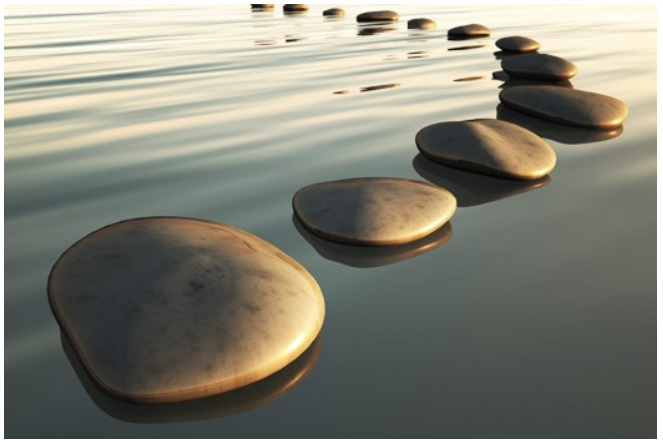
Questions:



http://www.ecology.com/2016/06/09

- how to do Ecology *ourselves*;
- what are the *skills* needed;
- how to *develop* those skills;
- different ecological *approaches*, their *strengths*, *weaknesses* and their *usage* (ˈjuːsɪdʒ);
- experimental *hypothesis* testing;
- "rules of thumb"[1] (Thəm);
- how to *work* (communicate) with other people;
- how to *write* scientific papers, how to *talk* to others, how to *prepare* proposals etc..

[1] it is a ***rule*** or ***principle*** that you ***follow*** which is not based on exact calculations, but rather on experience or hints, e.g. how to set up experiments? (1); how to analyze and interpret results? (2).

2. COMING UP WITH A RESEARCH QUESTION

2.1. *Why is it important to study Ecology?*

- The world is made up of *living* and non *living* things [1].
- We are all part of the *ecosystem*.
- There are mutual *relationships* there [2].
- The study of Ecology is all about *connections* [3].

[1] which have to ***coexist*** within the ecosystem;

[2] which we need to ***study*** and ***understand*** by using of scientific methodology e.g. via lab / field experiments we want to ***understand*** how the different organisms grow, populate, interact with other organisms;

[3] we can ***learn*** to **predict**, ***extinguish*** (ɪk'stɪŋgwɪʃ), ***counteract*** and ***prevent*** potentially adverse effects we might have on the globe around us.

Why to study Ecology? Well, because there is:

- a lack of *understanding* of Ecology: *degradation* of land and environment;
- a lack of ecological *know-how:* *deprivation* and *looting* (luːting) of natural resources;
- poor *understanding* of Ecology: *destruction* of the energy resources [1];
- this will *ensure* natural order of things [2].

[1] e.g. non renewable sources like ***oil***, ***coal***, natural ***gas*** etc);

[2] the way that life and the world are organized and intended to b

Note:

If your goal is to get ***reach***, doing ecology may be a ***mistake***.

If you ***passionate*** ('paSHənit) about ecology, it may be ***good*** for you.

