Fundamentals in Ecology

Scientific writing: How to write a report

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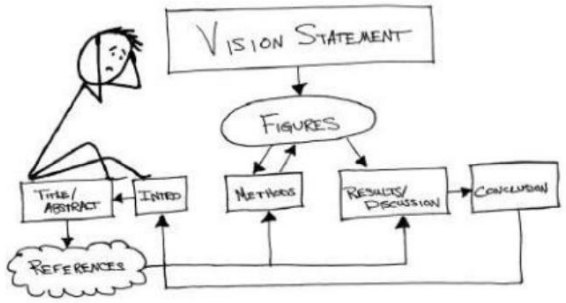
6 March 2024

THURSDAY - PRACTICALS - ENV 220			Week	Important deadlines
20/02/25	11h15-13h	Introduction to practicals	1	
27/02/25	11h15-13h	Setting up experiments	2	**Inform the experimental setup to TAs by email by 26/02/25**
6/3/25	11h15-13h	How to write a report	3	
13/03/25	11h15-13h	Introduction to R	4	
20/03/25	11h15-13h	Field measurements 1	5	
27/03/25	11h15-13h	Data visualization in R	6	
3/4/25	11h15-13h	Field measurements 2	7	
10/4/25	11h15-13h	How to do statistical analyses	8	
17/04/25	11h15-13h	Field measurements 3	9	
24/04/25	**Easter Holiday**			
1/5/25	**ENAC Week**			
8/5/25	11h15-13h	Field measurements 4	10	
15/05/25	11h15-13h	Data Analysis/Interpretation	11	**Weighting of plant material in GR B2 423 before 15/05/25**
22/05/25	11h15-13h	Questions / Discussion	12	
REPORT SUBMITTED on MOODLE BY 06/06/25				



How to write the report

What is a lab report?

A document that outlines the results of a scientific experiment or investigation.

It typically includes:

- Description of the experiment or investigation
- Methodology used
- Data collected
- Analysis of the data
- Conclusions drawn from the analysis.

What is a lab report?

The purpose of a lab report is to communicate the results of the experiment or investigation to others in a clear and concise manner.

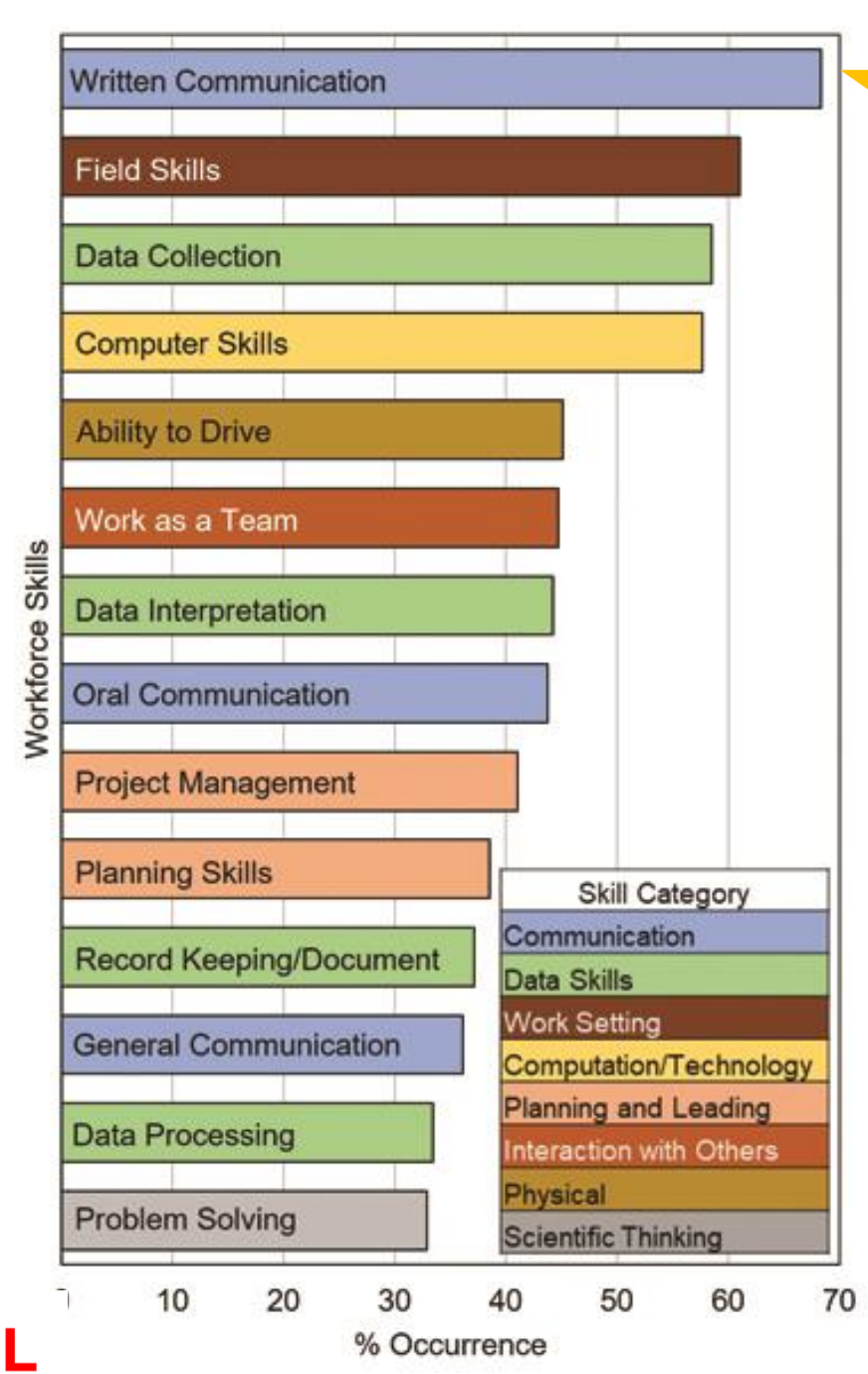
They should allow reproducibility of the experiments.

They may also include recommendations for further research or improvements to the experiment or investigation.

Why write a lab report?

1) Communication
2) Organization
3) Critical thinking
4) Attention to detail
5) Problem-solving
6) Research

Even if you do not plan to pursue a career in science, learning how to write a lab report can help you develop valuable skills that are useful in many areas of life.



Why write a lab report?

The most common skill desired in job advertisements (Shafer et al. 2022).

The assignment

- Maximum 5 pages
- Includes: Title, abstract, introduction, M&M, results, discussion and references
- Includes Table(s) & Figure(s)
- Discussion includes ≥ 5 citations
- Due June 6th

Do NOT copy previous reports.

