wp-content/uploads/2014/06/MAC23_PHOTO_ESSAY_SNAKES_CAROUSEL.jpg

# Other field research I have been involved with..









# I LOVE questions!

- So, please do not hesitate to contact me if you have ANY questions (e.g. BIOL121, non-121 questions – field work, cats, House of the Dragon, etc.)

- If you email me:
  - Please put section number in subject line or body of email.
  - If I do not respond within 36 hours, please email me again, as I may not have seen your email.

# Course Overview

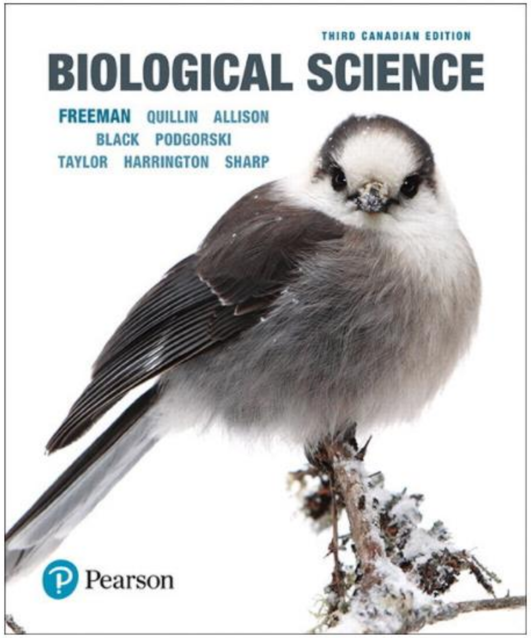
The lecture is being live-streamed and recorded.  Panopto link near top of Canvas home page.

# Textbook

Biological Sciences, 3rd Canadian edition by Freeman et al. (2019)

- either e-text or hardcopy

- other texts are possible (see syllabus)




I do not expect you to read relevant textbook pages ahead of class; but, if it helps – there are targeted readings on Canvas > Genetics – Other Information

Textbook goes into more detail that is testable (e.g. proteins involved in mitosis/meiosis).

**If I lecture on concept it is testable (unless I provide directions otherwise). If I don't lecture on a concept, I will not test you on that concept on the exam.**

# Mark breakdown

## EXAM MARKS – 80%

- Midterm #1 (Genetics): Tuesday, February 7th — 20%
- Midterm #2 (Evolution): Tuesday, March 14th — 20%
- Final Exam (Ecology + Cumulative): TBA — 40%
  - sometime between April 17 and April 28

- Exams typically involve multiple choice, select all, explanation-type questions
- May be some drawing
- May be some interpretation of drawings (e.g. chromosome drawings) and/or interpretation of data in tables and/or figures

- Improvement bonus: If a person earns a higher grade on the final exam than on one or both midterms, I will transfer up to 5% of the weight of the midterm(s) to the final exam.
  - e.g., if a student does better on the final exam than midterm #1,
    midterm #1 = 15%, and final exam = 45%

# Mark breakdown

## NON-EXAM MARKS – 20%

- Canvas quizzes, 1-2/week (correctness, 2 attempts) 3%
  - *I drop the two lowest quiz marks*
- Worksheets 1-2/week (submitted to Canvas, completion only) 3%
  - photos okay – please submit pdf, jpeg, doc/x, not .pages, HEIC
- Other Participation marks 4%
  - *Dr. Pam Kalas genetics survey, plus two feedback surveys*
- Group project 10%

- Unless otherwise noted, Canvas assignments are due on Sunday @ 11:59 pm.
- Submission link for worksheets will be left open for 3 days past deadline. Once submission link closes no submissions accepted except under exceptional circumstances.
- I cannot extend deadline for quizzes (by more than a few hours) because quizzes are marked for correctness, and answers are released noon the next day.

# Group Project

- 10% of grade
- Opportunity to explore a topic in biology (genetics, evolution and/or ecology) that you find particularly interesting
- Create an infographic presentation targeted at a general audience
- Marks for content (correctness, clarity), visual appeal, citations/references, and an educational activity.
- Group size 3-6 students (once you have created a team, sign up on Canvas > People > Group Project Teams ONLY).
- There is a link on Piazza ("Search for Teammates" Project) if you are looking for team members.
- I need everyone to submit possible topic (and group member names) on Canvas by Sunday, February 12* @ 11:59 pm. (error in syllabus)
- Project due on Sunday, March 26$^{th}$ @ 11:59 pm – <u>one submission per team</u>
- More details will be posted on Canvas very soon.

