Scientific reasoning - Rules and fallacies (In class)

Methods of Scientific Working for Crop Science (3502-440)

Prof. Dr. Karl Schmid

November 25, 2024

1 What are your premises?

Modified from Weston, Anthony (2017)

Assume that you are a bean breeder and you want to convince your friends to eat more beans.

Try to construct an argument that comes to the conclusion: "We should eat more beans".

In constructing an argument, it is important to identify and differentiate the premises from the conclusion, and also to differentiate the different premises.

Your task: Discuss with your neighbor different premises that would allow you to come to such a conclusion. To which of the premises would you commit in order to reach the conclusion?

2 Genetic engineering in plants - Pro or con?

The genetic engineering of plants is highly debated, and currently the European Union decides whether the genome editing is about to be regulated, or not.

There are a lot of public statements regarding the support versus opposition against genetic engineering.

Here are two examples:

166 Nobel prize winners signed a letter that supports precision agriculture based on genetic engineering using genome editing (e.g., using CRISPR/Cas technology) nob (2020) Figure 1 shows a subset of the signatories

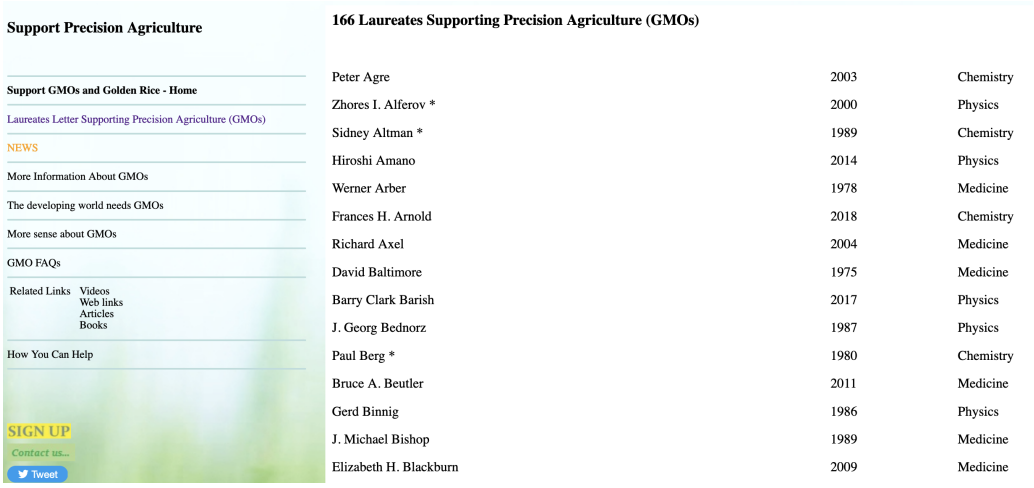

Figure 1: Subset of signatories of Nobel prize winners.

Then there are letters of people who oppose the deregulation of genome editing, which is commented by the German plant research Detlef Weigel in the following way @PlantEvolution (2023) as shown in Figure 2