The use of IA…

1.How ChatGPT Can Help:

1. **Research Assistance:** ChatGPT could provide additional resources and insights on the experiment topic.
2. **Structuring Support:** It could help organize the lab report into sections such as Introduction, Methods, Results, and Discussion.
3. **Language Refinement:** ChatGPT could offer suggestions to improve clarity, coherence, and grammar in the report.

2.Generating Content:

1. ChatGPT can assist in generating content for various sections of the lab report based on input prompts.

3.Revision and Feedback:

1. Students could use ChatGPT to receive feedback on their draft reports, helping them refine and improve their writing.

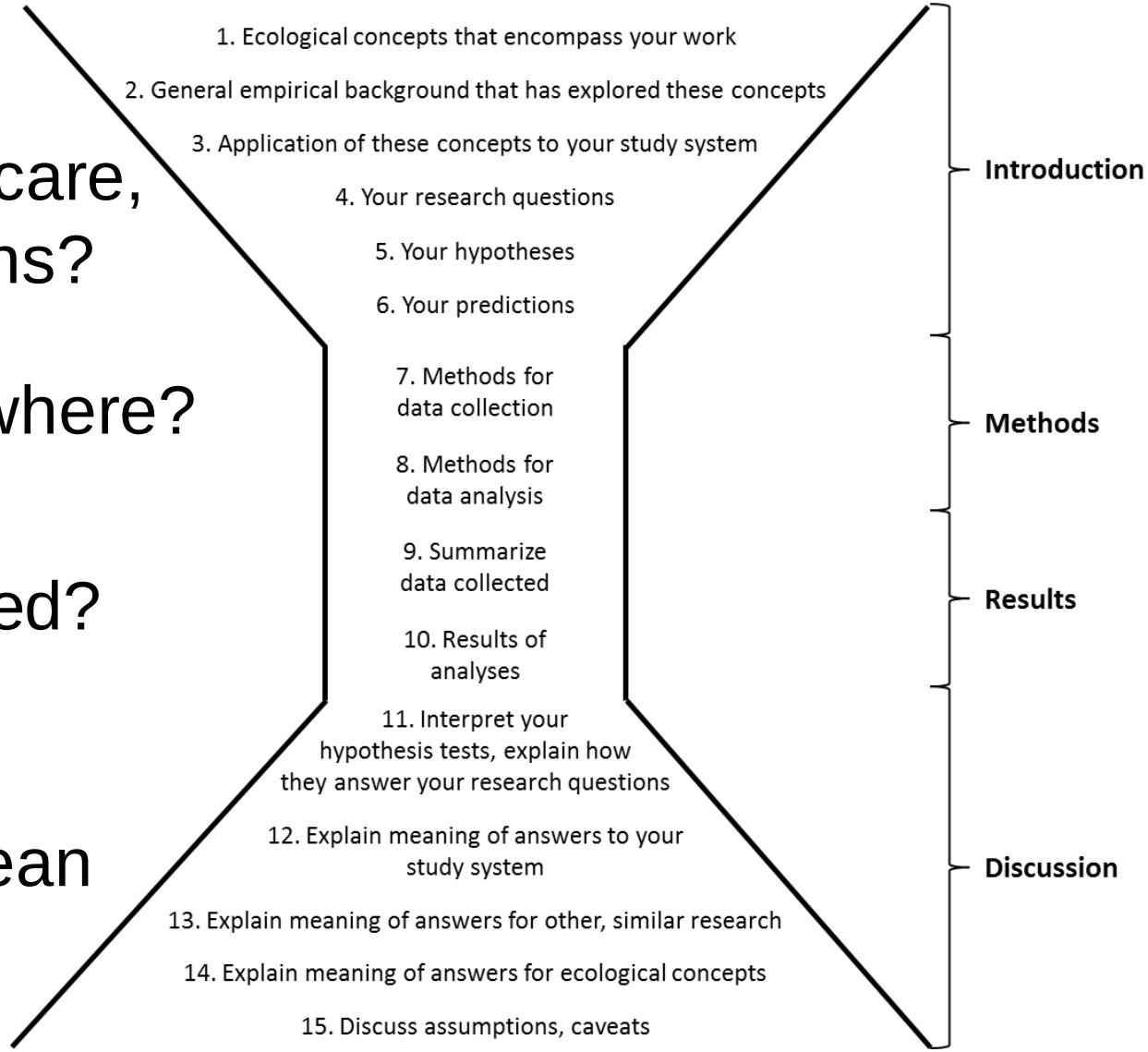
Lab report format

What topic, why care, and expectations?

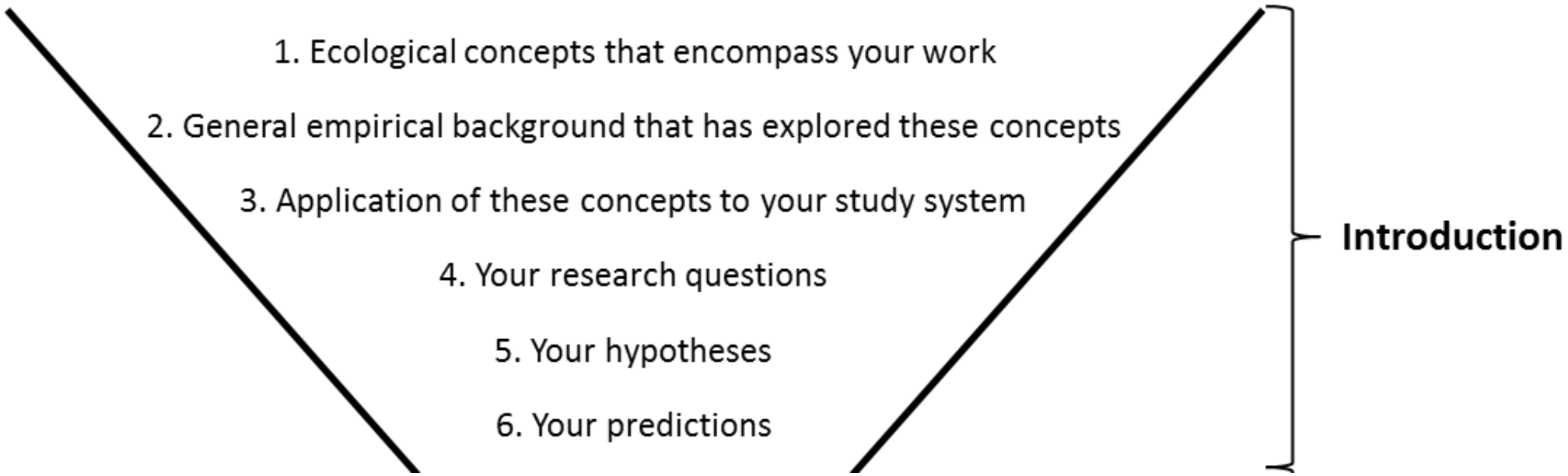
How, what, and where?