2.2. *Choosing a topic & research question: mid-term goal*

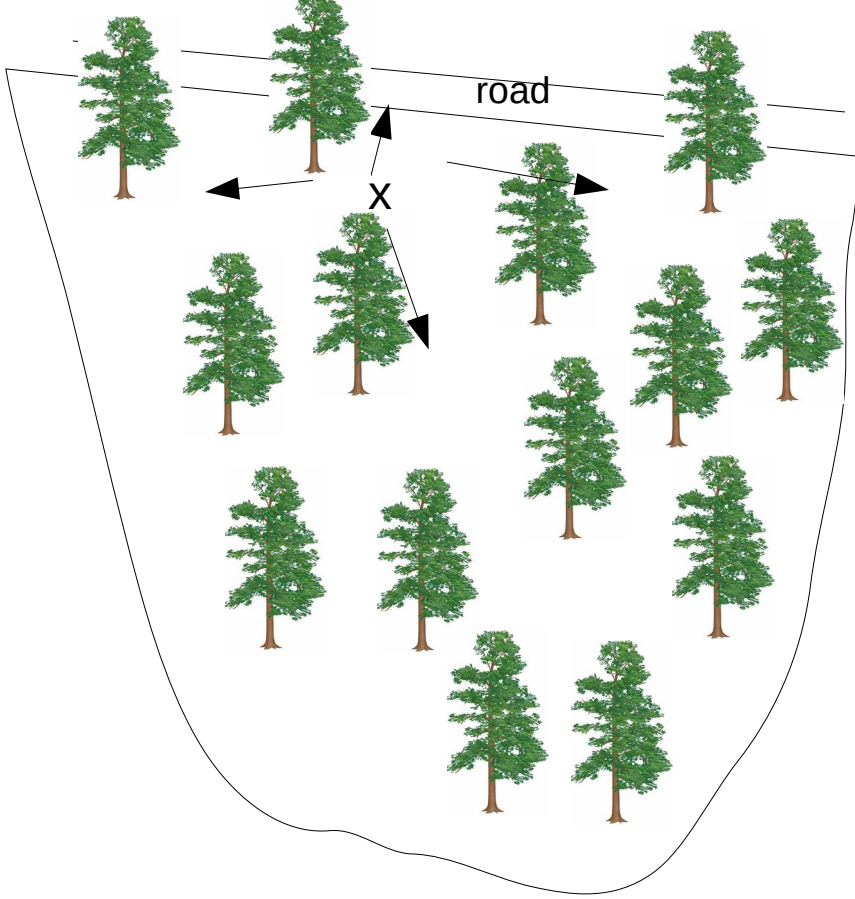
https://education.seattlepi.com

- *Picking* and *developing* a good research topic / question is an *important* skill.
- It is the most *critical* step in doing field Ecology [1].
- Why is it not *easy* task? - *Many* topics/questions sound equally *interesting*.
- The *first* question you should ask is “What am I *interested* in?"

[1] Paradox: this is the ***first*** thing you suppose to do, while you have the ***least*** experience.

- How to choose?
- Consider *mid*-term and *long*-term goals.

  The question you pick should reflect your *goals*.
- What is your *mid*-term goal? [1].



[1] Probably – getting a job. Many want to see:

a strong record of ***research*** and ***publication*** (even you will not to be expected to conduct research or publish a lot on the job).

that you are ***capable*** of advancing (may be teaching etc).

Other **“+”** (by doing research (exp.) you will:

- get *insights* into Ecology [1];
- see the ecological info. in textbook *differently*;
- easier *incorporate* the scientific methods in you own thinking;
- analyze reports & articles *critically*;
- share the info. with others more *efficiently*;
- learn yourself how to write more *effectively*, *concisely* (kənˈsīslē), *clearly*; etc.

[1] hardly possible to get such anywhere;

2.3. *Choosing a topic & research question: long-term goals* [1]:

1. Suggest a question that *satisfies* your goals [2, 3].

- Which question should I take? *Specific* or *general* (theoretical) one?

- A very *specific* question [4]: you result may be important to a very small community [5].

- Payne and Payne "in research we work from "*knowing less*" towards "*knowing more*" (2004: 114).

[1] are harder to formulate;

[2] i.e. try to figure out what you ***care about*** before picking a project; e.g. how we manage a habitat or a crop?

[3] e.g. it can be any project that ***suit you*** and not necessary e.g. you adviser, or your parents.

[4] e.g. to examine interactions of individual organisms with their environments (an autecological approach).

[5] e.g. what parts of ecosystems are ***changing*** or what the ***mechanisms*** of change involved?

- To *general* (theoretical) [1] one: than the question is if it reflects reality for at least one species [2].

  E.g. look at:

  Sutherland W., at al. Identification of 100 fundamental ecological questions. J of Ecology, 2013, 101, 58–67. https://besjournals.onlinelibrary.wiley.com [3].

[1] e.g. whether greater biodiversity tends to make ecosystems more or less susceptible (sə 'septəb(ə)l) to invasion by exotic species.

[2] e.g. How can we ***demonstrate*** that ecosystem ***complexity*** might increase ***stability*** in front human and natural perturbations?

[3] Authors identified 100 important ***questions*** of fundamental ***importance*** in pure ecology and which reflect the state of ecology today.

