

# Kevin Ahern's (and Friends') Wildly Popular Metabolic Melodies

This is the complete collection of Kevin Ahern's Wildly Popular Metabolic Melodies as of August 23, 2010.

The link page for individual melodies is  
<http://www.davincipress.com/metabmelodies>.

**The Metabolic Melodies Songbook** is available at  
<http://www.lulu.com/product/paperback/the-metabolic-melodies-songbook/6487402>

A **2010 Calendar** of the Metabolic Melodies is available at  
<http://www.lulu.com/product/calendar/metabolic-melodies-2010-calendar/5601103>

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Kevin

# The Muscle Energy Song

(to the tune of "*I Will*")

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For running and for jumping  
You need some energy  
Chemically the body stores it  
In the form of ATP

If backup should be needed  
Reserves are there in wait  
Muscles brimming with supplies of  
Tiny creatine phosphate

Ready whenever you are ever  
Wanting to exercise  
Steady as ever when whatever  
Energy needs arise

The action is exacting  
For leaping in the air  
Myofibrils all contracted  
Using energy extracted  
From reactions that react in me  
Using A-T-P  
You see

# They Call the Stuff Urea

(To the tune of "*They Call the Wind Mariah*")

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Get ATPs, bicarbonate,  
Ammonia catalyzing  
To make carba-mo-yl phosphate  
And then start the synthesizing

When joined up with an ornithine  
In THE mi-TOE-chon-DREE-a  
It turns into a citrulline  
When cycling to urea

Urea!  
Urea!  
They call the stuff urea!

On exit to the cytosol  
There's bonding aspartat-ic  
The argininosuccinate  
Is produced in this schematic

Bid farewell to a fumarate  
Amino panacea  
Arises when the arginine  
Gets lysed to form urea

Urea!  
Urea!  
You've just made some urea!

The body handles many things  
Requiring its attention  
Like balancing aminos for  
Uremia prevention

So if there's excess nitrogen  
It is a good idea  
To rid yourself of surplus by  
Producing some urea  
Urea!  
Urea!  
Go out and take a pee, yeah!

Urea!  
Urea!  
Have yourself a pee, yeah!

# I Studied So Hard Last Night

(To the tune of "*I Saw Her Again Last Night*")

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I studied so hard last night  
But you know that I couldn't  
Get all the reactions down right  
Oh my brain simply wouldn't

I made lots of tries  
To memorize  
But it seemed the more I read the book  
I never learned

'Twas much too complex in my head  
And so truly confusing  
Like most of the things Ahern said  
Awfully tough but amusing

I got so upset  
That I would forget  
Oh I had to find another way  
Or I'd never learn

(Bridge)

Metabolic Melodies  
The pathways I could sing in time  
They all put my mind at ease  
Using just the power of rhyme  
My grades began to climb

I studied so hard last night  
Now I'll never forget it  
The Melodies helped get it right  
Just the way Kevin said it

I won't get it wrong  
'Cause I know the songs  
And it makes me feel so good to know  
I've truly learned

# Histones

(To the tune of "*Meet the Flintstones*")

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Histones, tiny histones  
Wrap up eukaryotic DNA

Using lysine side chains  
They arrange a chromatin array

With them - DNAs of seven feet  
Fit in - side the nucleus so sweet

When you use the histones  
You have to deal with condensation  
And its ablation  
Inside your chromosomes

*Thanks to Tom Ellen for the inspiration for this song*

# To Make a Cholesterol

(To the tune of "*When Johnny Comes Marching Home*")

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Some things that you can build with acetyl-CoAs  
Are joined together partly thanks to thiolase  
They come together 1-2-3  
Six carbons known as H-M-G  
And you're on your way  
To make a cholesterol

To synthesize a mevalonate in the cell  
Requires reducing HMG-CoA, as well  
The enzyme is a RE-ductase  
Controlled in allosteric ways  
When the cell's impelled  
To make a cholesterol.

The mevalonate made in metabolic schemes  
Gets decarboxylated down to isoprenes  
They're linked together willy-nil  
To build a PP-geranyl  
In the cells' routines  
To make a cholesterol

A single step links farnesylys but that's not all  
The squalene rearranges to lanosterol  
From that there's nineteen steps to go  
Before the sterol's apropos

Which you must recall  
To make a cholesterol

The regulation of the scheme's complex in ways  
Inhibited by feedback of the RE-duc-tase  
And statins mimic so they say  
The look of HMG-CoA  
So we sing their praise  
And not make cholesterol

# Crappy Days Are Here Again

(To the tune of "*Happy Days are Here Again*")

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Crappy days are here again  
The sky above's not clear again  
And the sun has disappeared again  
Crappy days are here again

Rain is falling from the sky  
I wish I knew the reason why  
Guess I'll have to wait until July  
For the weather to be dry

(Bridge)  
I do not mean to harangue  
Since rain provides yin and yang

Because the flowers every one  
Love moisture followed by the sun  
Let's stay happy 'til the rain is done  
In Corvallis, Oregon

# Give Us Real Things

(To the tune of "*(Coke) It's the Real Thing*")

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I'd like to teach my students 'bout  
some biochemistry  
To keep them all from drinking Coke  
and make them *trans* fat free  
There'd be no taking creatine  
to help them run so fast  
And Sucralose and Nutrasweet  
would be things of the past

I'd lower fructose levels in  
the junk that people eat  
And salmon farmed, then colored up  
I'd work hard to defeat  
Organic food is good for you  
everybody knows  
So let's get rid of factory farms  
and all the GMOs

Give us real things  
Some for you, some for me  
Biochem's good you see  
Give us real things

# The Alcohol Song

(To the tune of "*Rudolph the Red-Nosed Reindeer*")

Copyright 2009, Tony Rianprakaisang

Cells go through fermentation  
When they're out of NAD  
Substrate phosphorylation's  
How they make their ATP

Cells are efficient makers ( . . .of)  
Energy on which to live  
With no electron takers  
They need an alternative

Oh glycolysis would stop  
Without NAD  
Isn't fermentation great?  
For reducing pyruvate!

And if you might be thinking  
"Man this isn't cool at all"  
Ask yourself when you're drinking  
"Where do we get alcohol?"

# Catalyze

(To the tune of "*Scarborough Fair*")

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My enzymes  
Truly are inclined  
To convert  
Things they bind  
Turn the key  
Covalently  
Cat-a-lyze

How do cells  
Regulate these roles?  
Allo-ster  
-ic controls  
Two forms, see  
States R and T  
Mod-u-late

Competing inhibition keeps  
The substrates from the active site  
They raise  $K_m$ , but leave  $V_{max}$  and shirk  
While the non-competers bind elsewhere  
And lift the plot made on Lineweaver-Burk

Other ways  
Enzymes can be blocked  
When things bind  
Then get locked

Stuck not free  
Tied to the key  
Su-i-cide

Penicillin's action stops  
Peptidoglycan cross-links in  
Bacterial cell walls in awesome ways  
Beta lactam ring's reactive site  
Starts bonding with D-D-transpeptidase

So there are  
Several enzyme states  
Counteract  
-ing substrates  
Now you see  
Blocking the key  
Regulates

Cat-a-lysts  
Have to be controlled  
Some get slowed  
Put on hold  
It's sublime  
How the enzymes  
(slow) Cat-a-lyze

ahhhhhhhhhhhhhhhhhhhhh - cat-a-lyze  
ahhhhhhhhhhhhhhhhhhhhh - cat-a-lyze  
ahhhhhhhhhhhhhhhhhhhhh - cat-a-lyze

# Photosynthesis is Divine

(To the tune of "*Scarborough Fair*")

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Photosynthesis is divine  
Fixing carbon using sunshine  
It's thanks to plants that we've got a prayer  
They pull CO<sub>2</sub> from the air

Reaping energy from the sun  
It's efficient second to none  
You grab the photons almost at will  
Protoporphyrin chlorophyll

