

iCAN's
DECLASSIFIED
SCHOOL SURVIVAL
Guide

The book cover features a camouflage pattern background. The title is presented in a white, rounded rectangular frame with a black border. The word "iCAN's" is at the top, followed by a small globe icon. Below it, "DECLASSIFIED" is written in a red banner-like shape, and "SCHOOL SURVIVAL" is stacked underneath. The word "Guide" is written in large, bold, black letters at the bottom. The entire book is set against a light brown wooden background.

群雄四分



BUILDING
~~MASTERING~~ THE FOUR
ELEMENTS OF A RICH iCONS
EXPERIENCE

ERIC WUESTHOFF
UMASS '19



天下一匡

MY iCONS I EXPERIENCE

SIXTH SENSE: SPRING 2016

CASE STUDY I: GREAT PACIFIC GARBAGE PATCH

- ❖ Topic chosen with cohort in December
- ❖ Conducted experiments on compostable plastic degradation in Paradise Lab

CASE STUDY III: SUPERCRITICAL FLUID SPECTROPHOTOMETRY

- ❖ Challenged by Waters Corporation to find new use for their technology
- ❖ Analyzed waste vegetable oil for impurities for alternative fuel applications

CASE STUDY II: ZIKA VIRUS IN BRAZIL

- ❖ Created mathematical models in Excel with super-groups
- ❖ Presented results to representative at CDC

CASE STUDY IV: CREATING A NEW CASE STUDY

- ❖ Designed case study for next years' students revolving around urban agriculture
- ❖ Presented poster to other peers, upper iCons students, & faculty

WATER

EMBRACE THE EVER-CHANGING FLOW OF RESEARCH

Science is an exercise in trial and error, and often a students' plans for an experiment will change over the course of the study. iCons case studies are realistic models of research and as such will often change course.

Accept that things will not always go according to plan and practice being adaptable. Be patient and communicate with your group and instructors to find creative solutions to new challenges.



EARTH

STAY GROUNDED, BE REALISTIC, AND
LEARN TO ACCEPT FAILURE



iCons I can feel speedy, especially when students are presented with such daunting and multi-faceted problems. It also challenges participants to jump in quickly out of the gate and push themselves.

Keep these global problems in perspective- you can only tackle a tiny piece over the course of a few weeks. They would already be solved if they were easy. Learn to accept that failure is a fact of science and grow from it by learning from your mistakes.

FIRE

CHANNEL YOUR PASSION FOR SOLVING PROBLEMS USING SCIENCE

iCons provides students with a burning desire to tackle problems the outlet to begin addressing some of the major challenges in our world today.

Remain committed to your case studies and always strive for success. This is how the problem-solvers of tomorrow keep going in the face of daunting or frustrating circumstances. Be enthusiastic and engaged.



群
AIR

LET GO OF YOUR INDIVIDUALIST MINDSET AND PRACTICE HUMILITY



Interdisciplinary teamwork is the backbone of iCons. The program consists of a diverse group of accomplished, intelligent, and driven people. It works best when students learn from each other.

Learn to be humble and work with others different from you. Be collaborative and make an effort to consider and discuss everyone's ideas and learn from your peers. Be proud to be a part of this program, but don't let it get to your head!

