Biology 111 Closed Book Take-Home Exam #2 – Information

There is no time limit on this test, though I have tried to design one that you should be able to complete within 3 hours. There are 5 pages in this test, including this cover sheet. You are not allowed to look at someone else's test, nor use your notes, old tests, the internet, any books, nor are you allowed to discuss the test with anyone until all exams are turned in no later than 9:30am on Monday Oct. 17. **EXAMS ARE DUE BY 9:30 am ON MONDAY OCTOBER 17**. If you turn in your exam late, then you lose a letter grade for each day you are late. The **answers to the questions must be typed on the test pages** unless the question specifically says to write the answer in different place. If you do not write your answers in the appropriate location, I may not find them.

I have provided you with a "Data Gallery" in the form of figures and tables. To choose a figure in support of your answer, simply state Figure #x. You do NOT need to move the image on your test. Do not assume how many of the data images you will use, or not use. Simply choosing the data is not sufficient support for your answer, however. You must explain the significance of the data and how they support your answer. I have given you sentence limits so be concise.

There are 5 Quick Recall questions that are multiple choice. The questions are available only online so you will need internet access to take this exam. http://moodle.davidson.edu/moodle/

-3 pts if you do not follow this direction.
Please do not write or type your name on any page other than this cover page.
Staple all your pages together when finished with the exam. Do not print test pages without answers. I only want to see your answers. You can type your answers right under each question.

Name (please print):

Read the pledge and sign if you can do so with honor:

_____

On my honor I have neither given nor received unauthorized information regarding this work, I have followed and will continue to observe all regulations regarding it, and I am unaware of any violation of the Honor Code by others.

How long did this exam take you to complete? (ranged from 2.5 – 13 hours, average about 3.5)

Lab Questions:

5 pts.

1) Let's assume you are able to generate antibiotic resistant bacteria. If the cells were not resistant before you started, how did they become resistant? Limit your answer to no more than 3 sentences and be precise in your word choice.

all populations contain mutants – DNA pol error rate
some mutations might produce resistance
we selected for mutants that are resistant and continue this cycle until we are done

5 pts.

2) Describe the emergent property of slime mold that you have seen in lab. To get full credit, you must describe which aspects you personally saw in lab. Limit your answer to no more than 3 sentences and be precise in your word choice.

starve → stream → slug → migrate → spores
we saw solitary cells, slugs, some migration, and spores

Lecture Questions:

15 pts.

2) List the five tenets of natural selection and provide an example of each using data describing the abiotic origins of life. As appropriate, choose one figure (by citing its number) from the data gallery to support your example by explaining how the data support your example. **The five items you list below should be limited to no more than 3 sentences each.**

Figure 8 is a cartoon and not data.
A. overproduction - #13 lots of different lipid vesicles
B. variation in the population - # 2, 6, 10 depending on your explanation
C. competition for limited resources - # 1, 2, 12, 13, 18 depending on your explanation
D. selective advantage - # 1, 2, 7 depending on your explanation
E. survival and reproduction - #12 abiotic vesicles reproductin

8 pts.

3) Use the origins of eukaryotes to address how the concept of a "missing link" is both informative and futile when discussing evolution. Support your answer with data. **You answer cannot exceed 4 sentences.**

- missing link = intermediate/transient stage in evolutionary adaptations
- informative = see examples of what could be a found missing link #11, 15, 34, 47 depending on your explanation
- futile = not always preserved, big leaps skip steps, hard to find if existing, not sure what you're looking for
-

8 pts.

4) Most Americans don't really understand the relationship between natural selection and evolution. Give one example of evolution that happened quickly and another example that took much longer. You may NOT use the origin of eukaryotes as one of your examples. Choose a figure by number and explain how those data are relevant to your answer. **Limit your answer to no more than 4 sentences.**

quick = #10 inversions, #5 genome duplications, #6 diatom engulfing, #20 short time span
longer = #20 genetic drift, #10 many changes total over time, #25 giant bacterial size and # genes
all examples depend on your explanation and relative time frames

10 pts.

5) Science is often perceived by the general public as a smooth, continuous progression toward improved understanding (though they often us the word prove).

a) Describe an example (with figure number) from these four chapters where incorrect information was published and later retracted.