Light reactions of System II  
Split up water, making O<sub>2</sub>  
Electrons pass through schemes labeled 'Z'  
Pumping protons gradiently

ATP's made due to a shift  
Of the protons spinning quite swift  
An enzyme turbine, cellular maze  
You know as A-T-P synthase

Carbon's fixed onto a substrate  
Ribulose-1,5-bisphosphate  
Rubisco acts in-efficient-ly  
Splitting it into 3PGs

If the enzyme grabs an O<sub>2</sub>  
It makes glycolate, it is true

The Calvin cycle works in a wheel  
Giving plants a sugary meal

So photosynthesis is divine'  
Cause it happens all of the time  
From dawn to dusk and times in between  
Solar panels truly are green

# The Mellow Woes of Testing

(To the tune of "*The Yellow Rose of Texas*")

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The term is almost at an end  
Ten weeks since it began  
I worried how my grade was 'cause  
I did not have a plan  
The first exam went not so well  
I got a fifty three  
'Twas just about the average score  
In Biochemistry

I buckled down the second time  
Did not sow my wild oats  
I downloaded the videos  
And took a ton of notes  
I learned about free energy  
And Delta Gee Naught Prime  
My score increased by seven points  
A C-plus grade was mine

I sang the songs, I memorized  
I played the mp3s  
I learned the citrate cycle  
And I counted ATPs  
I had electron transport down  
And all of complex vee  
I gasped when I saw my exam  
It was a ninety three

So heading to the final stretch  
I crammed my memory  
And came to class on sunny days  
For quizzing comedy  
I packed a card with info and  
My brain almost burned out  
'Twas much to my delight I  
Got the 'A' I'd dreamed about

So here's the moral of the song  
It doesn't pay to stew  
If scores are not quite what you want  
And you don't have a clue  
The answers get into your head  
When you know what to do  
Watch videos, read highlights and  
Review, review, review

# Major Groovy

(To the tune of "*Feelin' Groovy*")

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The DNA forms

A and B

Have bases

Complementary

Despite the similarities

They differ in their

Major groovies

Nanananananana major groovy

Transcription factors

With their bindin'

'Cause DNA to

Start unwindin'

Holding it

Aggressively

By forming bonds in

Major groovies

Nanananananana minor groovy

For proteins, the key

To sequence I-D

Is hydrogen bonding, each base pair unique

Purine, pyridine patterns discrete

In DNA's most

Major groovy

Nanananananana major groovy

# Your Poor Veins

(To the tune of "*You're So Vain*")

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Well I raced off to my doctor  
Cause I was feelin' the twinges of pain  
I was worried about my heart 'cause I  
Was overweight once a-gain  
She took one look at my profile and  
Just shook her head and complained

"You gotta wake up and change all that junk you've been  
eating Junk you've been eating. 'Cause

Your poor veins  
Are plugged 'cause you are wolfen' the butter  
And LDLs  
Are makin' your heart go a-flutter  
Flutter, Flutter"

She had warned me several months before  
But I just ignored what was said  
She told me, "You look like a heart attack"  
"It's surprising that you're not dead"  
I walked away in disbelief  
And ate more bad food instead

I loaded oodles of cream in my tall Macchiatos  
Tall Macchiatos and

LDLs  
Went up as I was gulping 'em down my

LDLs

Just turned a smile right into a frown  
A frown, a frown

I decided to make a change right there  
The diet was merely step one  
All the trans fats were banished from my food  
And I started to jog just for fun  
I had one foot in the grave when I  
Discovered what I had done

I moved away from the edge of the doorstep of death to  
Re-gaining my breath when my

HDLs

Increased since I was eating more smartly

HDLs

They lowered my cholesterol partly  
Partly, partly

Well you know I'm feeling much better now  
And my heart is surely relieved  
A factor certainly is the unsaturates  
Contained in my sunflower seeds  
Yeah the fatty acids were the keys  
Essential things that we need

Those fish oil capsules and o-mega threes cleaned  
My ar-ter-ies with

HDLs

They're more than just the latest hot crazes

HDLs

They saved me so I'm singing their praises

Praises, Praises

# Fermentation!

(To the tune of "*Oh Susannah!*")

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This song has not yet been recorded

Oh, late last night I went to jog  
when everything was still  
I came upon a gravel road  
a-windin' up the hill  
I don't know why I did it but  
I played a game with death  
Ran up that hill in double time  
And held in all my breath  
Fermentation!

I need some NAD+  
my cells are lackin' oxygen  
But using ATP

'bout half way up I felt the burn  
My hip down to my knee  
if only I had stayed awake  
In biochemistry  
then I'd have had a warning, but  
regrets were just too late  
I stood in pain - my body was  
reducing pyruvate!

Fermentation!  
I need some NAD+  
my cells are lackin' oxygen

But using ATP

Well up came my professor who  
was trailin' close behind  
he told me how fermenting was  
a process most unkind  
Oh ATP is energy  
It's keeping you alive  
It's mostly made by protons mov-ing  
through the complex five

Fermentation!  
I need some NAD<sup>+</sup>  
my cells are lackin' oxygen  
But using ATP  
In making ATP a pro-ton gradient is key  
to ADP's phosphoryla-tion, oxidatively  
Electrons pass through complex four  
And oxygen, you know  
picks up four more electrons and  
makes double H<sub>2</sub>O

Fermentation!  
I need some NAD<sup>+</sup>  
my cells are lackin' oxygen  
But using ATP

I hope that you can clearly see  
Exactly what I meant  
That oxygen is needed for

The proton gra-di-ent  
your muscles work in overdrive  
And use up ATP  
you might be breathin' hard but lack  
sufficient energy

Fermentation!  
I need some NAD+  
my cells are lackin' oxygen  
But using ATP

You're in a heap o' trouble and  
this breath may be your last  
if you can't make some ATP  
and NAD+ real fast  
It's lactate dehydrogenase  
To save the day, you see  
Turn pyruvate to lactate and  
Produce more NAD+!

Fermentation!  
I need some NAD+  
my cells are lackin' oxygen  
But using ATP

The NAD+'s important,  
Are You gettin' all of this?  
it gets fed back into the path-  
way of glycolysis"  
it hit my ear, it was so clear

and all made sense to me  
Although I had no oxygen  
I still made ATP

Fermentation!  
I need some NAD+  
my cells are lackin' oxygen  
But using ATP

For all he'd done I took my prof  
to sit down for a drink  
admitting that his lesson ear-  
lier had made me think  
I took a swig of ale  
And grinning wide, I said with glee  
Oh, fermentation hurts but all in all  
It's fine by me

Fermentation!  
I need some NAD+  
my cells are lackin' oxygen  
But using ATP

# The Immune Tune

(To the tune of *Yankee Doodle*)

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Antigen presenting cells  
Help to clear infection  
And they help your thymocytes  
Go through t-cell selection

Endocytose antigen  
And then cross-present it  
All to slow the illness down  
Or possibly prevent it

Activate a CD8  
This will help you be well  
It will differentiate  
To cytotoxic t-cell

Systems of immunity  
Fusing with perfection  
Thank Adaptive and Innate  
For giving such protection!

# Enzymes

(To the tune of *Downtown*)

Copyright 2008 **Kevin Ahern**

Reactions alone

Could starve your cells to the bone

Thank God we all produce

Enzymes

Units arrange

To make the chemicals change

Because you always use

Enzymes

Sometimes mechanisms run like they are at the races

Witness the Kcat of the carbonic anhydrases

How do they work?

Inside of the active site

It just grabs onto a substrate

and squeezes it tight

In an

ENZYME!

CAT-al-y-sis

In an ENZYME!

V versus S

In an

ENZYME!