# Questions during class

- Please use Piazza live Q & A.   Monitored by teaching team. Anonymous.

Outside of class time, please also consider posting your questions on Piazza – it helps everyone.  Also anonymous.

If sending an email, please put section in subject line (e.g. BIOL121-224).

# Any questions

# 3-minute break

- Where does the terminator look for toilet paper?

A. Aisle A front
B. Aisle A back
C. Aisle B front
D. Aisle B back

# 3-minute break

- Where does the terminator look for toilet paper?

A. Aisle A front
B. Aisle A back
C. Aisle B front
D. Aisle B back

# Tips & Tricks for Success #1

How to write a scientific explanation.

Learning Objective: Be able to write a clear, persuasive scientific explanation with a clear statement of claim supported by appropriate evidence (quantified, if possible) and logical reasoning.

- #1 reason for lost marks on a 121 exam – incomplete explanations
  - missing evidence; or
  - evidence present but **<u>not quantified</u>**
  - missing logical steps (logic/reasoning)
  - missing definitions/teaching moments

# One model for how to write a scientific explanation

## Claim, Evidence & Reasoning Model

- CLAIM = One sentence that answers the question. Should come first (because it provides context for the evidence and reasoning).
- EVIDENCE = factual information (qualitative and quantitative) that supports claim or conflicts with claim.
  - sufficient to be convincing, persuasive (use all relevant evidence provided)
  - quantified, if possible
  - described (not listed)
  - indicate magnitude of difference, direction (e.g. greater than), if relevant
  - indicate if there is a significant difference, if relevant ($p \leq 0.05$)
- REASONING = logical steps connecting evidence to claim
  - e.g. Therefore…, hence…, this shows…, this implies.., this suggests, this supports…
- Include teaching moments, definitions, as needed.

# Example question #1

Which animal would win a 100m dash – a corgi or a cougar?   Use the claim, evidence, reasoning format to explain your answer.

Note – an animal's rate of movement is a function, in part, of its stride length (i.e. distance travelled with each step).

Leg length ~ 23 cm

Leg length ~ 72 cm

You have 3 minutes to answer this question

*wikicommons*

# Example answer

Claim: A cougar would win a 100m dash if it was competing against a corgi

Evidence (Factual information): Cougars have legs that are more than twice as long (mean=72 cm) as corgis (mean=23 cm).

Reasoning (logic, linking evidence back to claim): Longer legs means the cougars have a longer stride length than corgis. A longer stride length means a faster movement speed, all else being equal. Therefore, cougars would win a 100m dash over a corgi because their longs legs allow for a faster movement speed than the corgis.

# Example question #2

The flight speed of animal is, in part, a function of its **body weight** and its **wing loading** (wing loading = mass of animal divided by wing surface area). All else being equal, the heavier the animal and the higher the wing loading, the faster it must fly to maintain lift and stay in the air.

Based on the data provided in the table below, which animal would fly faster: an adult Canada Goose or an adult bumble bee?

| | Adult Canada Goose  | Adult Bumble Bee  |
|---|---|---|
| Mean body weight (g) | 5662.0g | 0.88g |
| Mean wing surface area ($cm^2$) | 2820.0 $cm^2$ | 1.97 $cm^2$ |
| Mean wing loading ($cm^2$) | 2.01 $g/cm^2$ | 0.45 $g/cm^2$ |

You have 3 minutes to answer this question

# Example answer

CLAIM: An adult Canada goose would have a faster flight speed than an adult bumble bee.

EVIDENCE (factual information): Canada geese have a wing loading of 2.01 $g/cm^2$, which is more than 4X greater than the wing loading of bumble bees (0.45 $g/cm^2$). Adult Canada geese also have an average body weight of 5662.0g, which is more than 6,000X greater than the average body weight of adult bumblebees (0.88g).

REASONING: Therefore, given the higher the wing loading and body size of the Canada geese, the Canada geese must have a faster flight speed than bumblebees in order to maintain lift and stay in the air.

# Questions?

# iClicker Question

Have you been taught how to describe results from a figure?

A. Yes, very recently
B. Yes, but a few years ago
C. Yes, but I need a refresher
D. No

On the 121 exams we could expect you to read figures and/or describe results

# Reading a figure

In BIOL121, we are likely to show you a point graph or bar graph (see images on the right).

These researchers were looking at the effect of body temperature (°C) on jump distance (cm) in frogs.