What happened?

What does it mean and why?

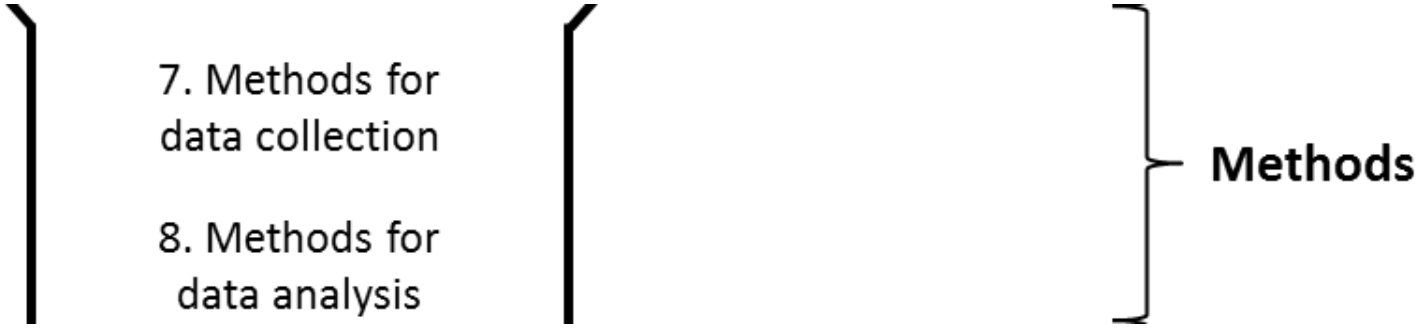


Introduction



Provide the necessary context to explain why your experiment is relevant both in the general context of ecology AND in the specific question.

Methods

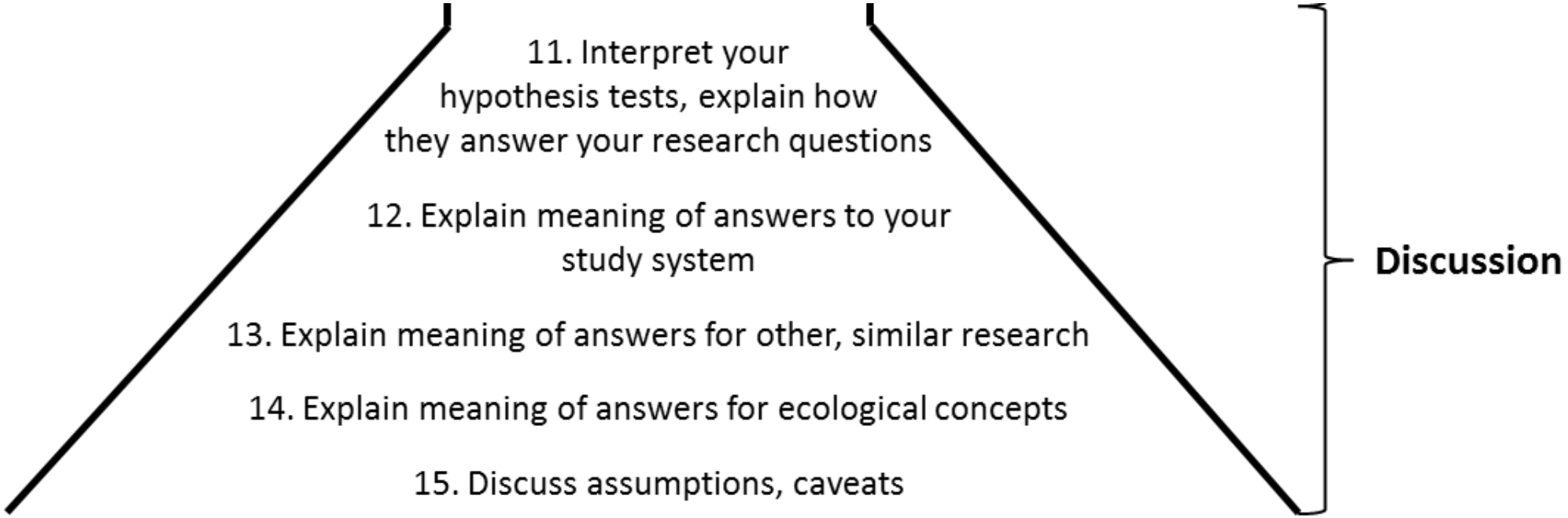


Describe where and how the experiment was performed, including how the data was collected and analyzed.

Results

Describe the outcome of the experiment **without** interpretation.
Describe data and the output of statistical analyses.

Discussion



Explain and interpret the results. Describe what is all means and link back to the bigger topic.

Where to put these things?

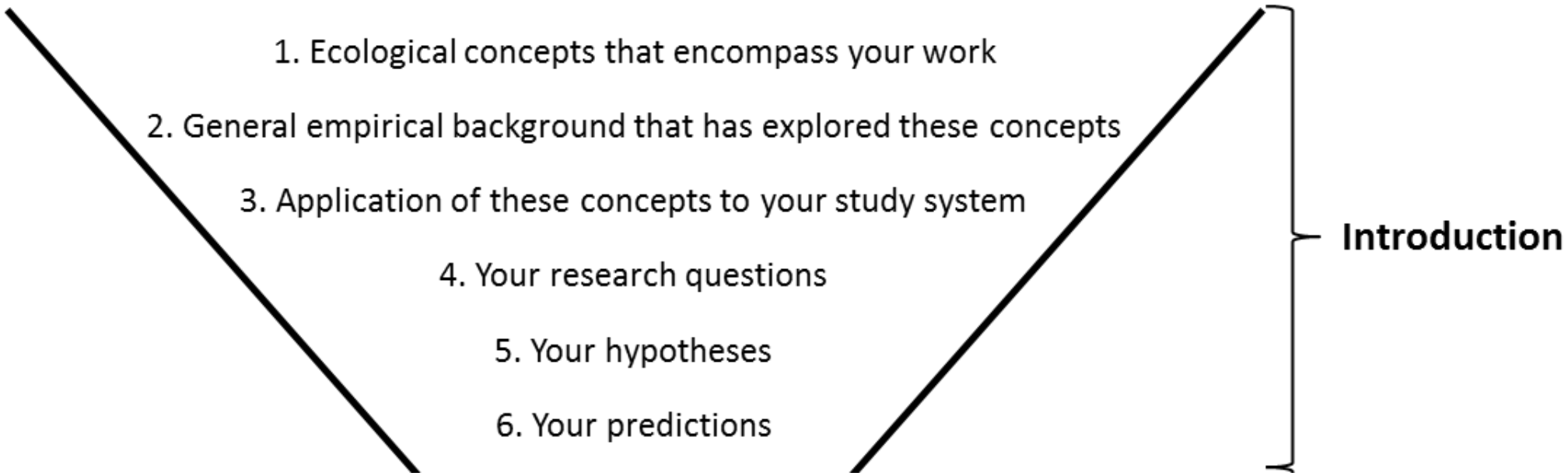
1) Data collected during experiment
2) Your hypothesis
3) How the experiment was prepared
4) Where the experiment was performed
5) Information on the topic of your study
6) Interpretation of results
7) A graph of data with results
8) Explanation if your hypothesis was correct
9) Statistical analyses performed on the data