All of this working for you

(Enzyme, enzyme)

## Enzymes (continued)

Energy peaks  
Are what an enzyme defeats  
In its catalysis  
Enzymes

Transition state  
Is what an enzyme does great  
And you should all know this  
Enzymes

Catalytic action won't run wild - don't get hysteric  
Cells can throttle pathways with an enzyme allosteric

You know it's true

So when an effector fits  
It will just rearrange  
all the sub-u-nits  
Inside an  
ENZYME!  
Flipping from R to T  
ENZYME!  
Slow catalytically  
ENZYME!  
No change in Delta G  
(Enzyme, enzyme)

## Enzymes (continued)

You should relax  
When seeking out the  $V_{max}$  though  
There are many steps  
Enzymes

Lineweaver Burk  
Can save a scientist work  
With just two intercepts  
Enzymes

Plotting all the data from kinetic exploration  
Let's you match a line into a best fitting equation

Here's what you do

Both axes are inverted then  
You can determine  $V_{max}$  and  
Establish  $K_m$  for your ENZYMES!  
Sterically holding tight  
ENZYMES!  
Substrates positioned right  
ENZYMES!  
Inside the active site  
Enzymes (Enzymes, enzymes, enzymes)

# Students Rejoice!

(to the tune of *Joy to the World*)

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Students rejoice.

The end is near

For bi-o-chem-is-try

No metabolic pathways, no enzymes we must know

And Ahern cannot sing

He really should not sing

Let's hope that in winter term he does not sing

# My 'A'

(To the tune of *My Way*)

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And now, the course is done  
Except for all that final testing  
Dear friends, let's have some fun  
There surely won't be much protesting

We've had a busy term  
Addressing all the content swiftly  
And so I sit and squirm  
B-B three fif-ty

Exams, there's been a few  
Our averages were somewhat lower  
The grades are all askew  
I wish that Ahern would go slower

I studied hard each time  
And even though my grades were iffy  
Oh no, I did not whine  
B-B three fif-ty

Yes it was tough  
You knew it too  
I memorized  
My knowledge grew  
And through it all  
I did not frown  
I thought it up  
And wrote it down  
I fought the fight  
I hope it's right  
B-B three fif-ty

## My 'A' (continued)

I laughed, I cried, I swore  
Just as I did here on the first day  
But since, the term is o'er  
Let's all go out for thirsty Thursday

I guess I have to face  
The fact that I am not a swifty  
But oh, I need to ace  
B-B three fif-ty

The end arrives  
Our grades are out  
As I log in  
To my account  
I say some things  
I truly feel  
I hope I don't  
Have to appeal  
There's no dismay  
I made my 'A'

B-B three fif-ty

# Citrate Sonata

(To the tune of *God Rest Ye Merry Gentlemen*)

Copyright 2008 **Tari Tan**

Our fats and carbs get broken down  
To acetyl CoA  
Oxaloacetate combines  
In cycles TCA  
The product of reaction one  
Oh, citrate is its name  
Iso-citrate, the product that ensues  
Atoms got moved  
Isocitrate is the product of step two

An oxidation soon occurs  
Reducing NAD  
An alpha-ketoglutarate  
Resulting from step three  
From here we could make glutamate  
That is, if there's a need  
Don't forget that we lost a CO<sub>2</sub>  
Yes it is true  
In reaction three we lost a CO<sub>2</sub>

So what's the point of all these steps?  
Well, let me tell you, friend  
We use electron carriers  
In working towards our end  
Of synthesizing ATP  
(A metabolic trend)  
Oxidize, and then oxidize some more  
Here in step four  
Ketoglutarate gets oxidized some more

## Citrate Sonata (continued)

The enzyme with cofactors five  
Including TPP  
Lipoate, FAD, CoA  
And also NAD  
A succinyl that's on CoA  
Is what gets made, you see  
This reaction occurs so fav'rably  
Don't you agree?  
It's a good reaction energetically

With four more steps, we're halfway there  
So let me summarize  
When CoA's lost we see that G-  
T-P is synthesized  
The succinate that is produced  
Will soon get oxidized  
FAD goes to FADH<sub>2</sub>  
What did we do?  
We made fumarate and FADH<sub>2</sub>

Add water 'cross the double bond  
And malate we create  
With one last NAD we can  
Then dehydrogenate  
To give a final product of  
Oxaloacetate  
It's removed, and this lowers Delta G  
Oh yes, indeed  
It's through pulling that this last step can proceed

# PCR Woes

(To the tune of *She'll Be Comin' Around the Mountain*)

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First you must design the primers- PCR!  
Make sure that they won't form dimers - PCR!  
Then you check the melting T's  
A's and T's are two degrees  
And it's four for G's and C's in PCR!

Oh the thermocycler's set for PCR!  
If this fails you'll be upset with PCR!  
First you melt and did I mention  
It's anneal and then extension  
Copying is the intention - PCR!

Many times the protocol you've tried to fix  
Checking all your tubes and then your mastermix  
Looking for contamination  
As you build up your frustration  
If there's no amplification - PCR!

You can use reverse transcription - PCR!  
Surely you'll throw a conniption - PCR!  
Other types may give you trouble  
Oh there's inverse and there's bubble  
Your anxiety will double - PCR

Oh you've really got to amplify this strand  
Hope that when you run your gel you've got a band  
Didn't get what you expected  
Damn this project you selected  
Now you're feeling quite dejected - PCR!

# Central Dogma Zen

(To the tune of *Those Were the Days*)

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Once upon a time a cell decided  
The time was ripe for it to split in two  
Had to copy cellular instructions  
For the daughter cell would need them too.

Bring in a helicase  
Unzip the DNAs  
To ease the stress a gyrase joins the fray  
Strands must be held apart  
SSBs do their part  
And primase builds a primer RNA.

Sliding clamp comes in behind clamp loader  
dNTPs floating all around  
In the wings a replicase is waiting  
For the chance to start another round.

Polymerase, my friend  
Starts at the 3' end  
It puts a 'T' across from every 'A'  
A 'G' across from 'C'  
Perfect simplicity  
The leading strand is made in just this way.

The lagging strand is made in little pieces  
Okazaki fragments, you recall  
Pol I fills the gaps that lie between them  
Ligase comes in next and joins them all.

## Central Dogma Zen (continued)

Blueprints can't have mistakes  
That's why polymerase  
Corrects its work with exonuclease  
Proofreading one by one  
Till all its work is done  
Hurray for D-N-A polymerase!

An organism's cellular construction  
With blueprints for the things they have to do  
Requires converting DNA instructions  
To ribopolymers, oh yes it's true

Because they've been bestowed  
With a genetic code  
The RNAs provide the cell with means  
To link amino A's  
In most directed ways  
Inside the protein-making cell machines

If "*coli*" cells don't have galactosidase  
And lactose should appear inside its food  
The lac repressor leaves the operator  
'Cause otherwise metabolism's screwed

Polymerase unwinds  
The DNAs it binds  
Adjacent to the start site where it docks  
Unravels A's and T's  
With such amazing ease  
At the promoter's little TATA box

## Central Dogma Zen (continued)

The process moves along without much trouble  
While making RNA inside the cell  
It all occurs inside transcription bubbles  
Where bases get linked anti-parallel

mRNA then roams  
To find some ribosomes  
Subunits large and small bind near the end  
The A-U-G's in place  
Inside the P site space  
Initiation you can comprehend

The mechanism shifts to elongation  
Proceeding by three bases at a stretch  
A GTP's required for translocation  
Advancing 5 to 3 the whole complex

The process moves anon  
Until a stop codon  
Arrives and causes movement to suspend  
Translation has to cease  
A peptide gets released  
And we have reached the central dogma's end.

