



Bob Eisenberg <bob.eisenberg@gmail.com>

# Illustrative Examples for Typical Scientists and Applied Mathematicians

Bob Eisenberg <beisenbe@rush.edu>

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Reply-To: beisenbe@rush.edu

To: Chun Liu <liu@math.psu.edu>

Cc: Bob Eisenberg <beisenbe@rush.edu>, Tai-Chia Lin 林太家 <tclin@math.ntu.edu.tw>, Fred Cohen <Fredric\_Cohen@rush.edu>

Dear Chun

I am eager to hear your diffusion talk!  
What a great way to focus your work.

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DIFFUSION EXAMPLE  
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The biologists and chemists will feel most at home if you weave your analysis around a classical example

Concentration 1    on one side  
Concentration 2    on the other side

and describe the fluxes AND THE COUPLING OF FLUXES OF DIFFERENT SPECIES that come from EnVarA.

Specifically, biologists and chemists "believe in their bones" that flux of one type of solute ONLY ONLY driven by the concentration gradient of that type of solute.

So one can get their attention by showing that flux of one type of solute occurs **EVEN WHEN THE CONCENTRATIONS OF THAT SOLUTE ARE THE SAME ON BOTH SIDES** (in compartment 1 and compartment 2).

And then explaining in painfully explicit detail how EnVarA has that happen. If you are using ions as your solutes, all the better. Then everyone will see everything.

This may seem trivial to you, but coupling of this sort is absolutely **THE KEY** to understanding the mechanism of what are called transporters (i.e., channel like proteins that move solutes against the gradient of chemical potential of that solute)

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**ADVANTAGES OF VARIATIONAL APPROACH**  
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The advantages of the variational approach are also **VERY** well illustrated, for much the same psychological reason, by the case where the concentration of **EVERY** solute is the same on both sides, **BUT** the diffusion coefficient is different on both sides.

Classical diffusion theory (which uses Stratonovich as shown in the papers I sent you last week) will give flux. This of course is wrong. It has to be fixed up "by hand" (i.e., by separate physical argument) to get rid of this artifact.

EnVarA will **AUTOMATICALLY BY ALGEBRA AND ANALYSIS** give zero flux because it will get the coupling right and create the correct drift term **without** separate physical argument.

This discussion will convince more people of the power of the (energetic) variational approach than any more logical abstract argument, given the way people actually think.

I look forward to your talk!

As ever  
Bob

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Return Address for email: [beisenbe@rush.edu](mailto:beisenbe@rush.edu)

Bob aka RS Eisenberg

Bard Endowed Professor and Chairman  
Dept of Molecular Biophysics & Physiology  
Rush University  
1653 West Congress Parkway  
Chicago IL 60612 USA  
Office Location: Room 1291 of  
Jelke Building at 1750 West Harrison

Email: [beisenbe@rush.edu](mailto:beisenbe@rush.edu)  
Voice: +312-942-6467  
FAX: +312-942-8711  
FAX to Email: +[708-455-8542](tel:708-455-8542)  
Department WebSite: <http://www.phys.rush.edu/Personal>  
WebSite: <http://www.phys.rush.edu/RSEisenberg/>

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