群雄四分

善

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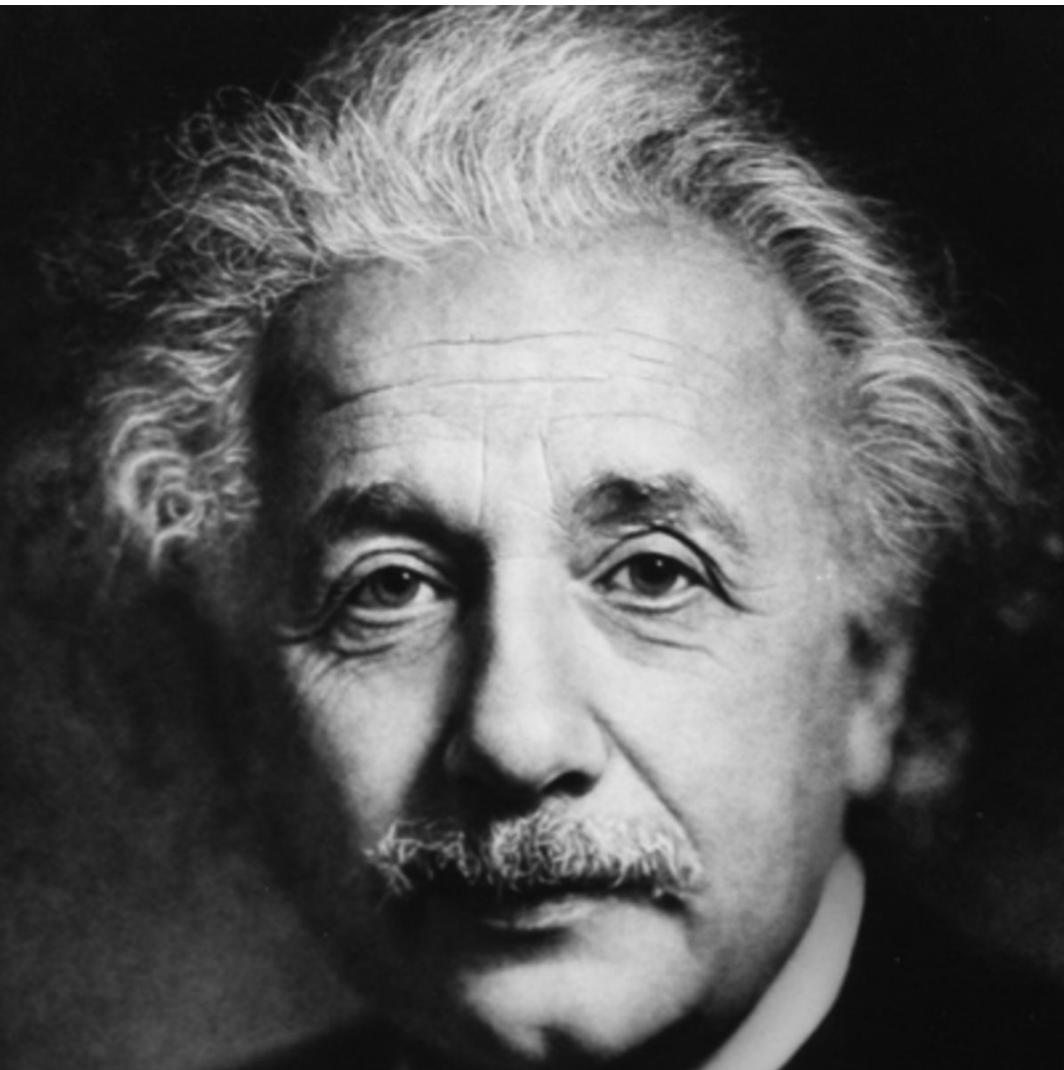
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THANK YOU!