# Test Gently on Glycolysis

(To the tune of *God Rest Ye Merry Gentlemen*)

Copyright 2007 by Tari Tan

In glycolysis, a glucose ring's first turned to G6P  
The enzyme hexokinase adds a phosphate –  $\text{PO}_3$   
The glucose then turns fructose – 6 carbons, called F6P  
Phosphoglu-cose i-som-er-ase, you see  
Makes F6P  
Phosphoglu-cose i-som-er-ase, you see

Fructose-1,6-bisphosphate, also known as FBP  
By phosphofructokinase has a second  $\text{PO}_3$   
By aldolase, it's cleaved in 2, one half gives GAP  
Glyceraldehyde-3-phosphate: GAP  
It goes on, you see  
Through glycolysis, this lucky GAP

The second half, DHAP, can't carry on this way  
You need to change this dihydroxyacetone phosphate  
To GAP, so call in "TIM", he'll make things go his way  
Triose phosphate isomerase – the same  
TIM is his name TPI and TIM, they are the same

Glyceraldehyde-3-phosphate de-hy-dro-ge-nase is next  
1,3-biphosphoglycerate is made; it is the best  
A reaction of high energy – it says so in my text  
GAPs go to 1,3-BPG  
Add  $\text{PO}_3$   
GAPs go to 1,3-BPG

## Test Gently on Glycolysis (continued)

The  $\text{PO}_3$ 's then lost, 'cuz phosphoglycerate kinase

By using ADP, it makes 3-phosphogly-cer-ate

This turns to 2PG with phosphoglycerate mutase

Losing water when it meets enolase

E-no-lase

Losing water when it meets enolase

Too many steps, I'm kinda lost, so let me get this straight –

A phosphate and an OH group switch places in step eight

Hence "mutase", 'cuz it changed, but what the heck is enolase?

It makes phos-pho-enolpyruvate

Isn't it great?

It makes phos-pho-enolpyruvate

In the 10<sup>th</sup> and final step (Hooray!) we make our pyruvate

Pyruvate kinase is our friend, he takes us all the way

The phosphate and the double bond – please take them both  
away

Leaving only our precious pyruvate

Py-ru-vate

Glycolysis is done, oh happy day!

# Gluconeogenesis

(To the tune of *Supercalifragilisticexpialidocious*)

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When cells have lots of ATP and NADH too  
They strive to store this energy as sugar yes they do  
Inside of mitochondria they start with pyruvate  
(slow) Carboxylating it to make oxaloacetate

Oh gluconeogenesis is so exhilarating  
Memorizing it can really be exasperating  
Liver cells require it so there's no need for debating  
Gluconeogenesis is so exhilarating

Oh, glucose, glucose come to be  
Glucose, glucose come to be

Oxaloacetate has got to turn to PEP  
Employing energy that comes from breaking GTP  
From there it goes to make a couple phosphoglycerates  
(slow) Exploiting ee-nolase and mutase' catalytic traits

Oh gluconeogenesis is liver's specialty  
Producing sugar for the body most admirably  
Six ATPs per glucose is the needed energy\*  
Gluconeogenesis is liver's specialty

Oh glucose, glucose joy to me  
Glucose, glucose joy to me

Converting phosphoglycerate to 1,3BPG  
Requires a phosphate that includes A-T-P energy  
Reduction with electrons gives us all an N-A-D  
(slow) And G3P's isomerized to make D-H-A-P

# Gluconeogenesis (continued)

Oh gluconeogenesis is anabolic bliss  
Reversing seven mechanisms of glycolysis  
To do well on the final students have to learn all this  
Gluconeogenesis is anabolic bliss

Oh, glucose, glucose factory

Glucose, glucose factory

The aldolase reaction puts together pieces so  
A fructose molecule is made with two phosphates in tow  
And one of these gets cleaved off by a fructose phosphatase  
*(slow)* Unless F2,6BP's acting blocking path-a-ways

Oh gluconeogenesis a pathway to revere  
That makes a ton of glucose when it kicks into high gear  
The cell's a masterminding metabolic engineer  
Gluconeogenesis a pathway to revere

Oh glucose, glucose jubilee

Glucose, glucose jubilee

From F6P to G6P, that is the final phase  
The enzyme catalyzing it is an isomerase  
Then G6P drops phosphate and a glucose it becomes  
*(slow)* Inside the tiny endoplasmic-al reticulums

Oh gluconeogenesis is not so very hard  
I know that on the final we will not be caught off guard  
'Cause our professor lets us use a filled out index card  
Gluconeogenesis is not so very hard

*\*Actually, you need two NADHs too, but that wouldn't fit the rhyme :-)*

# March of the Proteins

(To the tune of *The Ants Go Marching One by One*)

Copyright © 2007 **Tari Tan**

Oh there's a method you should know that's very huge  
It's spinning round and round inside the centrifuge  
The supernatant, pellet too  
You choose the one that's right for you  
And from there we pu-ri-fy  
What's inside

To size exclude filtration is the way to go  
The beads have pores small proteins can go in you know  
The largest ones, they come out fast  
The smallest ones eluting last  
And the proteins purified  
By their size

Electrons power gel e-lec-tro-pho-re-sis  
The protein is denatured thanks to SDS  
Proteins in a minus state  
Get sorted by atomic weight  
Smaller ones in speedy mode  
To the anode

Ion exchange is special chromatography  
To switch cations, you must have a minus bead  
Upon this bead, the proteins bind  
They're positive, not any kind  
And the others wash right through  
Out to you

## March of the Proteins (continued)

Oh my this song has given you a mighty list  
Perhaps we'll just skip over ol' dialysis  
So study HPL and C  
If you have questions, talk to me  
You will get through protein hell  
You'll do well.

# Oh Delta Gee

(To the tune of *Oh Danny Boy*)

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Oh Delta Gee - the change in Gibbs free energy  
Can tell us if a process will advance  
'Cause if the value's less than naught it translates that  
Reverse reactions haven't got a chance

But when the sign is plus it is the opposite  
And then the backwards happens all the time  
A factor is the standard Gibbs free energy  
So don't forget about the delta G naught prime

# When Acids Are Synthesized

(To the tune of *When Johnny Comes Marching Home*)

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The 16 carbon fatty acid, palmitate  
Gets all the carbons that it needs from acetate  
Which citric acid helps release  
From mitochondri - matrices  
Oh a shuttle's great  
When acids are synthesized

Carboxylase takes substrate and it puts within  
Dioxy carbon carried on a biotin  
CoA's all gain a quick release  
Replaced by larger ACPs  
And it all begins  
When acids are synthesized

A malonate contributes to the growing chain  
Two carbons seven times around again, again  
For saturated acyl-ates  
There's lots of N-A-DPH  
That you must obtain  
When acids are synthesized

Palmitic acid made this way all gets released  
Desaturases act to make omega-threes  
The finished products big and small  
Form esters with a glycerol  
So you get obese  
When acids are synthesized

# Prostaglandins

(To the tune of *Oklahoma!*)

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Prossss-taglandins

The ei-co-sa-noids creating pain

Are the ones to blame - when you get inflamed

And ouch(!) - they hurt inside your brain

Prossss-taglandins

Every throb and ache gets magnified

If you hope to win, cyclo-oxygen's

Generation's got to be denied

The Vioxx has all been recalled

So go get yourself Tylenol-ed

And if you aaaaaaaaaaaaaache

Blame PGH synthaaaaaaaaaase!

We must complain that

You make the aches prostaglandins

Prostaglandin - D2, F1, G2, E2

Prostaglandin, it's you

# Translation

(To the tune of *Maria* - from West Side Story)

Copyright © 2007 [Kevin Ahern](#)

Translation

The most intricate thing I ever saw

From five prime to three prime, translation, translation

The final step that we know about the central dog-ma

Amino, carboxyl, translation, translation. . . .

Translation, translation, translation . .

Translation!

I just learned the steps of translation

And all the things they say

About tRNA

Are true

Translation!

To form peptide bonds in translation

The ribosomal cleft

Must bind to an E-F

tee-you!

Translation!