#25 = eukaryote or #29 nanobacteria

b) Explain how the example you chose differs from fabrication, falsification and plagiarism.

fabrication = presenting data for experiments never done
falsification = altering data or cherry picking results
plagiarism = claiming the ideas of others
examples above none of these, just honest mistakes in interpretation, corrected through more research

8 pts.

6) Appraise the benefits and potential hazards of mutualism when it comes to evolution at the cellular level. Support your answer with data by citing figure number(s) and explaining how the figure(s) is/are relevant to your answer. **Limit your answer to no more than 3 sentences.**

#22 or #23 depending on your explanation
mutualism = both species benefit from the other, can be more efficient
but makes both dependent on the other and if one fails, they both fail

12 pts.

7) List four hallmarks of signal transduction. Give a specific example for each hallmark you list. **Limit each item to no more than two sentences.**

A. amplification
B. allosteric and covalent modulation
C. G proteins
D. reset mechanisms or crossing the membrane
a wide variety of examples were acceptable

9 pts.

8) Describe how a neuron manages to move the action potential in only one direction. Be sure to address 1) depolarization 2) repolarization and 3) resetting the neuron for another action potential. Support your answer with data appropriately by choosing a figure number and explaining how the data are connected to your answer. **Limit your answer to a maximum of 6 sentences total.**

Figures 38 or 33
key points:
ligand-gated Na+ channels open (threshold surpassed)
voltage-gated Na+ channels open (depolarization)
channels become refractory to opening again which prevents backwash
voltage-gated K+ channels open after a short delay (repolarization)
Na/K pump resets ion gradients so neuron is ready for another depolarization

10 pts.

9) You learned about a wide range of cells that seem to violate "rules" biologists propose to characterize different types of cells. The large cell called *Epulopiscium fishelsoni* presented a problem based on its size. **Limit your answer to a maximum 3 sentences each.**

a) What problem were biologists able to resolve related to *E. fishelsoni*'s large size?

The main problem was how such a large cell could allow diffusion of proteins to happen quickly enough to respond to environmental challenges. The solution nature provided and biologists discovered was that the genome is amplified tens of thousands of times so that enough transcription/translation happens to keep the number of proteins sufficiently high enough to reduce diffusional distances. Figure #32 could be used to support the problem and solution.

b) What limitation does *E. fishelsoni* face that was not resolved by data presented in the book, when you compare *E. fishelsoni* to other cells such as *E. coli* or the really tiny bacterium *Pelagibacter ubique*? This answer requires that you integrate your knowledge.

There are many problems yet to solve. Energy for a large cytoplasm. Surface area to volume ration. Cytoplasm vs slower plasma membrane diffusion rates.

Five "Quick Recall" Questions for 2 points each **http://moodle.davidson.edu/moodle/**

Data Gallery

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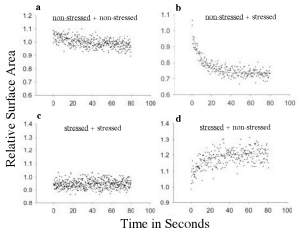

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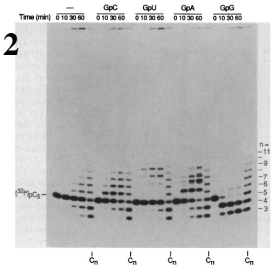

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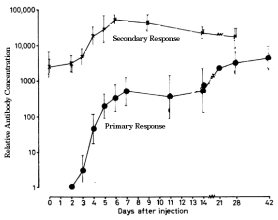

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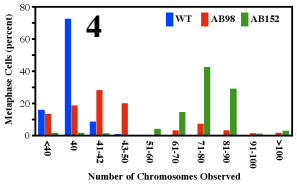

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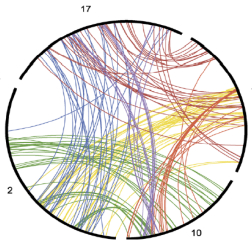

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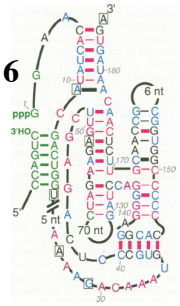

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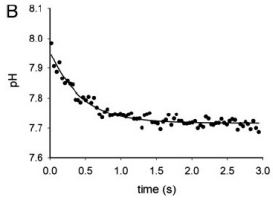