Where to put these things?

1) How many and what type of leaves were placed in the bags
2) How quickly leaf matter was lost
3) How treatments (e.g., pool vs. riffle) were different
4) Why leaf matter is important to stream ecosystems
5) The mean number of new leaves per treatment
6) How water availability is expected to affect plant growth
7) How plant growth was measured
8) What we learned from the experiment

Introduction

Introduction



Provide the necessary context to explain why your experiment is relevant both in the general context of ecology AND in the specific question.

Introduction

Lichens are prevalent and widespread in polar and alpine environments (Printzen et al. 2012, Armstrong 2017). They are complex holobionts, defined as a symbiotic association of fungal mycobionts, algal/cyanobacterial photobionts, and often with a non-photosynthetic microbial community (Miral et al. 2022). These complex microbial associations make lichens highly adapted to hostile conditions of cold habitats (Printzen et al. 2012). Alpine

A good introduction should:

- Provide a brief background of the study topic
- Provide any necessary definitions, along with common and scientific species names
- Explain how your study fits into existing research, with citations
- Provide rationale for your hypotheses and predictions

A good introduction should NOT:

- Be an exhaustive literature review – include only enough information to inform the reader on your study topic and logically present your hypothesis
- Provide extraneous information that does not specifically relate to your project
- Include detailed information on what you did
- Include results or discussion

Introduction

Citations are used to give credit to the sources of information that were used to inform the study.

Citations are typically used to:

- Provide background information
- Support the hypothesis or research question
- Highlight gaps in knowledge

“Typically, dissolved organic matter decomposition increases with increasing water temperature (Creed et al., 2015; Gannon et al., 2015).”

Use GoogleScholar to search for citations relevant to your study.

Summarizing literature

USE YOUR OWN WORDS

The goal is for you to understand the science and important themes, thus putting the ideas into your own words will demonstrate this.

Copy-pasting is not useful (and not allowed).

Which one is better?

Aquatic ecosystems rely on organic matter as a major energy and carbon source.

An ecosystem is a biological community of interacting organisms and their physical environment.

Which one is better?

Many environmental parameters, such as temperature, sunlight, microbial activity, oxygen concentration, water velocity, and pH, influence organic matter decomposition rates in streams.

Many environmental parameters, such as temperature or sunlight, influence organic matter decomposition rates in streams.

Which one is better?

Plants are important for the environment.

The growth of plants is influenced by a variety of factors, including soil nutrients, water availability, and light intensity.

Which one is better?

Increasing the amount of fertilizer given to plants will result in faster growth rates.

Plants will grow better if they are in better conditions.

Which one is better?

The rate of decomposition of organic matter will increase with increasing stream velocity.

Decomposition will be different.

Which one is better?

The role of leaves decomposition is crucial in providing a source of carbon and energy in streams and more generally in aquatic ecosystems. Leaves falling in streams undergo diverse physical (leaching, fragmentation or abrasion), chemical and biological transformations that drive the cycle of matter.

Overall, six different stages can be highlighted, bacterial, fungal and shredder biomass, dissolved organic matter, fine-particulate organic matter and inorganic mineralization products (such as CO2 or NH4+).

Many environmental parameters such as temperature or sunlight have been shown to influence decomposition rates in streams. First, temperature is related to breakdown rates as detritivore communities and litter quality will vary. 1-4°C rise will lead to an average increase of 10% of breakdown rates as activation energy of involved chemical processes will be reached more rapidly. In addition, sunlight availability such as organic matter decomposition.
To begin with, it was shown that light availability is strongly related to heterotroph processes t experiments involving omnivorous macro-invertebrates, it was observed that fungal growth rate and bacterial biomass (two major components to organic degradation) are influenced by light.

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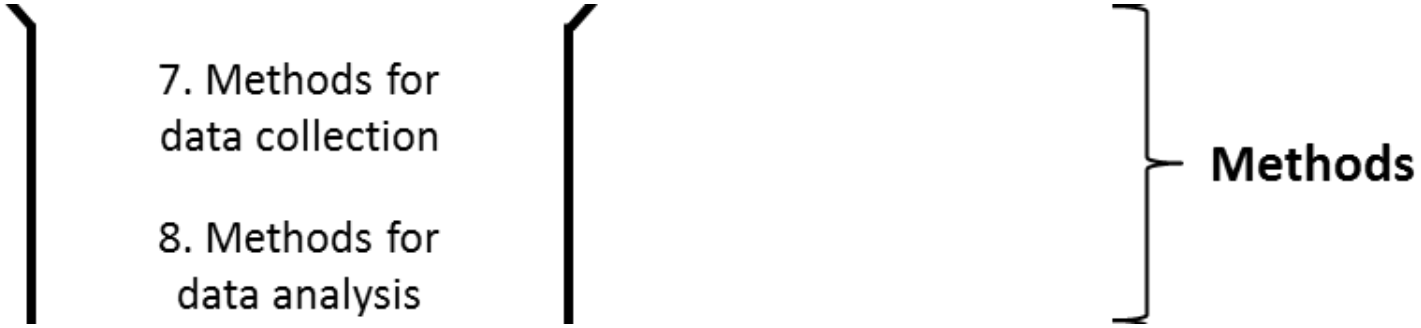
Methods

Methods



Describe where and how the experiment was performed, including how the data was collected and analyzed.

Methods

Study area: Describe your study area. Geographic location, size, boundaries, topography, and habitat type may be relevant.