A-U-G binds the f-met's cargo

16S lines up Shine and Dalgarno

Translation

I'll never stop needing translation

The most intricate thing I ever saw

Translationnnnnnnnnnnnnnnnnnnnnnn

# Thank God There's a Video

(To the tune of *Thank God I'm a Country Boy*)

Copyright © 2007 [Kevin Ahern](#)

Students sing text in RED

There's a bundle of things a student oughta know  
And Ahern's talk isn't really very slow  
Learnin' ain't easy / the lectures kinda blow  
Thank God there's a video

Well we've gone through the cycles and their enzymes too  
Studying the regulation everything is new  
I gotta admit that I haven't got a clue  
What am I gonna do?

So I got me a note card and bought me a Stryer  
Got the enzymes down and the names he requires  
I hope that I can muster up a little more desire  
Thank God there's a video

Just got up to speed about the NAD  
Protons moving through Complex Vee  
Electrons dance in the cytochrome C  
Gotta hear the MP3

Fatty acid oxidation makes the acetyl-CoA  
Inside the inner matrix of the mitochondri-ay  
It's very complicated, I guess I gotta say  
Thank God there's a video

So I got me a note card and bought me a Stryer  
Got the enzymes down and the names he requires  
I hope that I can muster up a little more desire  
Thank God there's a video

## Thank God There's a Video (continued)

Replication's kind of easy in a simple kind of way  
Copyin' the bases in the plasmid DNAs  
Gs goes with Cs and Ts go with As  
Thanks to polymerase

And the DNA's a template for the RNA  
Helices unwinding at T-A-T-A  
Termination happens, then the enzyme goes away  
Don't forget the poly-A

So I got me a note card and bought me a Stryer  
Got the enzymes down and the names he requires  
I think that I can muster up a little more desire  
Thank God there's a video

# The Tao of Hormones

(To the tune of *The Sound of Silence*)

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Biochemistry my friend  
It's time to study you again  
Mechanisms that I need to know  
Are the things that really stress me so  
"Get these pathways planted firmly in your head,"  
Ahern said  
Let's start with ep-inephrine

Membrane proteins are well known  
Changed on binding this hormone  
Rearranging selves without protest  
Stimulating a G alpha S  
To go open up and displace its GDP  
With GTP  
Because of ep-inephrine

Active G then moves a ways  
Stimulating ad cyclase  
So a bunch of cyclic AMP  
Binds to kinase and then sets it free  
All the active sites of the kinases await  
Triphosphate  
Because of ep-inephrine

Muscles are affected then  
Breaking down their glycogen  
So they get a wad of energy  
In the form of lots of G-1-P  
And the synthases that could make a glucose chain  
All refrain  
Because of ep-inephrine

# The Tao of Hormones (continued)

Now I've reached the pathway end  
Going from adrenalin  
Here's a trick I learned to get it right  
Linking memory to flight or fright  
So the mechanism that's the source of anxious fears  
Reappears  
When I make ep-inephrine

# Hemoglobin's Moving Around

(To the tune of *Santa Claus is Coming to Town*)

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Oh isn't it great  
What proteins can do  
Especially ones that bind to O<sub>2</sub>  
Hemoglobin's moving around

Inside of the lungs  
It picks up the bait  
And changes itself from T to R state  
Hemoglobin's moving around

The proto-porphyrin system  
Its iron makes such a scene  
Arising when an O<sub>2</sub> binds  
Pulling up on histidine

The binding occurs  
Cooperatively  
Thanks to changes qua-ter-nar-y  
Hemoglobin's moving around

It exits the lungs  
Engorged with O<sub>2</sub>  
In search of a working body tissue  
Hemoglobin's moving around

The proton concentration  
Is high and has a role  
Between the alpha betas  
It finds imidazole

## Hemoglobin's Moving Around (continued)

To empty their loads  
The globins decree  
"We need to bind 2,3BPG"  
Hemoglobin's moving around

The stage is thus set  
For grabbing a few  
Cellular dumps of CO<sub>2</sub>  
Hemoglobin's moving around

And then inside the lungs it  
Discovers ox-y-gen  
And dumps the CO<sub>2</sub> off  
To start all o'er agin

So see how this works  
You better expect  
To have to describe the Bohr effect  
Hemoglobin's moving around

# Oh Daddy Dear

(To the tune of *Oh Danny Boy*)

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Oh Daddy dear, this is my biochemistry  
The problems long. The course is really tough  
That last exam, it really put the fear in me  
I studied lots. I hope it was enough

But let's forget about it while you're visiting  
And bong a beer when we get out of class  
Then when you're gone I'll go back to my studying  
That Kevin Ahern really truly is an **ass** awesome instructor

# This Song's For BB Three Five Oh

(To the tune of *This Land is My Land*)

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It's one o'clock and  
Ahern's talkin'  
Henderson and  
Hasselbalch and  
pKa's and  
Buffers I should know  
This song's for BB three five oh

I hope that maybe  
He'll think the way we  
Wrote our answers  
Wasn't crazy  
I really need the  
Partial credit - so  
This song's for BB three five oh

It's really groovy  
That it improves me  
Watching lectures  
In Quicktime movies  
I really need to  
Go and download those  
Podcasts for BB three five oh

I'm feeling manic  
I'm in a panic  
I'd better study  
My old organic  
It has reactions  
That I need to know  
This song's for BB three five oh

# This Song's For BB Three Five Oh (continued)

I know he said it  
That's why I dread it  
'cause I skipped Friday's  
Extra credit  
'twil pro'bly haunt me  
That lowly ze-ro  
Grade in BB three five oh

It could be steric  
Or esoteric  
That carbons get so  
Anomeric  
I'm too hysteric  
Better let it go  
This song's for BB three five oh

# When Acids Get Oxidized

(To the tune of *When Johnny Comes Marching Home*)

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The fatty acids carried by  
CoA, CoA  
Are oxidized inside the  
mi-to-chon-dri-ay  
They get to there as you have seen  
By hitching rides on carnitine  
Then it goes away  
When acids get oxidized

Electrons move through membranes, yes  
It's true, it's true  
They jump from complex I onto  
Co-Q, Co-Q  
The action can be quite intense  
When building proton gradients  
And its good for you  
When acids get oxidized

The protons pass through complex V  
You see, you see  
They do this to make lots of  
A-TP, TP  
The mechanism you should know  
Goes through the stages L-T-O  
So there's energy  
When acids get oxidized

# Brain Farts Just Happen In My Head

(To the tune of *Raindrops Keep Fallin' On My Head*)

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Brain farts just happen in my head  
I think it might be due to something Kevin said  
Bi-o-che-mis-try  
Gets brain farts a poppin' in my head and they're poppin'

So I just wiped out the teardrops from my eyes  
And told my brain it had to do some men-tal exer-cise  
Burn some ATP  
So brain farts can stop inside my head they'll be stoppin'

'Cause there's one thing I've learned  
When energy increases it sure pleases  
My mental state - I'm doing great as tension eases

Now brain farts don't happen in my head  
So I'm sure the final will be easier instead  
Cyclic AMP  
Stops brain farts from poppin' in my head they're not poppin'

Thanks to caffeine  
Nothin's worryin' me

# Biochemistry Pie

(To the Tune of *American Pie*)

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A long nine weeks ago  
I can still remember  
How the lectures sometimes made me smile  
I pushed myself to study lots  
So I could fill my head with thoughts  
And then I'd find the effort all worthwhile

But mid-term one, it left me jaded  
I worried as exams were graded  
Sad news came from Kevin  
The average - forty seven

It was so bad I went in shock  
I couldn't stand to hear the talk  
Of Henderson and Hasselbalch  
And bi-o-che-mis-try

So why why biochemistry why  
Does percent misrepresent that  
My attention is high?  
And all the students have a rallying cry  
Singin' I will be a studious guy  
I will be a studious guy

Did you draw an alanine?  
And can you titrate a histidine?  
If you know its p-K-a  
Now do you believe you'll have it made  
If you can pull a decent grade  
And can recitation lead me to an 'A'?