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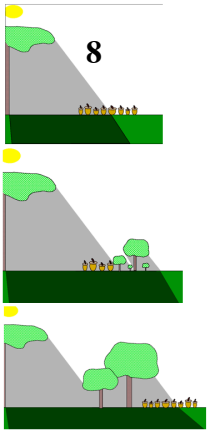

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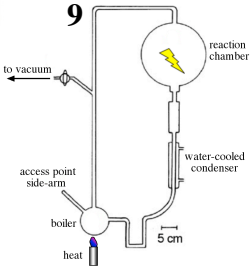

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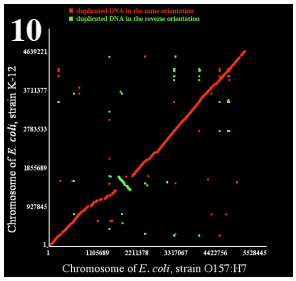

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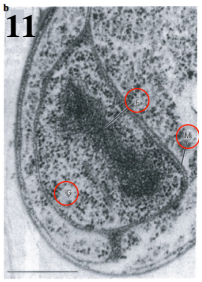

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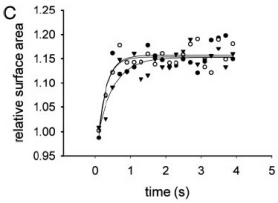

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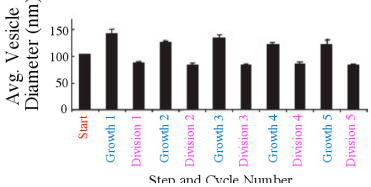

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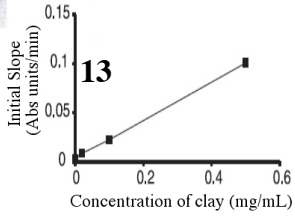

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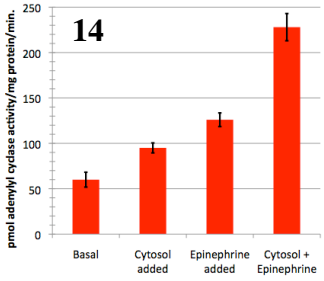

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Human Protein #	Protein Function	Protein Location	Best Match Domain
NP_001009	Translation	Cytoplasm/ rER	Archaea
NP_003185.1	Transcription Factor	Nucleus	Archaea
NP_001001937	ATP synthase	Mitochondria	Bacteria
NP_005521	Energy Harvesting	Mitochondria	Bacteria
NP_000393	Energy Harvesting	Cytoplasm	Bacteria
NP_004138	Cell Signaling	Cytoplasm	Archaea
NP_061816	Cytoskeleton	Cytoplasm	Bacteria

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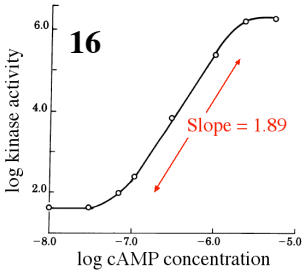

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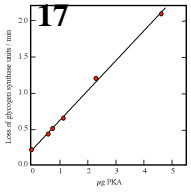

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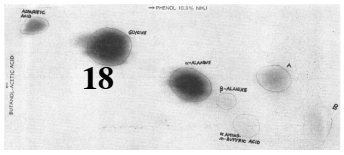

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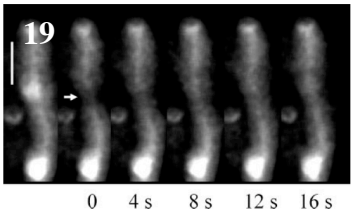

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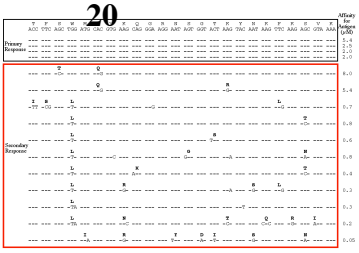

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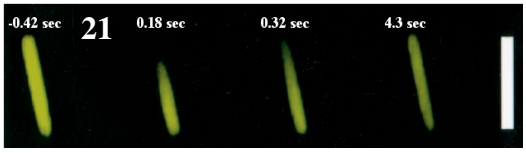

