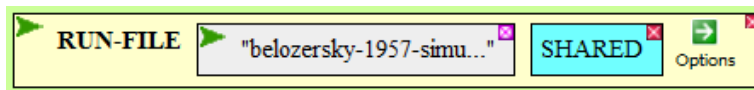


Molecular Biology Through Discovery

Problem Set 9: mRNA

1. Respond to Scenario 1 (word length survey) in the companion to Belozersky and Spirin (1957) and relate it to the results in the article.
2. Respond to Scenario 2 (automobile structure) in the companion to Belozersky and Spirin (1957) and relate it to the results in the article.
3. What does the data of Belozersky and Spirin (1957) mean? If you can calculate using only genomic information the substance of their Tables 1 and 2, you might get a step closer to understanding.

- Go to the [BioBIKE Portal](#)
- Enter the PhAnToMe/BioBIKE public site (no second choice!).
- Log in as usual (or enter non-registered).
- Once into BioBIKE, go to the INPUT/OUTPUT menu and click RUN-FILE.
- Fill in the *file-name* box with "belozersky-1957-simulation.bike" (in quotes).
- Mouse over the Options icon and click SHARED. You should get this:



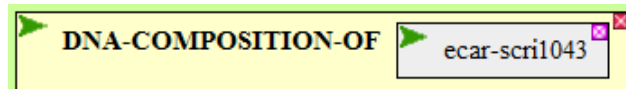
- Execute the now completed function by double-clicking RUN-FILE.

In a few seconds, you should get a message that loading completed successfully. As a result, you will have two new functions on your FUNCTIONS button.

- 3a. Reproduce a portion of Table 1 from Belozersky and Spirin (1957). To do this, mouse over the FUNCTIONS button and click DNA-COMPOSITION-OF. In the *organism* box type in the nickname for any one of the following organisms (these are both present in Table 1 and have genome sequences known by BioBIKE):

Organism name	Nickname
Clostridium-perfringens-str-13	Cper-13
Escherichia-coli-K12	EcoK12
Shigella-dysenteriae-M131649	Sdys-M131649
Erwinia-carotovora-subsp-atroseptica-SCRI1043	Ecar-Scri1043
Corynebacterium-diphtheriae-NCTC-13129	Cdip-13129
Brucella-abortus-biovar-1-str-9-941	Babo-9-941
Mycobacterium-tuberculosis-CDC1551	Mtub-1551

You should see something like the following (depending on which nickname you chose)

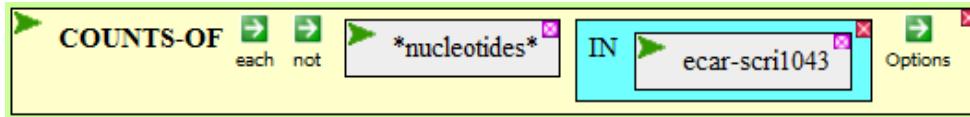


Execute the function. Try it again with a different organism.

How do your numbers relate to the numbers of Belozersky and Spirin (1957)?

- 3b. What do those numbers mean? Recall *What is a Gene?* You've done this problem before.
 - From the green ALL menu, bring down the COUNTS-OF function.

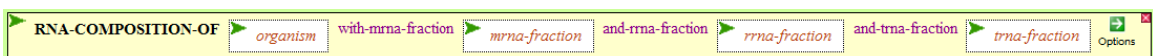
- Click the *query* box to open it.
- Mouse over the blue DATA menu and click *nucleotides*.
- Mouse over the Options icon and click IN
- Open the *value* box of IN and enter a nickname of an organism. You should see:



- Execute the function. You should see four numbers in the Result pane at the bottom of the screen.

What do these numbers mean? How could you get them yourself by hand (if you had a *lot* of time)? How do they relate to the numbers of **3a**? If you want to play more, you might recall the LENGTH-OF function, which will tell you how many total nucleotides are in a given genome.

- Now on to Table 2, a listing of RNA base composition. As before, you'll calculate this... wait a second! What does RNA composition mean? How could you calculate it from just the genome sequence? What would you need to know?
- Let's see what the function can do for you. Mouse over the FUNCTIONS button and click RNA-COMPOSITION-OF, getting:



The function demands four things from you. In the *organism* box, enter your favorite organism nickname from the table on the previous page. The other three boxes ask you for the fractions of RNA for mRNA, rRNA, and tRNA (which should add up to 1). How do you know what they are? You don't, but be thankful the function didn't ask you for the fraction of RNA for every gene in the organism!

What values for the three fractions enable you to reproduce Table 2 from Belozersky and Spirin? Why?

- Redraw Fig. 2 from Brenner et al (1961), presuming that ribosomes freely dissociate into their component proteins and then reassociate to form ribosomes again, prior to centrifugation.
- Redraw Fig. 6 from Brenner et al (1961), presuming that their Model I is correct.
- Redraw Fig. 7 from Brenner et al (1961), presuming that their Model II is correct. Redraw it presuming that Model I is correct.
- What were the two critical observations (i.e. experiment + evidence) of Astrachan and Volkin (1958)¹? How did the experiments of Brenner *et al* show a way out of the dilemma posed by their work?

¹ Astrachan L, Volkin E, (1958). Properties of ribonucleic acid turnover in T2-infected *Escherichia coli*. Biochim Biophys Acta 29:536-544.