2.4. *Steps to developing a research question*

1. Choose an *interesting* general *topic* [1].

2. Do some preliminary *research* on your general topic [2].

3. Consider your *audience* [3].

4. Start *asking* questions [4].

[1] Most focus on topics they are really ***interested*** in studying.

[2] Do a few quick ***searches*** in current periodicals and journals on your topic to ***see*** what's already been done.

[3] Would that particular ***audience*** be ***interested*** in the question you are developing?

[4] *e.g.* "how" and "why" ***questions*** about your general topic.

5. *Evaluate* your question [1].

e.g.

- *unfocused*: What is the effect on the *environment* from *global* *warming*?
- *focused*: What is the most significant effect of *glacial* *melting* on the lives of penguins in Antarctica?

6. *Begin* your research [2].

https://hbculifestyle.com/research-paper-topics-50-ideas/

[1] i.e. ask whether they would be ***effective*** research ***questions*** or whether they need more revising/refining:

Is your research question ***clear***?

Is your research question ***focused***? i.e. is it narrow enough that it can be answered thoroughly ('THərōlē) / completely / comprehensively.

Is your research question ***complex***? i.e. requires synthesis and analysis of ideas.

[2] think about the possible ***paths*** your research could take, e.g. ***sources*** to seek answers, etc.

2.5. Novelty and originality

- All projects have to be *novel* and *original* [1] to some extend [2].
- How to succeed with *novelty* [2]?
- This may sometime allow you to get started in *new* exiting *direction*.
- Is *novelty* always on the first place?

https://indianexpress.com

[1] data (info.), ideas for which no reliable, published sources exist.

you cannot ***repeat*** work that has already been ***done*** i.e. ***nobody*** will be ***excited*** with you results, we all like to hear ***new*** stories and ***new*** ideas;

[2] e.g. one way to begin may be to ***repeat*** an exp./study that captured your ***attention***/imagination.

- Not *always* [1].
- Nevertheless, you should keep your eyes open for *alternative* answers/approaches.

https://www.editage.com/insights/a-young-researchers-guide

- *Originality*: an original research produces *new knowledge* instead of summarizing what is already known in a new form [2].

[1] e.g. if your project was funded by an agency to answer ***specific*** question: your first priority is to generate relevant data for the agency;

[2] how to produce new knowledge?: via observations, exp., new approaches to solving existing problems, etc. ***Dissertation*** is often called an ***original*** research paper.

2.6. What is "the perfect study"?

- *Perfectionism* [1].
- It is typically viewed as a *positive* trait rather than a *flaw*.
- Do not try to conduct "*perfect*" study before you are willing to begin.
- "*Perfectionism*" - one of the most *unsuccessful* traits in research.

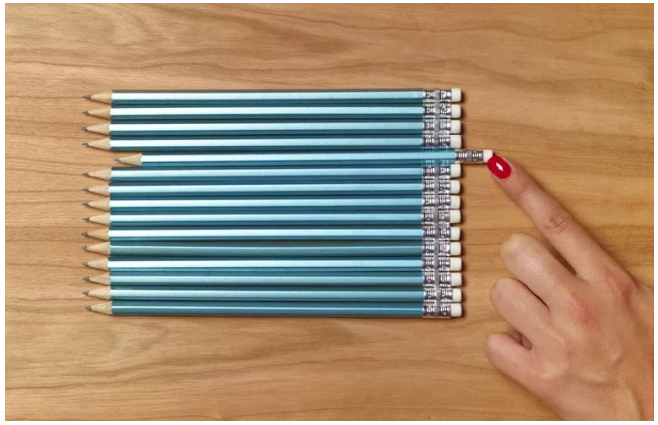
[1] "the need to be or appear to be *perfect*, or even to believe that it's possible to achieve *perfection*".