Procedure: What you did – write in paragraph format (no point form or numbered steps). Include an explanation of your experimental design, sample size, replicates, measurement techniques, etc.

Methods

Materials: Within the prose of your procedure text, integrate materials that you used. Include model numbers of specialized lab equipment, concentrations of chemical solutions, and other such details.

Data Analysis: What statistical tests you used (including tests of normality), significance level set (α=?), and any data manipulation required. Include specific calculations, if appropriate.

Methods

A good methods section should...

- Provide enough detail to allow an accurate reproduction of the study
- Be written in a logically flowing paragraph format
- Provide details on the study site, materials, procedure, and statistical analyses

A good methods section should NOT...

- Be a recipe-book-style instruction guide
- Provide a list of materials
- Use bullet points
- Cite other studies for comparison

du Québec 2009). For this study, snow replicates from different sub-environments of the *Uapishka* mountain range was sampled along an altitude gradient (Fig. 1), from the R-389 access road (457 m a.s.l), to the alpine tundra of the summit of Mont Jauffret (1058 m a.s.l) and included sampling replicates above and below the boreal treeline, and under different densities of tree cover (Figure S1). These included samples from the tundra (T), boreal forest (BF), near a road (R), a road closer to a boreal forest (RBF), and a snowmobile trail (ST). Two sets of samples were collected in

Which one is better?

Leaves were put in 18 bags and then put in the stream in a pool and a riffle.

Approximately 2g of dried pine needles were sealed in mesh bags. The bags were then placed in the stream, with 9 bags placed in a pool section and 9 bags in a riffle section.

Which one is better?

Soil temperature was measured.

Soil temperature was measured at 10-15 cm depth at the center of each pot.

Which one is better?

After two weeks, the dried leaves were weighed.

The process took a few days so we had to come back two weeks later in order to weigh the dry semi-decomposed leaves.

Which one is better?

Statistical analyses and visualizations were done in R.

The data collected had to be analyzed with a statistical program, R coding was used to create appropriate graphs and visualize the results accurately.

Results

Results

Provides a concise summary of the data you collected and analyzed during the course of your investigation. Reports the empirical results, observations, measurements, and results of any statistical analyses performed.

NO INTERPRETATION!

~2 paragraphs with at least one Table/Figure

Results

A good Results section should:

- Accurately and objectively represent the data collected.
- Describe the results of the statistical analyses performed.
- Use Figures and Tables to effectively show data, and refer to them in the text.
- Be organized following the flow of the experiment.

A good Results section should NOT:

- Interpret the results.

The microbial functional diversity substrate Richness (R) index was assessed via Biolog EcoPlates (Fig. 2) at 10°C and 0°C incubations. As the average well color development (AWCD) was low and R equaled to 0 for a portion of the samples, Shannon diversity in-

Which one is better?

a) The mean heights of the plants in the control group, low nitrogen group, and high nitrogen groups were 20.3, 25.1, and 29.6 cm, respectively.

b) The heights of the plants in the different groups were 20.3, 25.1, and 29.6 cm.

Which one is better?

a) The results were different between groups.

b) Using a one-way ANOVA to calculate the effect of nitrogen fertilizer level on plant height, the results demonstrated statistically significant ($p = .03$) height differences between groups (Table 1).

Which one is better?

a) The correlation was significant, indicating the increase in temperature causes the increase rate of decomposition.

b) The correlation was significant, indicating a strong relationship between temperature and decomposition.

Which one is better?

a) RESULTS:

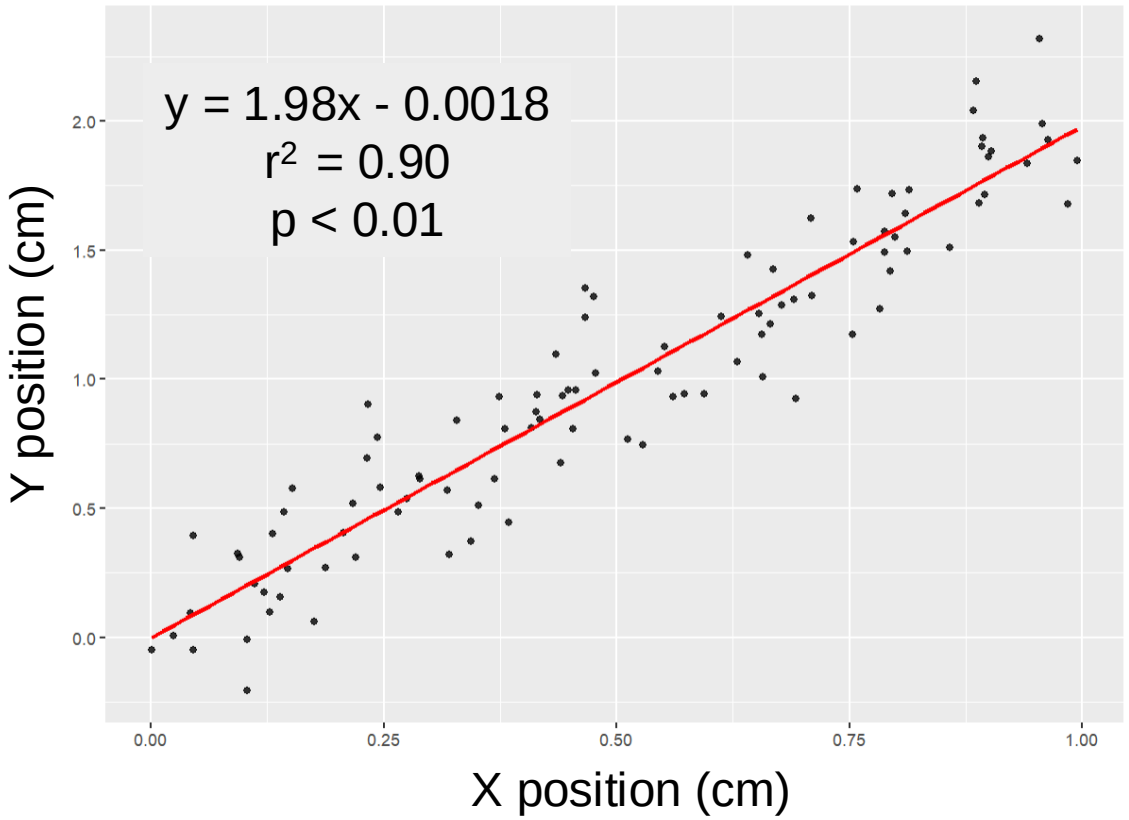
The difference in plant growth demonstrates that fertilizer application is critical to maximizing yield.

