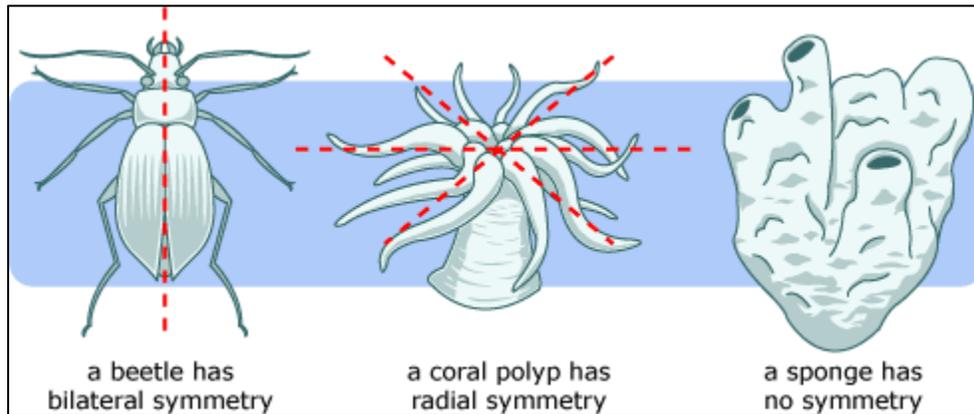


### *Contrapositive and Grue*

1. You are in charge of choosing among applicants for research grants offered by the University of Snarkville. You are considering proposals for a \$10,000 grant to study a question about the physiology of the common snipe. The research question is this: **Do all healthy snipes display no symmetry?**



From [https://evolution.berkeley.edu/evolibrary/article/arthropods\\_04](https://evolution.berkeley.edu/evolibrary/article/arthropods_04)

Your task is to decide between two proposals (from Applicant 13 and Applicant 42). The University is experiencing financial hardship, so all departments are required to justify expenditures over \$100. It is important that you be able to give a justification for your decision, both to the biology department, and to the university budget office. Here are the budgets of the two proposals:

<b>Applicant 13</b>	
I will investigate this hypothesis: If $x$ is a snipe, then $x$ has no symmetry. To do so, I will travel to all known snipe habitats via cargo ship, working for my passage. I will still need to purchase food and accommodations in the countries I visit. This will take approximately 2 years.	
\$8000	Food and accommodations for 2 years
\$2000	Digital camera and specimen collection materials for documenting observations.

<b>Applicant 42</b>	
I will investigate this hypothesis: If $x$ has symmetry, then $x$ is not a snipe. To do so, I will examine all symmetric objects I can find in downtown Snarkville. I will need to pay for food in downtown restaurants while I am conducting my research, but I will sleep in my dorm room on campus, and use my cellphone camera to collect documentation. It will take approximately 2 days.	
\$100	Food for 2 days.
\$9900	I will donate this money to the University of Snarkville's capital fund campaign.

What is your decision? How will you justify your decision to both the biology department, and the university budget office?

2. Your friends have invited you to attend a lecture by a speaker who claims to have extremely good evidence for his claim that the earth will stop revolving around the sun in the year 2040. Since you are interested in astronomy, you attend the lecture with them. The speaker says

Newton's familiar law of gravitational, applied to the earth and the sun, states that

$$F_{Sun \text{ on Earth}} = G_N \cdot \frac{M_s \cdot M_e}{d^2}$$

where  $G_N$  is Newton's gravitational constant,  $M_s$  is the mass of the sun,  $M_e$  is the earth's mass, and  $d$  is the distance from the center of the sun to the center of the earth.

My hypothesis is that the gravitational constant is actually not a constant at all, but will decrease to 0 in the year 2040. From that time forward, all objects (including the earth and the sun) will continue in motion in a straight line, since they will no longer be acted on by the gravitational force. For this reason, I prefer to call the gravitational force the gravitemporal force.

So my law of gravitemporality is

$$F_{Sun \text{ on Earth}} = \begin{cases} G_N \cdot \frac{M_s \cdot M_e}{d^2}, & \text{for all years} < 2040 \\ 0, & \text{for all years} \geq 2040 \end{cases}$$

The evidence for my law is quite extensive. Objects here on earth, in the solar system, and everywhere in the observed universe, have been following my law of gravitation for as long as observations have been conducted (and even longer for those astronomical observations based on light which has been traveling to earth since the big bang!) Every bit of evidence that there is for Newton's law of gravitation is also evidence for my law.

During the question and answer period following the lecture, your friends all look to you to ask a question. What question would you ask?

3. You have been studying a noxious weed called Leafy Scourge, which first appeared in equatorial regions in the 1700s, and has been gradually spreading both north and south of the equator since then. The plant has thus far spread to lands between 40° North latitude and 40° South latitude. According to extensive observations you have made, Leafy Scourge plants have been decreasing in size at a rate of 2% per degree of latitude away from the equator. The plants just do not seem to grow as well in cooler climates. So you predict that the plants will never reach locations north of 50° North latitude, or south of 50° South latitude, since  $50 \times 2\% = 100\%$ , and therefore the plants will have decreased in size by 100%, i.e. they will no longer exist. This is good news for farmers 50° or more away from the equator. They will not need to purchase the expensive new herbicides being developed to combat Leafy Scourge.

A spokesman for the major manufacturers of herbicides has publicly attacked your theory. "The theory that Leafy Scourge migration will suddenly vanish at locations more than 50° from the equator is just like those silly theories that the gravitational attraction of the sun will give out in 2040, or that at some future date all emeralds will turn blue. All these theories are based on misunderstandings of how evidence confirms scientific theories."

How could you reply to this critic?