## Biochemistry Pie(continued)

Well we learned that protein structure is  
A bunch of pleats and helixes  
True beauty to behold  
Man I dig how proteins fold!

There are seniors in pre-pharmacy  
Learning all that chromatography  
Gel filtration / HPLC  
For bi-o-che-mis-try

I started Singin'  
Why why biochemistry why  
Must performance be enormous for  
My grade to be high?  
And all the students have a rallying cry  
Singin' I will be a studious guy  
I will be a studious guy

Now for ten weeks we've been crammin' in  
The fact that nuc-le-i have spin  
But that's not all there is to see  
There are six enzyme classes from EC  
A cat-a-lytic triad three  
And a voice that whispers Delta G

Oh, with enzymes there are lots of facts  
Like low Kms and high Vmax  
Some zymogens break down  
If trypsin is around  
And while Kevin lectured Milam Hall  
His camera captured movies small  
Sometimes they had no sound at all  
In bi-o-che-mis-try

## Biochemistry Pie (continued)

We were singing  
Why why biochemistry why  
Should I lament my last percent  
If my incentive was high?  
And all the students have a rallying cry  
Singin' I will be a studious guy  
I will be a studious guy

R state, T state metabolic soul mates  
Protein forms that we appreciate  
ATCase binding siii---iiiites  
They grab a C-T-P upright  
The enzyme gets itself uptight  
With aspartate on the sidelines out of sight

Then the stage was set for ex-am two  
And some of us were feeling blue  
I almost lost my nerve  
Whoa, 'til I moved up on the curve  
'cause my memory to me revealed  
The answers that had been concealed  
As if the key had been unsealed  
For bi-o-che-mis-try

I'm always Singin'  
Why why biochemistry why  
Must a student be so prudent  
Just to qua-a-lify?  
And all the students have a rallying cry  
Singin' I will be a studious guy  
I will be a studious guy

(two stanzas skipped here)

## Biochemistry Pie (continued)

We all pulled down the MP<sub>3</sub>s  
And memorized the older keys  
Then I just smiled and carried on  
I went down to the class web site  
To download ev-e-ry highlight  
But the server said the pages were all gone

And in their rooms, the students stayed  
The chemists crammed and the pre-meds prayed  
There was no indecision  
The end was in our vision  
And the section that had made me fret  
The questions for the problem set  
I nailed them all without a sweat  
In bi-o-che-mis-try

And I was singin'  
Bye bye biochemistry bye  
You can debit all my credit  
'Cause my grade is so high  
And all the students have a rallying cry  
Singin' there'll be a party tonight  
There'll be a party tonight

And I was singin'  
Bye bye biochemistry bye  
You can debit all my credit  
'Cause my grade is so high  
And all the students have a rallying cry  
Singin' there'll be a party tonight

# The Codon Song

(To the tune of *When I'm Sixty Four*)

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Building of proteins, you oughta know  
Needs amino A's  
Peptide bond catalysis in ribosomes  
Triplet bases, three letter codes  
Mixing and matching nucleotides  
Who is keeping score?  
Here is the low down  
If you count codons  
You'll get sixty four

Got - to - line - up - right  
16-S R-N-A and  
Shine Dalgarno site

You can make peptides, every size  
With the proper code  
Start codons positioned  
In the P site place  
Initiator t-RNAs  
UGA stops and AUGs go  
Who could ask for more?  
You know the low down  
Count up the codons  
There are sixty four

# This Biochemistry

(To the tune of *My Country 'Tis of Thee*)

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This bi-o-che-mis-try  
Will be the death of me  
Oh hear my plea

God knows that I have tried  
To learn the glycosides  
And all the polysaccharides  
Oh let me be

Just what makes muscles sing  
Is Cori cycling  
Here's how it goes

Hypoxic muscles make  
A wad of lactate  
The liver acts to generate  
Some new glucose

Regulation is a zoo  
PFK one and two  
And there is more

Instructors make a fuss  
With all their kinases  
Like Michael Jackson's trial was  
A crashing bore

# The Ribosome

(To the tune of *America the Beautiful*)

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O beautiful with R-N-A  
That makes the peptide bonds  
You hold t-RNA so it  
Can pair up with co-dons

The Ribosome! The Ribosome!  
Translate m-RNA  
Initiate and translocate  
From start to U-G-A

# Glucagon is Coming Around

(To the tune of *Santa Claus is Coming to Town*)

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## *Instructor sings*

You've gotta admire  
What molecules do  
Their cellular fire  
Is ready on cue  
Glucagon is coming around

Whenever it binds  
Receptor outside  
G protein finds  
G nucleotides  
Glucagon is coming around

## *Everyone sings*

They activate cyclases  
That make cAMPs  
Which bind to protein kinases  
And pull the R's from C's

## *Instructor sings*

The glycogen shrinks  
In liver quite fast  
The glucose into  
The bloodstream is passed  
Thanks to this you have energy

Your muscles uptake  
The glucose in turn  
Obtaining a substrate  
That all of them burn  
Thanks to this you have energy

# Glucagon is Coming Around (continued)

## *Everyone sings*

The pool of phosphatidyl  
Inositides in you  
Can send two separate signals  
When they get split in two

## *Instructor sings*

The IP<sub>3</sub> sets  
The calcium free  
Turning on  
Protein Kinase C  
And it happens so easily

The muscles contract  
When calcium's free  
Lowering levels  
Of Creatine-P  
And it happens so easily

## *Everyone sings*

Those little calcium ions  
I hope you've learned them well  
Are just like Martha Stewart  
All locked up in a cell

## *Instructor sings*

This story's complete  
I know it's a load  
My hope is your head  
Ain't gonna explode  
You will really need it next week

# Biochemistry/Biochemistry

(To the tune of *Oh Christmas Tree*)

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Biochemistry Biochemistry  
I wish that I were wiser  
I feel I'm in way o'er my head  
I need a new advisor

My courses really shouldn't be  
Such metabolic misery  
Biochemistry Biochemistry  
I wish that I were wiser

Biochemistry Biochemistry  
Reactions make me shiver  
They're in my heart and in my lungs  
They're even in my liver

I promise I would not complain  
If I could store them in my brain  
Biochemistry Biochemistry  
I wish that I were wiser

Biochemistry Biochemistry  
I'm truly in a panic  
Your mechanisms murder me  
I should have learned organic

For all I have to memorize  
I ought to win the Nobel Prize.  
Biochemistry Biochemistry  
I wish that I were wiser

# N-A-D

(To the tune of *Penny Lane*)

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In the catabolic pathways that our cells employ  
Oxidations help create the ATP  
While they lower Gibbs free energy  
Thanks to enthalpy

If a substrate is converted from an alcohol  
To an aldehyde or ketone it is clear  
Those electrons do not disappear  
They just rearrange – very strange

N-A-D is in my ears and in my eyes  
Help-ing mol-e-cules get oxidized  
Mak-ing N-A-D-H then

And the latter is a problem anaerobically  
'Cause accumulations of it muscles hate  
They respond by using pyruvate  
To produce lactate

Catalyzing is necessity for cells to live  
So the enzymes grab their substrates eagerly  
If they bind with high affinity  
Low  $K_m$  you see – just trust me

N-A-D is in my ears and in my eyes  
Help-ing mol-e-cules get oxidized  
Mak-ing N-A-D-H then

# The *E. coli* Song

(To the tune of *Rudolph the Red-Nosed Reindeer*)

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## *Instructor sings*

*E. coli's* very simple  
That's the way the story goes  
But if you worked around it  
You would probably hold your nose

Most of the other cell types  
Have a mitochondrion  
They use to make triphosphates  
By phos-phor-y-la-she-un

## *Everyone sings*

When there is no oxygen  
*Coli's* got it made  
Glucose breakdown products all  
Wind up making ethanol

## *Instructor sings*

Then all the cells around it  
Shout *E. coli's* name with glee  
“You make us feel light-headed”  
“When you act fermentally”

# The Vegetarian's Song

(to the tune of *Blowin' in the Wind*)

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## *Instructor sings*

How many hot dogs did you eat today?  
With all of those nitrites inside?