b) DISCUSSION:

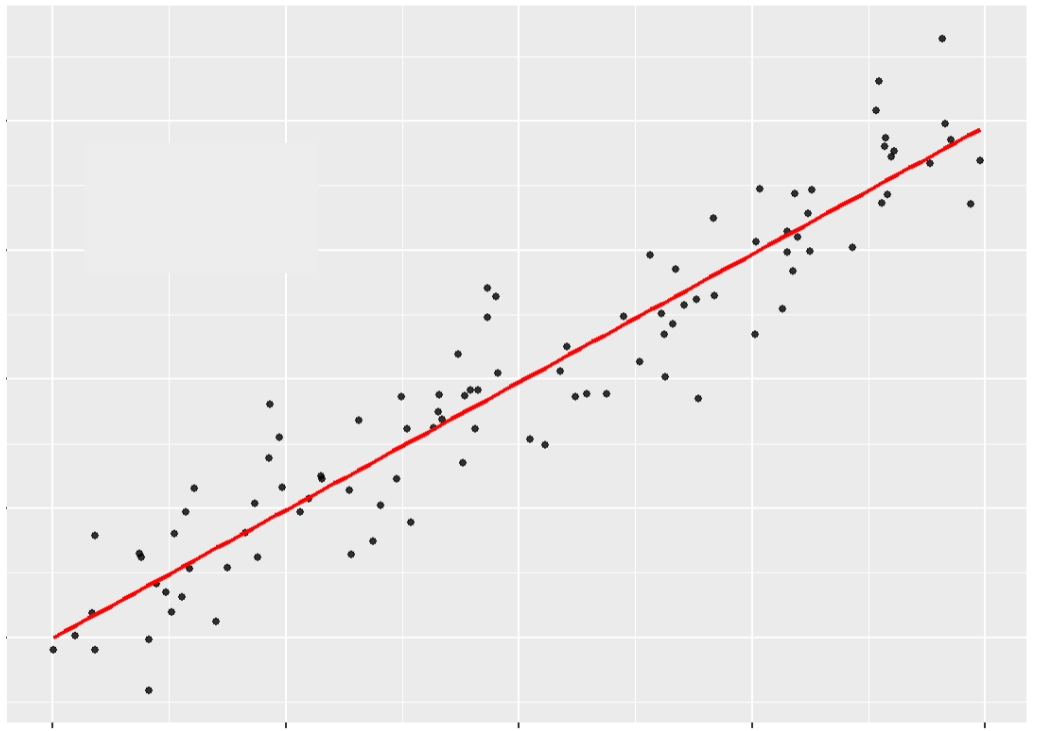
The difference in plant growth demonstrates that fertilizer application is critical to maximizing yield.

Which one is better?

a)



b)



Which one is better?

a)

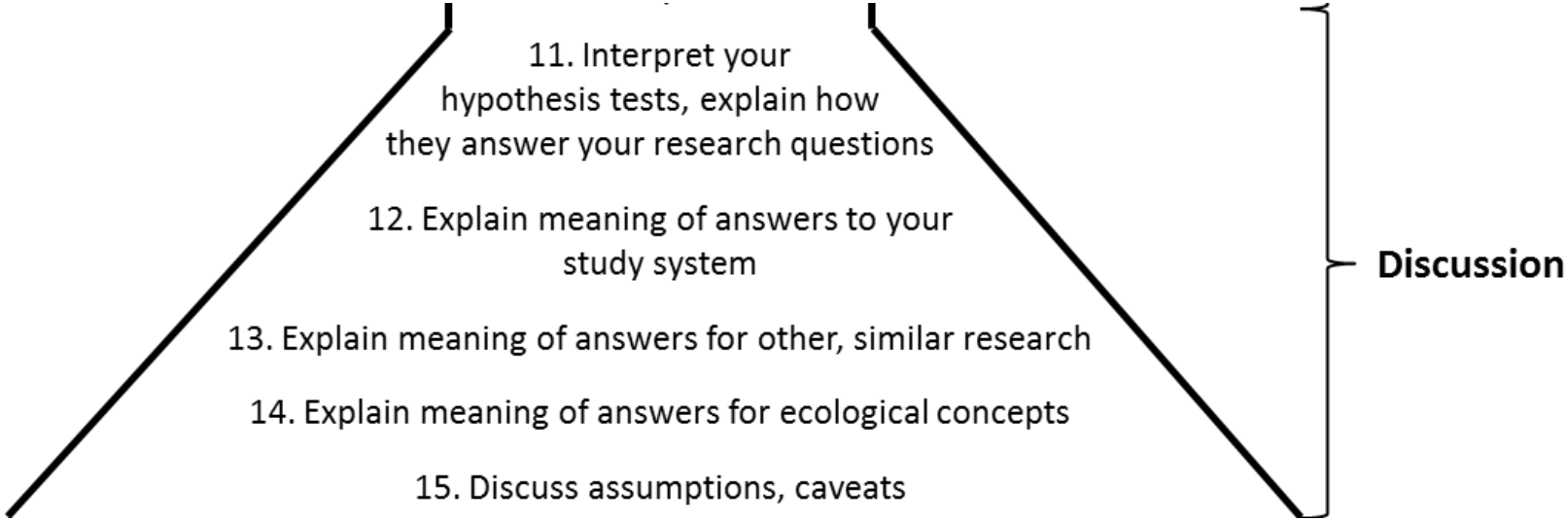
ID	Length	Mass
C04	12.2342342	1.2341423
E14	17.1523423	1.423432
N41	15.143423	1.043232
C22	1.4234123	1.6532423

b)

ID	Length (cm)	Mass (g)
C04	12.2	1.23
E14	17.1	1.42
N41	15.1	1.04
C22	1.4	1.65

Discussion

Discussion



Effectively summarizing and interprets the results obtained during the experiment, including comparing with expectations (hypothesis), considerations of limitations, and the relation to larger scientific concepts and theories.

≥ 3 paragraphs

Discussion

A good Discussion section should:

- Describe the key findings of the analysis.
- Address how the results support the initial hypothesis.
- Include citations to further support conclusions or identify how results do not match previously reported results.
- Describe what the results of the experiment mean for the broader scientific concepts described in the Introduction.

A good Discussion section should NOT:

- Include new data or results.
- Provide personal opinions or unsupported claims.