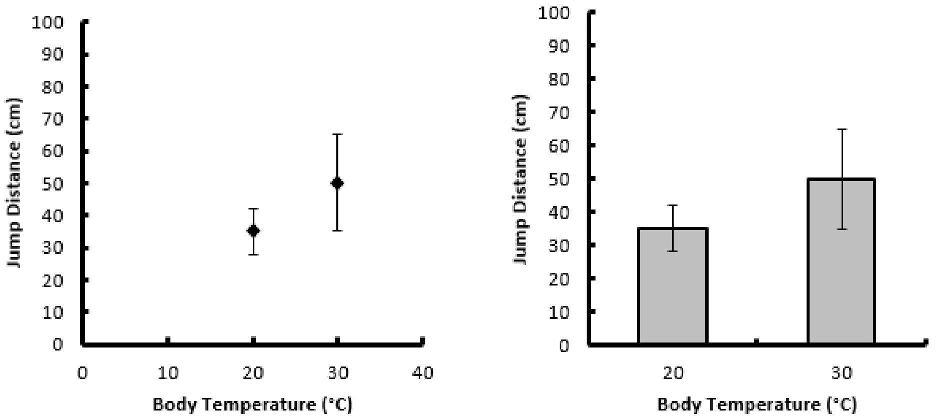
The independent variable ( body temperature) is plotted on the x-axis.

The dependent variable (jump distance) is plotted on the y-axis.

Both figures show the same data; just different formats

Error bars beyond scope of 121; often a measure of variation in data

Dependent variable on y-axis




Independent variable on x-axis

# Describing results for BIOL121

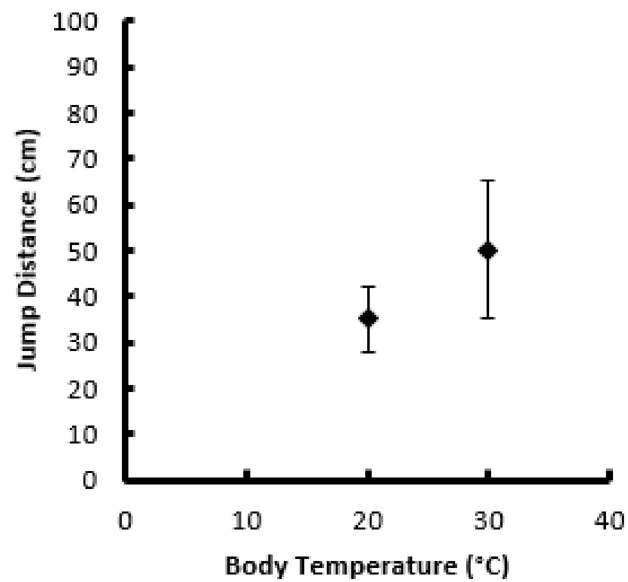
A common error when describing results is to simply list numbers/values. That is a list, not a description, and makes your reader work

1. State the pattern or trend* (*if 3 or more points)

2. Quantify the values (if possible)

- I recommend including direction, and some measure of difference, if appropriate)

3. If a statistical test has been done, state whether there is a significant effect/significant difference in values



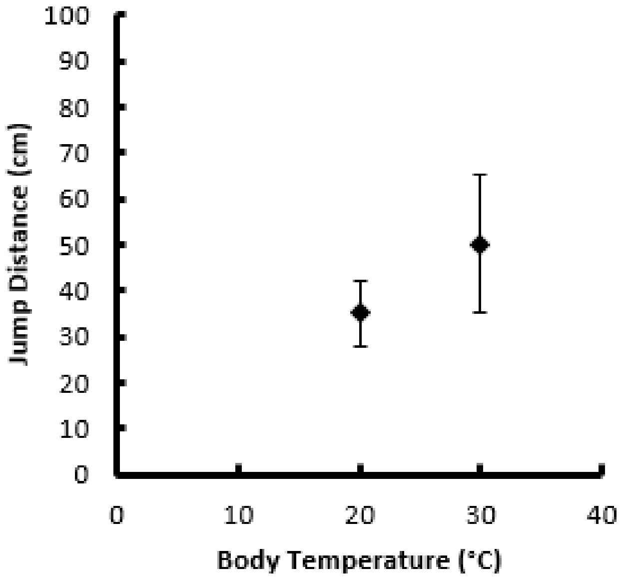

*You will know if a statistical test has been done if you are given a p-value or an * (p-value may be in figure/figure caption/or results description). A p-value ≤ 0.05 means there is a significant difference.*

What would you point out to your reader for this figure that shows the effect of body temperature on frog jump distance?

