

1. Using rules one and two of Strong Inference answer the following question: What is causing the increase in infections of people with antibiotic resistant bacteria? (10 pts)

Propose 2 or more hypotheses and at least one experiment to eliminate the hypotheses. Example: Hypo's- Overuse of antibiotics. Increased UV from ozone hole. Unsanitary conditions. Expt's- Increase sanitation and see if antibiotic resistant infections decrease. Treat bacteria with UV and see if antibiotic resistant infections increase.

2. Researchers destroy the RNA and proteins from some heat killed S bacterial cells (lethal type), add the remaining material to living R cells (non-lethal), and find that the R cells (non-lethal) are transformed into lethal cells. They conclude that DNA is the transforming material. Have these researchers properly used Strong Inference? Why or why not? (8 pts)

No, they never tested whether DNA was the transforming agent. They did not try to eliminate DNA.

3. In the experiment looking at the function of the 5'-cap and the poly-A tail, both mRNA stability and the amount of protein produced are significantly reduced in mRNA lacking a 5'-cap. How do we know that the reduction in translation seen after removing the 5'-cap is not simply due to the loss of mRNA stability? (8 pts)

mRNA stability decreased about 50%, but the protein levels decreased more than 95%.

4. You have some *E. coli* that have a problem in the regulation of the *lac* or *ara* operons. The genes downstream of the operon promoters are intact and functional. Below are the results of some growth assays you performed. What problem with regulation of the *lac* or *ara* operons in *E. coli* would lead to these results? (8 pts)

sugar----- result

lactose only----- *E. coli* die

arabinose only----- *E. coli* grow

glucose only----- *E. coli* grow

The lac repressor is not responding to the presence of lactose by unbinding from the operator. RNA polymerase and/or sigma factor do not bind to the lac promoter.

5. You are looking at some corn, and it has all yellow kernels. Does this corn contain an active transposon? Why or why not? (8 pts)

No, it is homozygous recessive or it has a transposon in the dominant purple allele, but this transposon is not moving because there is no variegation.

6. You are studying the response of fingertip cells to taking a genetics test, and you have observed that when correct answers are being written calcium enters the cells in a distinct pattern of calcium influx and efflux. You are able to induce this pattern of calcium influxes and effluxes in the fingertip cells, but wrong answers are written. Why? (10 pts)

The pattern is correct, but the spatial distribution of calcium may be critical for correct answers. Or The calcium fluxes are a result of the correct answers not a cause.

7. If you took the promoter of a gene and flipped it 180°, what would be **two** differences about the transcription of the gene? As an example: original gene NON-GENE-PROMOTER-GENE, after flipping NON-GENE-RETOMORP-GENE. (8 pts)

the other strand of DNA would be transcribed. Transcription would occur in the other direction.

8. Given the DNA and mRNA sequences below, which DNA strand does the tRNA anticodon more closely match? Give **two** reasons why the match might not be perfect between the tRNA and the DNA across all three codon nucleotides. (8 pts)

ACG TTG ACC ATC–1 DNA
TGC AAC TGG TAG–2 DNA

UGC AAC UGG UAG–mRNA

Match #1. Wobble means that tRNA can have 1 nucleotide difference from mRNA. RNA has U, DNA has T.

9. In a signal transduction chain involving calcium, could the step immediately following calcium be a change in transcription of a gene? Why or why not? (8 pts)

No, calcium is in the cytoplasm and transcription changes occur in the nucleus. Calcium could induce a translocation of a transcription factor from the cytoplasm into the nucleus.

10. Is it possible that early life could have performed metabolic processes without proteins? Why or why not? (8 pts)

Yes, some RNA, ribozymes, can catalyze chemical reactions.

11. You identify the coding region of a gene that is 400 nucleotides long. There are no introns. This coding region codes for a functional protein. Why is this surprising, and how could it be true? (8 pts)
400 is not divisible by 3. RNA editing could add 2, or 5, or 8, etc nucleotides to make the mRNA divisible by 3.

12. Given this figure from the experiment looking at the arrest of rDNA transcription after DNA damage:

a. Does the signal transduction chain for the inhibition of rRNA transcription after DNA damage involve proteins outside the nucleolus? How does this figure support your answer? (4 pts)

No, the signalling occurs only inside damaged nucleoli. Undamaged nucleoli do not decrease rRNA transcription.

b. If the cells lacking the ATM protein were shown in this figure, what would the graph look like? Why? (4 pts)

(You can draw your answer on the graph, or describe your answer, but make certain that your answer is clear and obvious.)

ATM is required for the signal transduction of DNA damage to inhibition of rRNA transcription. So without ATM there will be no decrease in transcription.

Bonus: Give **two** examples of how van Helmont did not follow the rules of Strong Inference when he did his experiment looking at “what plants eat” by growing a plant in a pot with soil. For each answer, tell what rule he did not follow, and what he needed to change to correctly follow that rule. (3 pts)

He did not have multiple hypotheses; he should have proposed alternate explanations. He did not do any controls or have multiple samples; he needed a control with soil and no plant plus multiple plants.