Discussion

2019). The dominance of *Cyanobacteria* does not seem to be universal as this phylum was present at very low amounts in our samples (0%–0.1%), this is perhaps due to *Uapishka* snow being sampled early in the winter when the snow is still mostly fresh, powdered, and frozen, while *Cyanobacteria* tend to be more abundant in late season snow (Larose et al. 2010). Low abundance of

rochloris). High abundance and ubiquity of lichen-associated taxa in the snow replicate samples regardless of other variables (anthropogenic traffic, altitude, vegetation cover, month) suggest that these taxa are part of the core alpine tundra/boreal snow microbiome. As they were able to maintain viability in the snow environment (as well as having flagellar genes in the algal/bacterial isolates), it is possible that these lichen-associated fungi, algae, and bacteria utilize the snow medium to "mix & swap" their symbiotic partners and to disperse throughout the ecosystem during snowmelt, and potentially to nearby mountain ranges including above tree-line summits during heavy winds and snowstorms.

Which one is better?

a) The higher concentration of nitrogen observed in Treatment A compared to Treatment B indicates that the addition of organic compost resulted in increased nutrient availability in the soil, supporting the hypothesis that organic amendments enhance soil fertility.

b) I think the nitrogen levels in Treatment A were higher because the organic compost worked really well in improving the soil quality.

Which one is better?

a) The higher DOC concentrations downstream are probably due to pollution.

b) The higher DOC concentrations downstream may be due to pollution, which is shown to increase organic matter concentrations in nearby streams (Smith et al. 2017).

Which one is better?

a) The species diversity in the logged forest area was low, so logging is bad for the environment.

b) The loss of habitat complexity as a result of logging may have led to the decline in species diversity, highlighting the importance of maintaining intact forest ecosystems for biodiversity conservation.

Which one is better?

a) The relatively small sample size of the observed populations may have restricted the generalizability of our findings to a larger ecological context.

b) We didn't have a lot of data, so our findings might not mean much.

Improve these examples…

These different considerations lead us to the formulation of different hypotheses. First one could state that a greater light exposure leads to a greater algae growth. On the other hand, the thrive of algae could also negatively impact leaves breakdown.

Based on these studies, we hypothesize that greater light exposure will increase the rate of leaf decomposition. While not quantified in this study, we believe this is a result of higher algal growth, which attracts additional decomposers.

Improve these examples…

Three bags were collected every two weeks. The leaves were cleaned, dried, and weighed.

Three litter bags from each of the two treatments were collected every 2-3 weeks. In the lab, the leaves were gently removed from the bags, rinsed of debris and invertebrates, and allowed to dry in an oven at 60^{o}C for one week. The dry mass of the leaves from each pack was then measured.

Improve these examples…

The plants all grew 10 to 30 cm in height. The plants which experienced drought grew less on average.

The average growth of plants in the drought conditions was 12.5 ± 5.3 cm, while in the normal conditions was 19.9 ± 6.7 cm. As determined by a t-test, the plants under drought conditions grew significantly less ($p = 0.03$).

Improve these examples…

As it was previously reported, the most accurate model to fit our olive tree leaves decomposition appears to be zero order kinetics. However in most natural processes of decomposition, first order decomposition is often observed. The difference in these results is not known.

Our finding, that leaf decomposition follows zero order kinetics, differs from previously reported studies (Evans et al. 2005; Lee et al. 2012). This difference could result from the experimental design of our study, which took place during the Spring in which the temperature of the stream increased throughout the experiment.

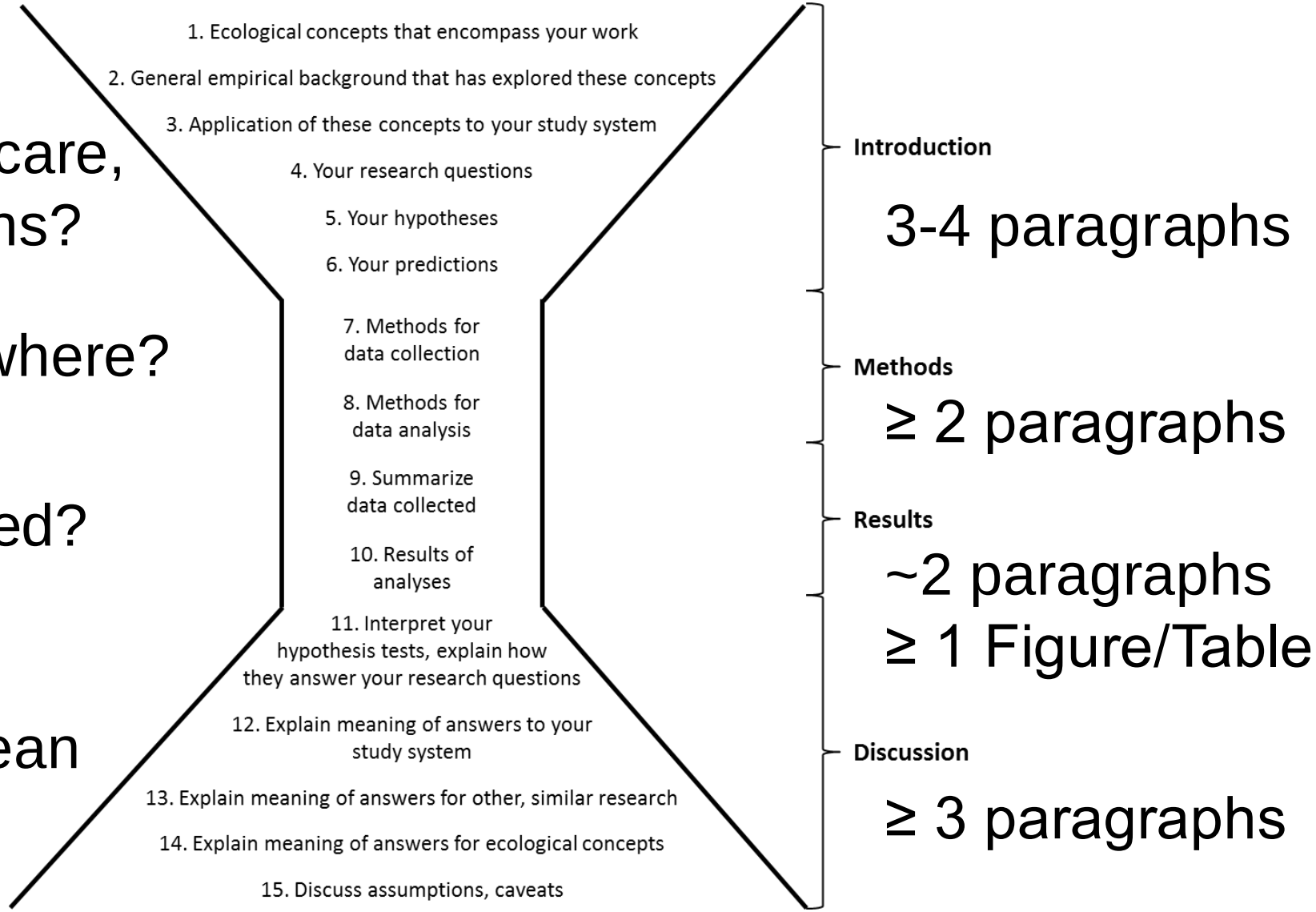
Lab report format

What topic, why care, and expectations?

