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

This is the complete collection of Kevin Ahern's Wildly Popular Metabolic Melodies as of December 4, 2009.

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

There are now four CDs with recordings of the melodies available for purchase at the URLs below:

Volume 1 - http://www.lulu.com/content/1307905

Volume 2 - http://www.lulu.com/content/5039349

Volume 3 - http://www.lulu.com/content/7361370

Greatest Hits - http://www.lulu.com/content/5044787

A **2010 Calendar** of the Metabolic Melodies is available for sale at http://www.lulu.com/content/7801220

Please let me know if the melodies are fun and useful to you. My email address is ahernk@onid.orst.edu

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Kevin

Give Us Real Things

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

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

Catalyze

(To the tune of "*Close to You*")

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 Km, but leave Vmax 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
Reg-u-lates

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

ahhhhhhhhhhhhhhhhhh - cat-a-lyze
ahhhhhhhhhhhhhhhhhh - cat-a-lyze
ahhhhhhhhhhhhhhhhhh - cat-a-lyze

The Alcohol Song

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

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?"

Photosynthesis is Divine

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

Photosynthesis is divine
Fixing carbon using sunshine
It's thanks to plants that we've got a prayer
They pull CO_2 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_2
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-e-fficient-ly
Splitting it into 3PGs

If the enzyme grabs an O_2

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*")

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*")

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*")

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 wolfin' 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!*")

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+
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_2O

Fermentation!
I need some NAD+
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,
AreYou 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

Athough 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"*)

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"*)

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 Vmax 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 Vmax and
Establish Km 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*)

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*)

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"*)

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_2
Yes it is true
In reaction three we lost a CO_2

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 $FADH_2$
What did we do?
We made fumarate and $FADH_2$

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"*)

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"*)

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"*)

In glycolysis, a glucose ring's first turned to G6P
The enzyme hexokinase adds a phosphate – 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 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 PO_3
GAPs go to 1,3-BPG

Test Gently on Glycolysis (continued)

The 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^{th} 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"*)

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"*)

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"*)

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"*)

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!*")

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 aaaaaaaaaaaache
Blame PGH synthaaaaaaaase!

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)

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
Translationnnnnnnnnnnnnnnn

Thank God There's a Video

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

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*)

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*)

Oh isn't it great
What proteins can do
Especially ones that bind to O_2
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_2 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_2
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_2
Hemoglobin's moving around

And then inside the lungs it
Discovers ox-y-gen
And dumps the CO_2 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*)

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 3-5-0

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

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 3-5-0 (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*)

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*)

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*)

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 siiii----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_3s
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*)

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*)

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*)

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*)

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_3 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*)

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*)

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 Km 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*)

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*)

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*)

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*)

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*)

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*)

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 triacylglyerol (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*)

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*)

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*)

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*)

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
GPa from GPb
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*)

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*)

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*)

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 FADH2s

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*)

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