- Three *kind* of ecologists:

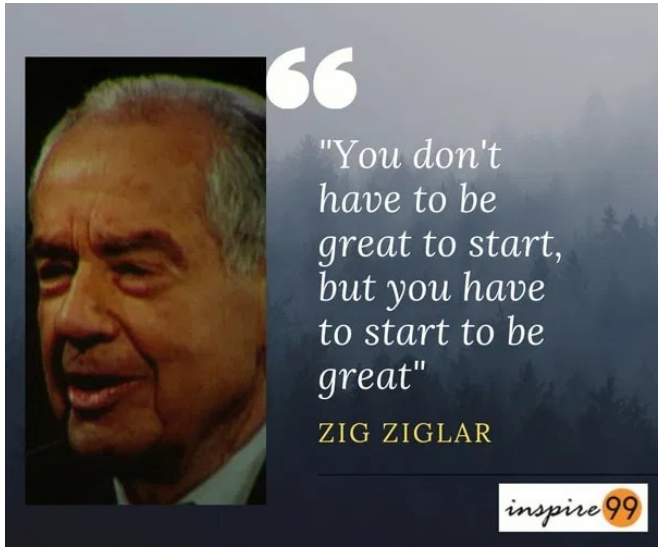
1. The "*perfectionists*" - cannot get started [1];

2. The *jackrabbits* - a lot of energy and willing to get started before thinking their goals [2];

3. Those who are between 1 & 2[3].



https://www.verywellmind.com/perfectionism



Hilary Hinton "Zig" Ziglar (1926 – 2012), an American author, salesman, and motivational speaker.

[1] advice: they just have to ***start***; the experience and insights that they will get by doing "***imperfect***" exp. will help them getting better in the future;

[3] advice: to step ***back*** for a minute, and think a little which question is better;

[4] advice: just ***do*** it.

- How it look like? (how to *start*?)

- You start asking one *question* ⇒
- get exposed to *ideas* / *observations* [1], and soon ⇒
- you are asking *question* which is very *different* and much *better* than your initial naive ones.

- Many (if not most) projects don't progress as we *originally* conceived (kənˈsiːvd) them.

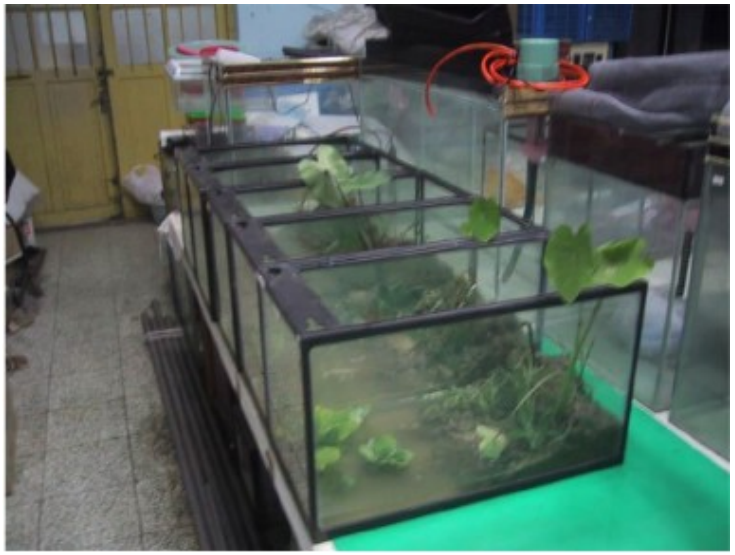
[1] you hadn't previously ***considered***.

2.7. *"Small" or "big" question. Pilot study*

- "*Small*" (specific) questions (little replications) is *better* than *bigger* ones [1].

- "*Pilot* study": a *small* pilot exp. will not give definitive *answers* but likely provides useful *insights* about how to *conduct* that exp..

- If the *pilot* study results turn out as *expected*, you can *start* a bigger project.



Aquarium set up, Y. Chang, 2018

[1] more ***modest*** goals can be achieved with relatively ***few*** data and much more ***quickly***.

Many believe that narrowing a topic means ***lessening*** its ***importance***. This is not true; the ***opposite*** happens.

When you narrow your topic your issue becomes ***extremely*** ***important*** for a select group of people (specific audience).

- E.g., a *small* exp. in a lab costs very *little*, and mistakes can be *easily* corrected (**small question**).

- An exp. with many organisms is *expensive* (**big question**).