# Describing results

1. Pattern or trend

- *The frogs jumped farther when their body temperature was warmer, i.e. at 30°C* ***compared to 20°C.***




2. Quantification of values (not listed)

- *- Individuals tested at 30°C jumped an <u>average</u> of 53 cm, which is approximately 20 cm farther, on average, than individuals tested at 20°C (<u>mean</u>=~35 cm)*

3. Significant difference or not

- - can't say anything:
  - no *p*-value given
  - nor, no asterix *

# How would you <u>describe</u> the results of this study?

In their study of the feeding preference of sea stars (*Pisaster ochraceus*) by McClintock & Robnett (1986), sea stars were presented with equal numbers of four sizes of blue mussels (*Mytilus californianus*). The sizes of the mussels eaten was recorded.

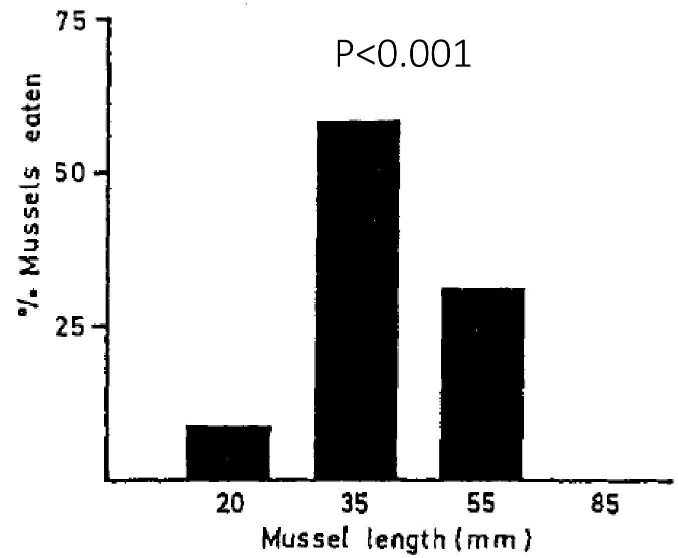



Fig. 1. Percent of available prey ingested by *Pisaster ochraceus* (70–110 mm R) simultaneously offered equal numbers of four sizes of clumped *Mytilus californianus* (20, 35, 55, 85 mm shell length) (n = 31).

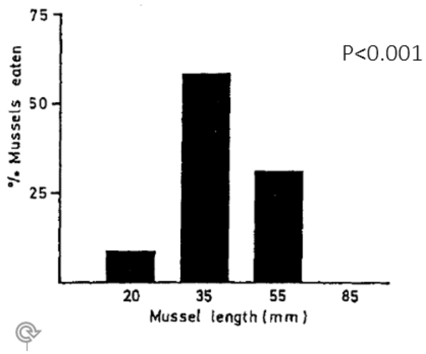
Pattern (or trend, if present)
Quantification
- direction, indication of magnitude of difference

Significant effect or not

# iClicker Question

Which results description should receive the highest mark?  Why?

A.  The sea stars consumed <10% of the smallest mussels (<20 mm in length),~60% of the mussels that were 35 mm in length, and ~30% of the mussels that were 55 mm in length.  This was a significant difference.




*Weakest description (lowest mark).  Results listed, not described; no p-value mentioned; no referral to the largest mussels (85 cm) being avoided.*

B.  The sea stars showed a significant preference (p<0.001) for blue mussels with a medium body size (p<0.001).  Mussels with a body size of 35 mm were chosen most frequently, while small (20 mm) and larger (55 mm) mussels were chosen least frequently.

*Better.  Most results described; direction provided, but no mention of magnitude; no mention of sea stars avoiding largest mussels.  p-value mentioned twice, not critical, but unnecessary*

C.  The sea stars showed a significant preference for feeding on blue mussels with a body size of 35 mm (p<0.001).   Blue mussels with a body size of 35 mm were eaten more than twice as frequently (~60% eaten) than the larger mussels (55mm, ~30% eaten) and smaller mussels (20 mm, <10% eaten). The largest blue mussels were avoided (85 mm, 0% eaten).

*Best (highest mark).  Complete description of results, including approximate magnitude of difference.  Only description that included 85 mm mussels.*

# Next class (Thursday):

- Start the Genetics Unit
- Cell cycle:  G1, S, G2 phase, Mitosis
  - a lot of terminology (e.g. chromosome, ploidy, gene, allele, chromatid)