And those heterocyclic amines in your steak  
Were not something you should have tried

## *Everyone sings*

There's cancer my friend  
Inside your bottom end  
There's cancer inside your bottom end

# B-DNA

(To the tune of *YMCA*)

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Phosphates

Are in nucleotides

I say phosphates

Cover bases inside

I say phosphates

Span the 5 and 3 primes

There's no need - to - be - all - mixed - up

Bases

Carry info you see

I say bases

Are all complement'ry

I say bases

Like A,T,G and C

They have got - to - be - all - paired - up

It's fun to play with some **B-DNA**

It's got a boatload of **G-C-T-A**

It's got everything

A polymerase needs

When you melt all the A's and T's

It's fun to play with some **B-DNA**

It's got a boatload of **G-C-T-A**

You can make RNAs

With a po-ly-mer-ase

Just by pairing up U's with A's

## B-DNA (continued)

Proteins

Full of amino A's

I say proteins

Come from mRNAs

I say proteins

Require tRNAs

There is more - you - need - to - trans-late

Codons

Like our friend U-A-C

I say codons

Come in clusters of three

I say codons

Have one base wobble -ee

Now you can - go - forth - and - tran-slate

It's fun to play with some **B-DNA**

It's got a boatload of **G-C-T-A**

All those hydrogen Bs

And right-hand he-li-ces

Anti-par-a-llel fives and threes

It's fun to play with some **B-DNA**

It's got a boatload of **G-C-T-A**

All those hydrogen Bs

And right-hand he-li-ces

Anti-par-a-llel fives and threes

It's fun to play with some **B-DNA**

It's got a boatload of **G-C-T-A**

All those hydrogen Bs

And right-hand he-li-ces

Anti-par-a-llel fives and threes

# Oh Little Protein Molecule

(To the tune of *Oh Little Town of Bethlehem*)

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## *Instructor sings*

Oh little protein molecule  
You're lovely and serene  
With twenty zwitterions like  
Cysteine and alanine

## *Everyone sings*

Your secondary structure  
Has pitches and repeats  
Arranged in alpha helices  
And beta pleated sheets

## *Instructor sings*

The Ramachandran plots are  
Predictions made to try  
To tell the structures you can have  
For angles phi and psi

## *Everyone sings*

And tertiary structure  
Gives polypeptides zing  
Because of magic that occurs  
In protein fol-ding

## *Instructor sings*

A folded enzyme's active  
And starts to catalyze  
When activators bind into  
The allosteric sites

## Oh Little Protein Molecule (continued)

### *Everyone sings*

Some other mechanisms  
Control the enzyme rates  
By regulating synthesis  
And placement of phosphates

### *Instructor sings*

And all the regulation  
That's found inside of cells  
Reminds the students learning it  
Of pathways straight from hell

### *Everyone sings*

So here's how to remember  
The phosphate strategies  
They turn the GPb's to a's  
And GSa's to b's

# The Cell's Lament

(to the tune of *Yesterday*)

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## *Instructor sings*

Woe is me

My substrates are losing entropy  
Causing gains in Gibbs free energy  
Oh I can't lose no en - tro - py

Re-a-lly

I could use a source of enthalpy  
To combat the rise in Delta G  
Oh I believe in enthalpy

## *Everyone sings*

I crave en-er-gy  
Don't you see?  
It's getting worse

My re-actions all  
Soon will stall  
And then rever-r-r-se

## *Instructor sings*

ATP  
It's the metabolic currency  
Guess I'll spend a bit judiciously  
To help reduce the Delta G  
Help reduce the Delta G

# If You're Molecular and Know It, Clap Your Hands

(To the tune of *If You're Happy and You Know It, Clap Your Hands*)  
Copyright © 2003 Kevin Ahern (with assistance from his mother)

**Instructor sings black text, class sings red text**

If you want to have a lot of energy (En-er-gy)  
You had better make a lot of ATP (A-T-P)  
I will only tell you once  
You need proton gradients  
And a bunch of starting stuff like ADP (A-D-P)

If you hanker for a sweet thing you can taste (You can taste)  
And your Atkins diet book has been misplaced (been misplaced)  
You should know adrenalin  
Is an aid to getting thin  
Putting phosphates onto enzymes trims your waist (trims your waist)

If you're feeling kind of achy in your ways (in your ways)  
And that hangover has hung around for days ('round for days)  
You should know you silly dear  
Pain does not come from your beer  
Prostaglandin's made by PGH synthase (H synthase)

There are acids in the bile that make up gall (make up gall)  
Which emulsify triacylglycerol (glycerol)  
If your health is gone to hell  
You should blame the LDLs  
'Cause they carry all of that cholesterol (lesterol??)

Some phosphates and a sugar on a base (on a base)  
Make up C's and G's and U's or T's and A's (T's and A's)  
You can make a DNA  
Or a strand of RNA  
If you add a template and polymerase (lymerase??)

## If You're Molecular and Know It, Clap Your Hands (continued)

If you want to ace this test with utmost ease (utmost ease)  
You don't really have to get down on your knees (on your knees)  
And you need not say a prayer  
So please don't pull out your hair  
Just go download QuickTimes or the MP3s (MP3s)

# The Sound of Glucose

(to the tune of *A Few of My Favorite Things*)

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## *Instructor sings*

Aldehyde sugars are always aldoses and  
If there's a ketone we call them ketoses  
Some will form structures in circular rings  
Saccharides do some incredible things

Onto a glucose we add a 'P' to it  
ATP energy ought to renew it  
Quick rearranging creates F6P  
Without requiring input energy

## *Everyone Sings*

At a high rate  
Add a phosphate  
With PFK  
F1,6BP is made up this way  
So we can run and play

## *Instructor sings*

Aldolase breaks it and then it releases  
DHAP and a few G3Pieces  
These both turn in to 1,3 BPG  
Adding electrons onto NAD

Phosphate plus ADP makes ATP  
While giving cells what they need - en-er-gy  
Making triphosphate's a situa-shun  
Of substrate level phosphoryla-shun

# The Sound of Glucose (continued)

## *Everyone Sings*

3-B-P-G

2-B-P-G

Lose a water

PEP gets a high energy state

Just to make py-ru-vate

## *Instructor sings*

So all the glucose gets broken and bent

If there's no oxygen cells must ferment

Pyruvate / lactate our cells hit the wall

Some lucky yeast get to make ethanol

This is the end of your glucose's song

Unless you goof up and get it all wrong

Break it, don't make it to yield ATP

You'll save your cells from fu-til-i-ty

# Hark the Sucrose

(to the tune of *Hark the Herald*)

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Carbohydrates all should sing  
Glory to the Haworth ring

Anomeric carbons hide  
When they're in a glycoside

Glucopyranose is there  
In the boat or in the chair

Alpha, beta, D and L  
Di-aster-e-omer hell

Alpha, beta, D and L  
Di-aster-e-omer hell

# God Rest Ye Merry Lipoproteins

(To the tune of *God Rest Ye Merry Gentlemen*)

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## *Instructor sings*

God rest ye merry dieters  
With high cholesterol  
Your chylomicrons all contain  
Triacylglycerols  
And move from lymph to capillaries  
Where their progress stalls

## *Everyone sings*

Tha-anks lipo protein li-pase,  
Protein lipase  
O-oh thank you lipo protein li-pase

## *Instructor sings*

And after their fat goodies  
Have been hydrolyzed away  
The chylomicron remnants  
Go along their merry way  
The liver grabs them from the blood  
And puts them all away

## *Everyone sings*

Just as we should do with Kenneth Lay,  
Kenneth Lay  
O-oh just as we should do with Kenneth Lay (*the Enron guy*)