2.8. *Failure or success with a project*

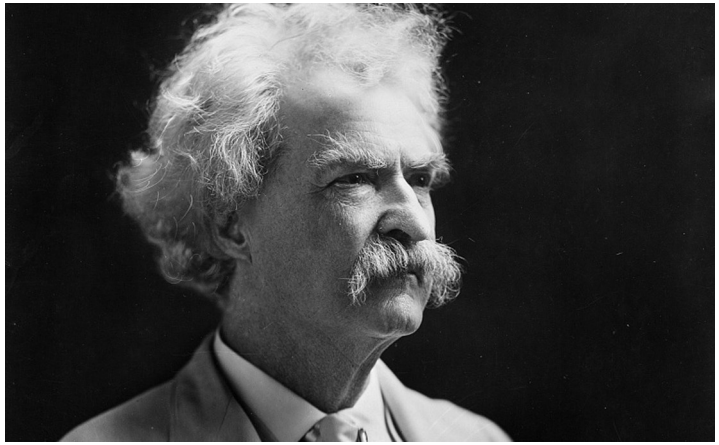
- Field exp. is not an *easy* task [1].
- *Important*: whether your ideas are *feasible* or not [2].
- Probably, you should try *several* pilot studies *simultaneously*.
- Do not be *discouraged* about the ones that does not work: you should feel *fortunate* if 2/7 work well.

[1] many factors associated with ***failure*** or ***success*** are beyond your control;

[2] e.g. do you have the ***resources*** and ***knowledge*** to complete the project?

- Work *hard* + feel *excited* = **good** exp..

- So, project should intellectually *stimulating* to you.



"Find a job you *enjoy* doing, and you will *never* have to work a day in your life."

Mark Twain.

2.9. *Starting with the question?*

- There are 2 *approaches* to picking a project:
  starting with the *question*
  or starting with the *system*.

- The *difference* between these two is relatively "*small*".

- In both cases make sure that you are *satisfying* a list of *criteria* related to both.

1. Start with a *question* [1].

[1] e.g. you are interested in a particular kind of ***interaction*** or ***pattern***: you want to check the hypothesis, that more ***diverse*** ecosystems are in fact more ***stable***.

Interactions: the effect that a pair of organisms living together in a community have on each other (either of the same species (intraspecific), or of different species (interspecific).

Pattern: how communities are ***organized***, its ***structure***. E.g. some species never occur together in the same place due to e.g. one species may exclude the other through competition or, alternatively, they simply prefer different habitats.

- Two *outcomes*:
- 1st - it is *true* - you can propose it as a basis for e.g. *conservation* policy [1];
- 2nd - it is *not* so - you should not propose it as a basis for *conservation* policy.

- Is this approach *good* enough?

- Not *always*, Why? apparently many studies address the *same* *questions*.

- Alternative approach: e.g. think what is at the *basis* /*core* of the relation between *biodiversity* and *stability*.

[1] deals with the ***preservation*** and ***management*** of ***biodiversity*** and natural ***resources***

- Even questions “answered” by many may still have *components* that have yet to be asked [1].

- By asking a question, you will need to find a suitable *system* to answer it [2].

[1] e.g., have previous studies addressed these key ***elements/questions***? (1); are there ***novel*** ***aspects*** of this question that haven’t been addressed yet? (2); are there ***assumptions*** that scientists take for ***granted*** but have never ***tested***? (3);

[2] e.g., it should ***conveniently*** located, ***protected***, ***suitable*** to the manipulations and to the observations.

- What can be done *additionally*?

- look at *similar* studies in the literature;
- ask *around*;
- look at what is *available* at field stations;
- look at what is *available* at other protected sites close to your home [1].

[1] e.g. how treatments affect ***fitness*** (you will need an ***annual*** rather than long-lived species); to study ***coevolution*** (you should probably consider ***native*** systems rather than ***recently introduced*** species).

Fitness (in biology): how many babies he or she can produce in a lifetime, i.e. the ability to ***survive*** to reproductive age, *find* a mate, and produce offspring.

Coevolution: when two (or more) species reciprocally affect each other's evolution, e.g. an evolutionary change in the morphology of a plant, might affect the morphology of an herbivore that eats the plant, which in turn might affect the evolution of the plant, which might affect the evolution of the herbivore...and so on.