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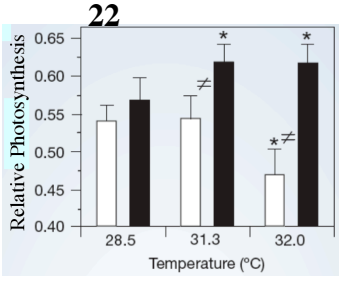

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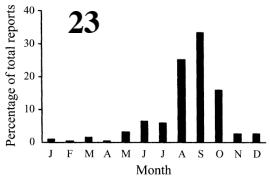

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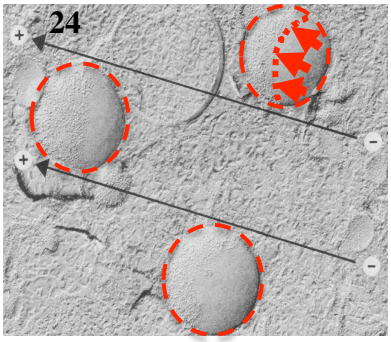

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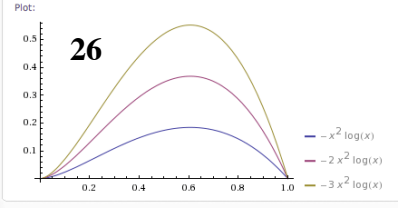

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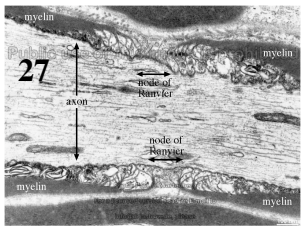

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Gene Name	Average Copy Number	Copy Number Range
fisZ	80,600	35,800-198,800
dnaA	48,700	29,800-153,000
recA	120,000	60,300-205,000
16S rRNA	368,000	241,000-737,000

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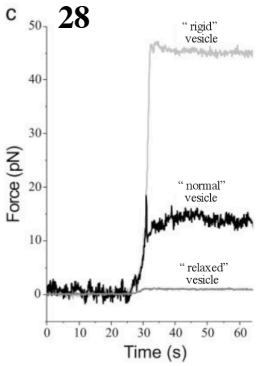

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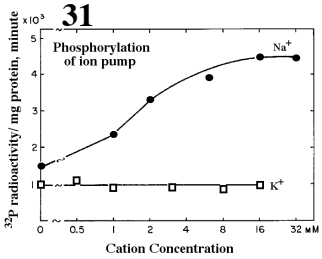

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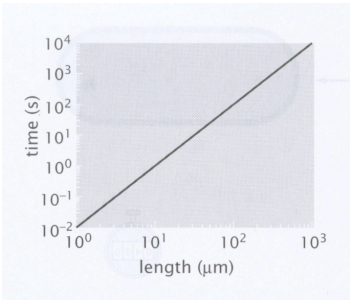

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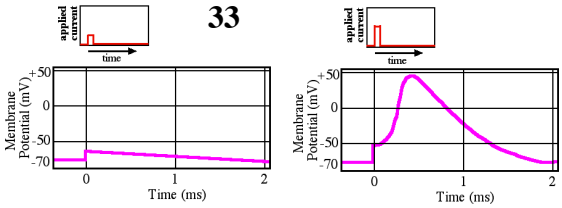

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Species	Domain	Description	Genome Mbps	Proteins
Candidatus Carsonella ruddii	Bacteria	Plant eating insect endosymbiont	0.16	182
Candidatus Sulcia muelleri	Bacteria	A leafhopper symbiont	0.25	227
Buchnera aphidicola	Bacteria	Endosymbiont of the aphid	0.42	362
Nanoarchaeum equitans	**Archaea**	Hot vent tube worms symbiont	0.49	536
Mycoplasma genitalium	Bacteria	Urinary tract pathogen	0.58	477
Candidatus Phytoplasma mali	Bacteria	Apple proliferation disease	0.60	479
Ureaplasma parvum	Bacteria	Urinary tract pathogen	0.75	614
Mycoplasma pneumoniae	Bacteria	Bronchitis and pneumonia	0.82	689
Borrelia turicatae	Bacteria	Tick-borne relapsing fever	0.92	818
Chlamydia trachomatis	Bacteria	Leads to blindness and STDs	1.00	874
Escherichia coli	Bacteria	Diarrhea (from undercooked meat)	5.50	5423

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Table 11.2 Mobility of proteins in and on *E. coli*.