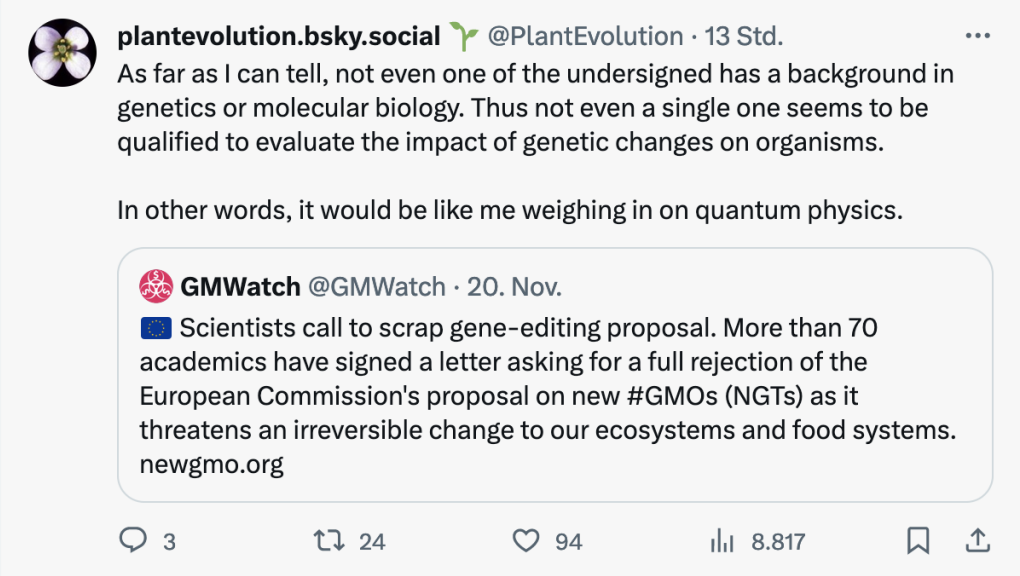

Figure 2: A comment on a letter opposing the deregulation of genome-edited plants

Task: If you compare both statements: Which potential fallacy in logic, rhetorics or argumentation do you recognize that may not be in line with the scientific method? What would be your counterargument against the notion of such a fallacy (i.e., you would argue that it is not a fallacy).

3 Arguments by example - How strong are they?

Consider the following argument on renewable energy:

Premises:

- Solar power is widely used.
- Hydroelectric power has long been widely used.
- Windmills were once widely used and are becoming widely used again.

Conclusion:

- Therefore, renewable energy is widely used.

Task: Try to find counterexamples to this argument. If you consider the counterexamples, which criticism you can develop about the conclusion? How would you modify both the premises and the conclusion to counter such criticisms?

4 How to argue about gene drives?

Consider the following quote from an essay by me (Source: Laborjournal)

> Gene drives alter the Mendelian rules of inheritance and can lead to the replacement of gene variants in a population within a few generations. For example, they can be used to sterilize males in populations of malaria-transmitting mosquito species, to locally reduce the population and thus limit the spread of the disease. Gene drives are often cited as a worst-case scenario to demand restrictive regulation of genome editing as a whole, because an uncontrolled spread of this system could lead to the extinction of species. However, in nature, there are numerous examples of gene drives in mammals and insects. Both natural and laboratory-studied gene drives typically show a rapid evolution of resistances against these systems, which is why they do not inherently represent an uncontrollable danger, but must be considered on a case-by-case basis.

[…]

At this point, one can also demonstrate another frequently used strategy, by claiming that there are other processes that cannot be controlled. For example, in biological pest control, where beneficial organisms can get out of control through coevolution, or in the use of commercial pollinating insects, which can negatively affect the genetic composition and pathogen load of neighboring wild insect populations. If no one is calling for the abolition of biological pest control or foreign pollinators, why then should gene drives be banned?

Task: How would you call and describe a strategy that is mentioned in the second paragraph? Did you observe it in different contexts as well?

5 Mendel's rules

Gregor Mendel postulated is rule on the independent assortment of hereditary factors after observing the frequency of two different states of seven traits in peas (Table 3).

Table 2-1 Results of All Mendel's Crosses in Which Parents Differed in One Character

Parental phenotypes	F_1	F_2	F_2 ratio
1. round × wrinkled seeds	All round	5474 round; 1850 wrinkled	2.96:1
2. yellow × green seeds	All yellow	6022 yellow; 2001 green	3.01:1
3. purple × white petals	All purple	705 purple; 224 white	3.15:1
4. inflated × pinched pods	All inflated	882 inflated; 299 pinched	2.95:1
5. green × yellow pods	All green	428 green; 152 yellow	2.82:1
6. axial × terminal flowers	All axial	651 axial; 207 terminal	3.14:1
7. long × short stems	All long	787 long; 277 short	2.84:1

Figure 3: Frequency of dominant versus recessive phenotypes in seven traits of Mendel's peas.

He concluded that the ratio of the dominant over the recessive phenotype is 'on average 3:1'.

Discuss:

- What type of scientific reasoning does his conclusion represent?
- How would you define the next step in a scientific investigation to test that his conclusion would be correct?

References

(2020) Laureates Letter Supporting Precision Agriculture (GMOs) | Support Precision Agriculture. URL `https://www.supportprecisionagriculture.org/nobel-laureate-gmo-letter_rjr.html`

@PlantEvolution (2023) URL `https://twitter.com/PlantEvolution/status/1728879870279872564`

Weston, Anthony (2017) A rulebook for arguments, 5th edn. Hackett Publishing Company, Inc., Indianapolis/-Cambridge