E.g. many plants and their pollinators are actually dependent on one another.

2.10. Starting with the system

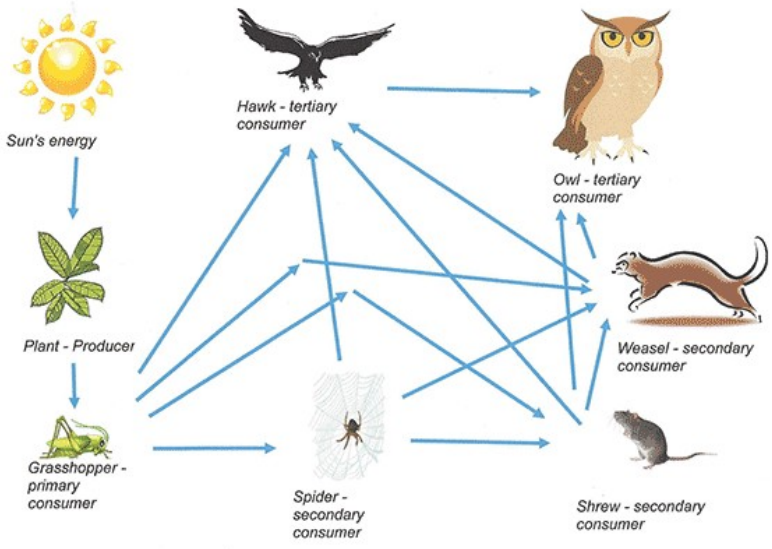
- Imagine you have a *system* (e.g. pond /pɒnd/)
- By starting with a *system* you will find yourself in search of a *question*.

How to *succeed*?

http://www.tr3dent.com/ecosystems

- Try reading *background* to get a sense of the kind of questions.

- E.g. often **one** organism becomes a *model* for one kind of question.
- But it has not been *explored* for **others**.
- Imagine you do not already have a *system* in mind, but want to use this *approach*.
- What can you do?
- Try going to a *natural* area and spending a few hours / days just looking what is there.



http://idahoptv.org/sciencetrek/topics/ecology

- Generate a *list* of systems & questions in your notebook, *prioritize* (prīˈôrəˌtīz) them.

- Another approach is to start with a natural *pattern* that you observe, *quantify* it, try to find a natural *variation* in e.g. organisms density, activity etc[1].

- After quantifying these patterns, you can ask [2].

https://bmagblog.wordpress.com

[1] For example:
are the snails (*равлик*) in some spots more active then those in other places?
is there variation between individuals?
are the snails in some microenvironments bigger than those in others?
are bigger snails more active?

[2] For example:
what mechanisms could cause the patterns that you observe?
what consequences might the patterns have on individuals and on other organisms?

2.11. *How to answer questions as completely as possible?*

- You have selected a *question* and *collected* some preliminary data.
- You know it is *feasible* to answer the question.
- How to answer it as *completely* as possible (some suggestions):
- 1. Consider *alternative* hypotheses to produce the *patterns* and *results* that you observe. (will be discussed later).
- 2. Think about whether the *phenomenon* that you are studying applies *generally* [1].

[1] you may want to ***repeat*** your studies that gave interesting ***results*** at other field sites / with other species

3. Explore whether your *phenomenon* operates at realistic *spatial* and *temporal scales* [1].

4. If possible, work at levels both *below* (mechanisms) and *above* (consequences) the level of your pattern [2].

5. You may not be *able* to answer *all* of these *questions*, and you do not *need* to do that.

6. Still, the more *complete* your story is, the more *useful* and *appreciated* your work is likely to be.

[1] if you conducted a small-scale ***experiment***, do your results apply at the larger scales where the organisms actually live (coming later);

[2] e.g., what ecological ***mechanisms*** could generate the pattern that you observe? What other organisms or processes could affect the pattern?

7. While you are *answering* one question, you are likely to see *other* ones, which likely *nobody* else has seen.

8. Rather than trying to *force* your organisms to *answer* your questions, allow them to *suggest* new ones to you.