Harry Potter and the Scientist's Story

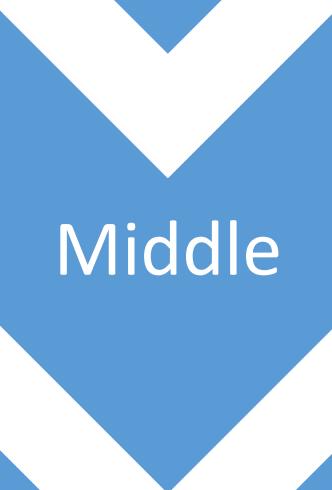
Communicating is Key





Beginning

- Set the stakes
- Introduce the world/tools



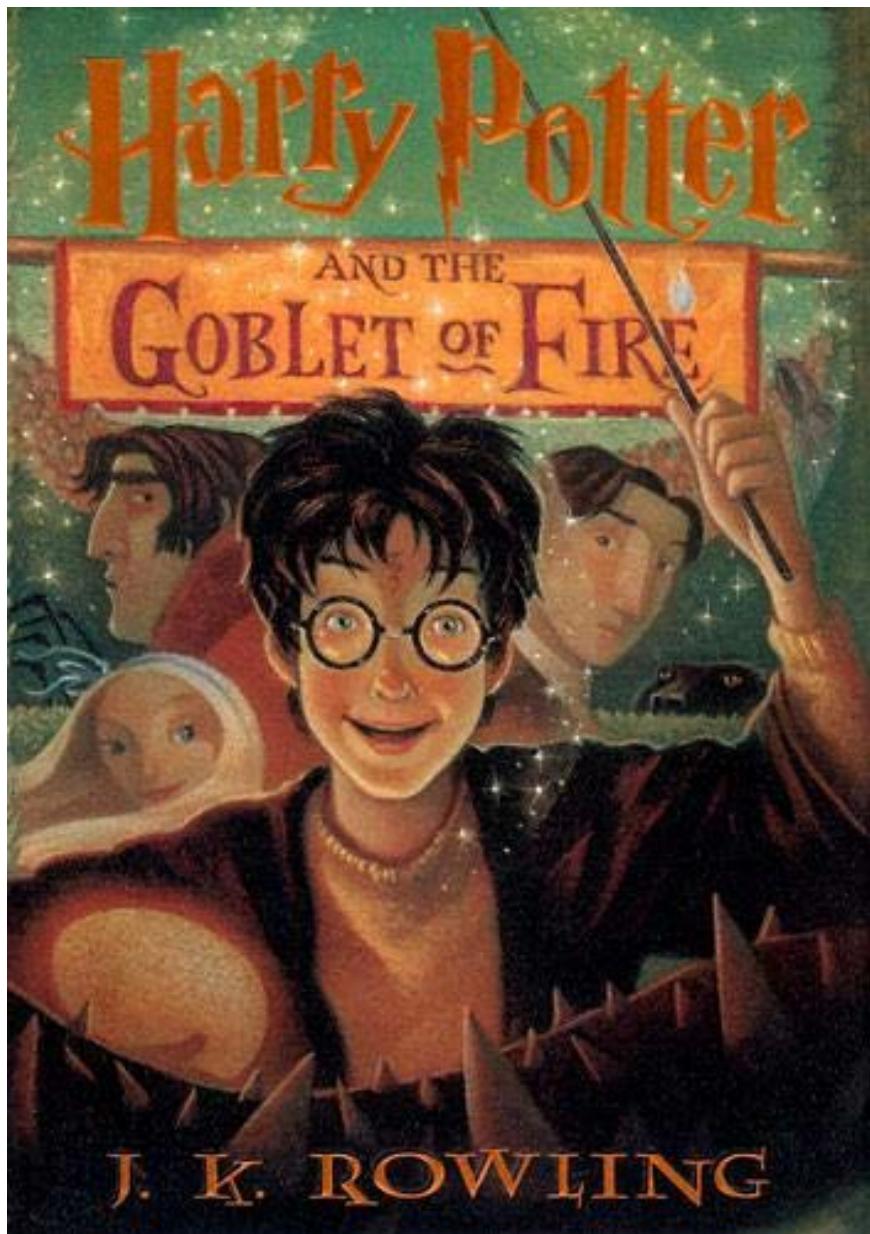
Middle

- Set up obstacles
- Overcome obstacles



End

- Summarized what has been achieved
- Preview the challenges to come



Interactions of PAK2 and caspase-3

Jacob Lytle¹, Elizabeth Barrett¹, Yunlong Zhao, and Professor Jeanne Hardy
Departments of Chemistry and Biochemistry, UMass Amherst



¹. Authors Contributed Equally

Abstract:

Caspases are a family of cysteine-aspartate proteases that are involved in the execution of apoptosis, or regulated cell death, amongst other functions. As such, the regulation of these executor caspases, caspases-3, 6, and 7 is extremely important. Dysregulation of apoptosis has been linked to both degenerative diseases, such as Alzheimer's or Huntington's, as well as proliferative diseases such as cancer. Understanding the systems of regulation could lead to insights in how these diseases progress. In this project, the tangle of relationships between PAK2 and caspases is interrogated. Caspase-3 activates PAK2 by cleaving it, and PAK2 is known to inactivate caspase-7 via phosphorylation. There is evidence that PAK2 is also able to phosphorylate caspase-3, but the exact form of caspase-3 phosphorylated and the impact on activity from this phosphorylation has not yet been deduced. In this project the relationship between the structure of caspase-3, the degree of phosphorylation by PAK2, and the resulting impact on activity is being assessed. Several different versions of recombinant caspase-3 have been purified, as well as a constitutively active version of PAK2. When incubated with radiolabelled ATP, the degree of phosphorylation of different proteins can be quantified. Preliminary results indicate that active, processed versions of caspase-3 are most heavily phosphorylated while inactive unprocessed versions of caspase-3 are least phosphorylated. Future studies will continue to explore how PAK2 recognizes the differences between the two caspase-3 species as well as untangle what effect the phosphorylation has on activity.