Protein	Location	Diffusion Rate (μm² / sec)	Fold Slower
GFP	Water	87.0 ± 2.0	n.a.
GFP	Cytoplasm *E. coli*	8.0 ± 2.3	~10 X
GFP over produced	Cytoplasm *E. coli*	3.6 ± 0.7	~24 X
GFP + sugar-binding protein	Cytoplasm *E. coli*	2.5 ± 0.6	~35 X
GFP	Periplasm *E. coli*	2.6 ± 1.2	~33 X
GFP + TatA protein	Outer Membrane *E. coli*	0.13 ± 0.03	~669 X

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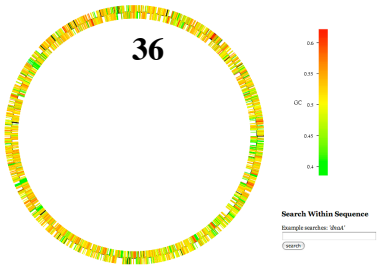

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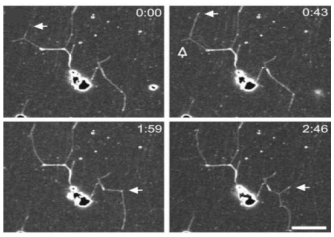

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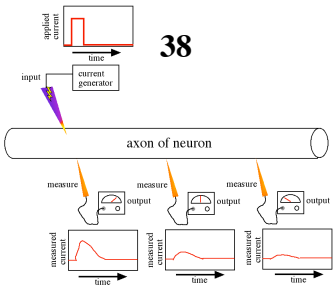

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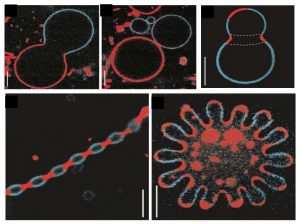

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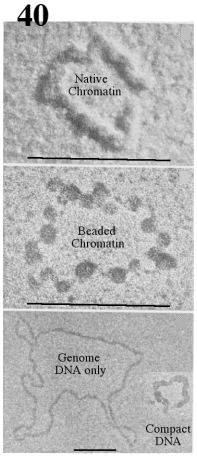

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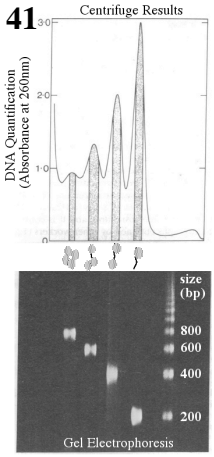

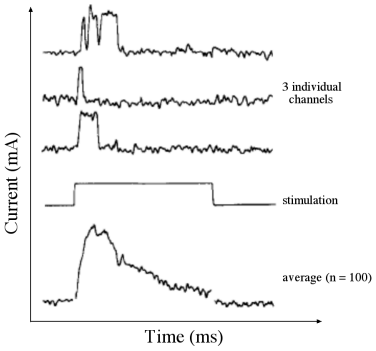

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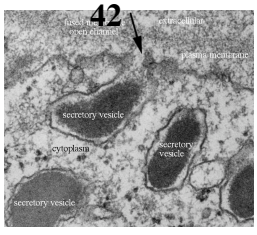

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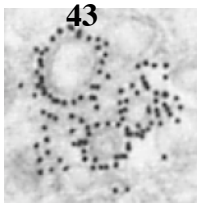

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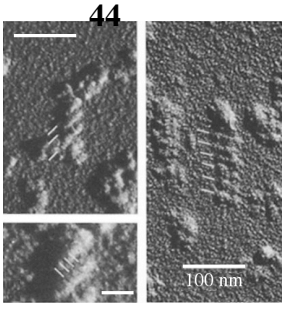

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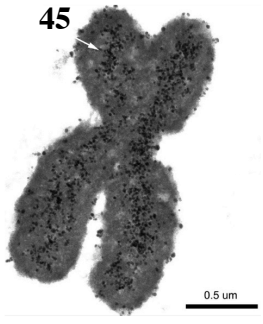

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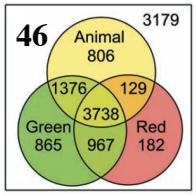

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