How, what, and where?

What happened?

What does it mean and why?



Title and abstract

- The title should be precise and explain the main results:

“Drought stress decrease biomass in *Hedera Helix*”

“Leaf composition mediates degradation rates in temperate streams”

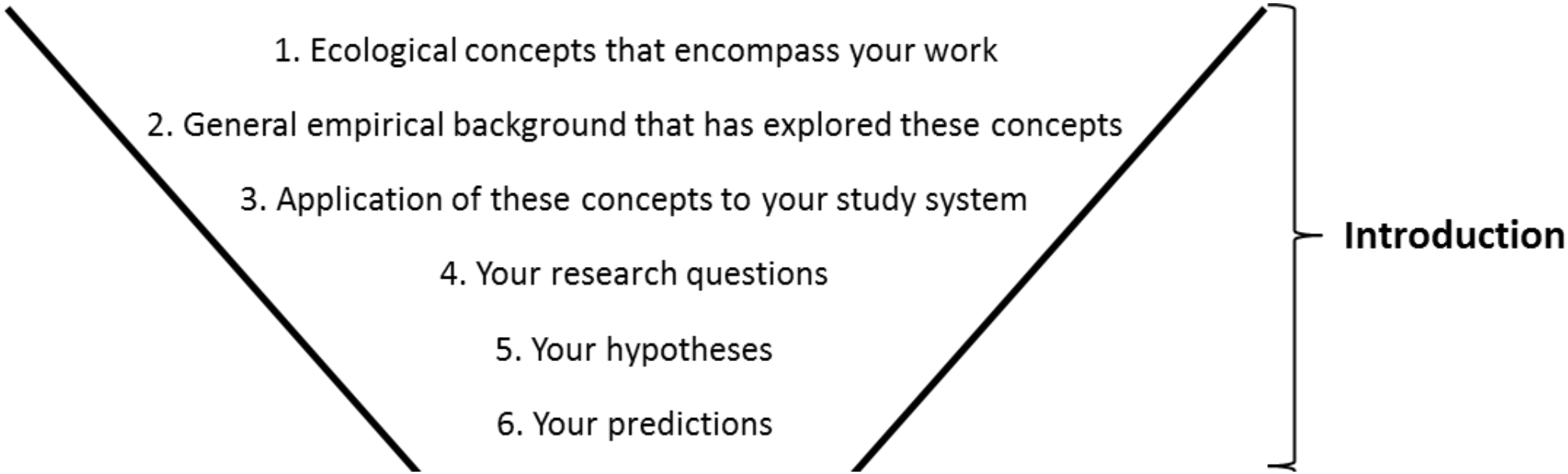
“~~Fundamentals in ecology report~~”

- The abstract is a short summary of the report (~150 words). Aim for a one-sentence summary for each sections.

Common areas to improve reports

1) **Connection between context and research question**

   E.g., Providing background on how temperature affects plant growth, then forming a hypothesis on soil moisture. How is temperature and moisture connected?



Common areas to improve reports

2) Using specific language and useful information

E.g.1, Instead of "We measured soil humidity,“ use "We measured soil humidity with a TDR-100 at 10 cm depth".

E.g.2, “We ended up with a excel spreadsheet for our dataset”, “In the laboratory”, “To produce the figure we need”, “Statistical tests are needed”… not required

E.g.3, Use past tense in the Methods, and you don’t need to sub-sub-divide the sections ☺

Common areas to improve reports

3) Incorporating references

E.g., Instead of “Carbon cycling in streams is influenced by various factors (Smith et al., 2018),” use “high levels of terrestrial organic carbon inputs have been shown to increase carbon export from streams (Aufdenkampe et al. 2016).”

Introduction

Lichens are prevalent and widespread in polar and alpine environments (Printzen et al. 2012, Armstrong 2017). They are complex holobionts, defined as a symbiotic association of fungal mycobionts, algal/cyanobacterial photobionts, and often with a non-photosynthetic microbial community (Miral et al. 2022). These complex microbial associations make lichens highly adapted to hostile conditions of cold habitats (Printzen et al. 2012). Alpine

Reference section (end of the report)

Printzen C, Fernández-Mendoza F, Muggia L *et al.* Alphaproteobacterial communities in geographically distant populations of the lichen *cetraria aculeata*. *FEMS Microbiol Ecol* 2012;**82**:316–25.

Prjibelski A, Antipov D, Meleshko D *et al.* Using SPAdes de novo assembler. *Curr Protoc Bioinformatics* 2020;**70**:e102.

Pulliainen J, Luojus K, Derksen C *et al.* Patterns and trends of Northern Hemisphere snow mass from 1980 to 2018. *Nature* 2020;**581**:294–8.

Common areas to improve reports

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Introduction

include bacteria, archaea, algae, fungi [1–3]. These cold-adapted microorganisms are termed as psychrophilic (optimum temperature below 15 °C) or psychrotolerant (optimum above 15 °C) [4], and are able to maintain viability for thousands of years in glacial ice [5, 6]. Microbial communities in these environments have to

Reference section (end of the report)

1. Goordial J, Davila A, Lacelle D, Pollard W, Marinova MM, Greer CW, et al. Nearing the cold-arid limits of microbial life in permafrost of an upper dry valley, Antarctica. ISME J. 2016;10:1613.
2. Mykytczuk NC, Foote SJ, Omelon CR, Southam G, Greer CW, Whyte LG. Bacterial growth at −15 C; molecular insights from the permafrost bacterium *Planococcus halocryophilus* Or1. ISME J. 2013;7:1211.
3. Margesin R, Miteva V. Diversity and ecology of psychrophilic microorganisms. Res Microbiol. 2011;162:346–61.
4. De Maayer P, Anderson D, Cary C, Cowan DA. Some like it cold: understanding the survival strategies of psychrophiles. EMBO Rep. 2014;15:508–17.
5. Hassan N, Rafiq M, Hayat M, Shah AA, Hasan F. Psychrophilic and psychrotrophic fungi: a comprehensive review. Rev Environ Sci Bio. 2016;15:147–72.