## *Instructor sings*

And when the liver gets a message  
From the body's cells  
It makes up little packages  
We call VLDLs  
They seem like chylomicrons, but turn  
In to something else

## God Rest Ye Merry Lipoproteins (continued)

*Everyone sings*

Please don't become the LDLs ,  
LDLs  
O-oh please don't become the LDLs

*Instructor sings*

For LDLs cause chaos  
When their insides oxidize  
The macrophages bind to them  
And foam cells can arise  
You'd better watch your diet  
Or your blood flow will downsize

*Everyone sings*

And that would not be very wise,  
Very wise  
No-oh that would not be very wise

*Instructor sings*

So if you take some lessons from  
This little comic bit  
Your diet should be healthy  
And you should try to stay fit  
Eat greens and drink red wine but try  
Not to overdo it

*Everyone sings*

And your heart will never ever quit  
Want to quit  
No, no your heart will never ever quit

# En-er-gy

(To the tune of *Let It Be*)

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## *Instructor sings*

When I was walking through the forest  
Grizzly bears came after me  
So I was badly needing  
En-er-gy

My body dumped some epinephrine  
Out into the blood for me  
'Cause I was badly needing  
En-er-gy

## *Everyone sings*

En-er-gy / En-er-gy  
En-er-gy / En-er-gy  
I was badly needing  
En-er-gy

## *Instructor sings*

The epinephrine gave a kick to  
Enzymes deep inside of me  
To make a bunch of cyclic  
AMP

And when this hit my protein kinase  
Catalytic ecstasy  
The C subunits started  
Adding P's

## *Everyone sings*

Adding P's, adding P's  
Adding P's, adding P's  
Phosphorylation city  
Adding P's

# En-er-gy (continued)

## *Instructor sings*

The protein kinase put a phosphate  
Onto PBK for me  
Using energy from  
ATP

And PBK in turn provided  
GP<sub>a</sub> from GP<sub>b</sub>  
So I released a ton of  
G1P

## *Everyone sings*

G1P / energy  
G1P / energy  
California needs some  
G1P

## *Instructor sings*

And when the chaos had subsided  
I consumed some Frito Lays  
Which soon began reversing  
These pathways

The glucose halted epinephrine  
Insulin began the race to  
Turn on Phosphoprotein  
Phosphatase

## *Everyone sings*

Phosphatase - cleaves the P's  
Phosphatase - cleaves the P's  
The dephosphorylation  
Cleaves the P's

# En-er-gy (continued)

## *Instructor sings*

And so they were removed from action  
Cellular kinases  
Thanks to Phosphoprotein  
Phosphatase

I'll end my story here before I  
Get depressed from one last fact  
That dephosphorylation  
Favors fat

## *Everyone sings*

Favors fat, favors fat  
Favors fat, favors fat  
Dephosphorylation  
Favors fat.

# I'm a Little Mitochondrion

(To the tune of *I'm a Lumberjack*)

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## *Instructor sings*

Oh I'm a little mitochondrion  
Who gives you energy  
I use my proton gradient  
To make the ATPs

## *Class sings*

He's a little mitochondrion  
Who gives us energy  
He uses proton gradients  
To make some ATPs

## *Instructor sings*

Electrons flow through Complex II  
To traffic cop Co-Q  
Whenever they arrive there in  
An FADH-two

## *Class sings*

Electrons flow through Complex II  
To traffic cop Co-Q  
Whenever they arrive there in  
An FADH-two

## *Instructor sings*

Yes tightly coupled is my state  
Unless I get a hole  
Created in my membrane by  
Some di-ni-tro-phe-nol

## I'm a Little Mitochondrion (continued)

### *Class sings*

Yes tightly coupled is his state  
Unless he gets a hole  
Created in his membrane by  
Some di-ni-tro-phenol

### *Instructor sings*

Both rotenone and cyanide  
Stop my electron flow  
And halt the calculation of  
My "P" to "O" ratio

### *Class sings*

Both rotenone and cyanide  
Stop his electron flow  
And halt the calculation of  
His "P" to "O" ratio

# The Battle Hymn of Biochemistry

(To the tune of *The Battle Hymn of the Republic*)

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## *Instructor sings*

By now you know the story of the respiratory stew  
Where the fatty acids get chopped up in units two by two  
Their electrons pass through coenzymes referred to here as Q  
Electrons flow along

## *Everyone Sings*

Glory to electron transport  
Glory to electron transport  
Glory to electron transport  
Electrons flow along

## *Instructor sings*

Eee - lectron transport complexes are working dusk to dawn  
Managing electron energy they just keep passing on  
And for handling the energy they get to pump protons  
As the gradient marches on

## *Everyone Sings*

Glory to the proton gradient  
Make the mitochondry - radiant  
Glory to the proton gradient  
The gradient marches on

## *Instructor sings*

If you need a lot of energy your cells have got a way  
To break fatty acids down to yield some acetyl-CoA  
Going on inside peroxisomes and mitochondri "ay"  
Fatty acids oxidized

## *Everyone Sings*

Glory, glory oxidation  
It's the heart of respiration  
Learn it without consternation  
Fatty acids oxidized

# The Battle Hymn of Biochemistry (continued)

## *Instructor sings*

HMG-CoA reductase leads to bits of isoprene  
That link up together in the cell to synthesize terpenes  
Don't forget before cholesterol you've got to make squalene  
As the lipids march along

## *Everyone Sings*

Glory, glory to the lipids  
Glory, glory to the lipids  
Glory, glory to the lipids  
As the lipids march along

## *Instructor sings*

If a bee should come and sting you when you're sitting in a daze  
You had better take some aspirin for PGH synthase  
Otherwise arachidonate goes to cyclic path-a-ways  
And you'll start to feel the pain

## *Everyone Sings*

Oh, don't make the prostaglandins  
Causing pain with great abandon  
No, don't make the prostaglandins  
You are going to feel the pain

# We All Need Just a Little ATP

(To the tune of *Yellow Submarine*)

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## *Instructor sings*

In the cells, inside of us, there's a sugar on adenine  
Which is linked, to phosphate groups, and you know it as ATP

## *Everyone Sings:*

If we build up a lot of ATP, we've too much energy, metabolically  
If we build up a lot of ATP, we've too much energy, metabolically

## *Instructor sings*

And the cellular decree, calls for storing up the energy  
So we save, it chemically, building acids onto ACP

## *Everyone Sings:*

Making fat stores a lot of energy, creates NADP, and uses ATP  
Making fat stores a lot of energy, creates NADP, and uses ATP

## *Instructor sings*

When we need, some energy, we burn fats in fancy cell machines  
Acids all, get shuttled in, on the backs of little carnitines

## *Everyone Sings:*

We break acids every hour today, in mitochnodri-ay, to acetyl-CoA  
We break acids every hour today, in mitochnodri-ay, to acetyl-CoA

## *Instructor sings*

One more thing, about this tune, should be remembered by, all of you  
Burning fat, converts a few, FADs to FADH<sub>2</sub>s

## *Everyone Sings:*

NADH is a product too, that you can surely use, when NAD's reduced  
NADH is a product too, that you can surely use, when NAD's reduced

# Fatty Acids in Our Cells

(To the tune of *Halls of Montezuma*)

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From the fatty acids in our cells  
To the lipids in our brains  
We are made of biochemicals  
Built in metabolic chains

Using glycolytic ATP  
And electron energy  
We can synthesize most everything  
With the help of Delta G

A cell will tend to pump out sodium  
But potassium it imports  
It accomplishes this magic with  
ATPase antiports

Our bilayer lipid membranes  
Protect the cells' insides  
Partly made of sphingolipids  
We know as gangliosides

When it comes to regulation  
The little cell has got it made  
It phosphorylates a lot of things  
With its own kinase cascade

Stimulated at a hormone site  
Metabolic yang and yin  
That's turned on by epinephrine  
And turned off by insulin