Social Problem, Dysregulation of Apoptosis

- Neurodegenerative and proliferative diseases take a huge economic and human toll both globally and within the United States
- Cancer treatments could cost a total of \$173 billion by 2020 and kill over 500,000 a year in the US alone
- Alzheimer's is projected to cost \$253 billion by 2050, and impacts an estimated 5.2 million people in the US today
- As our society ages these two diseases will have an increasing impact

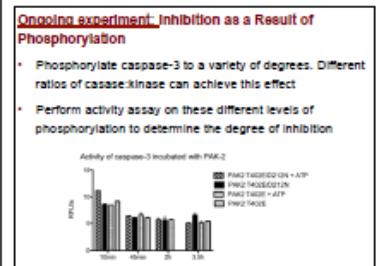
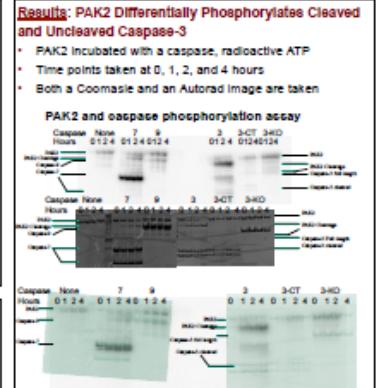
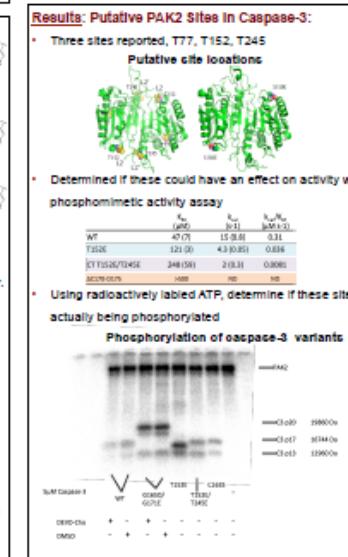
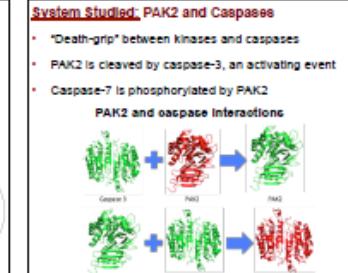
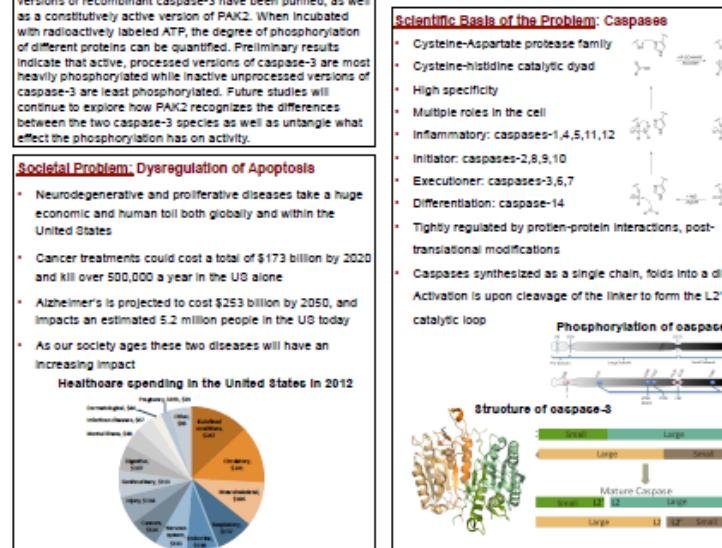
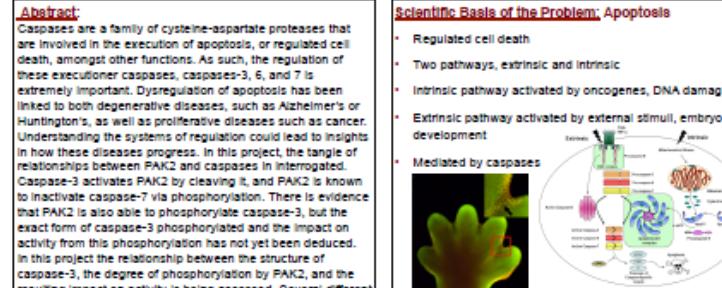
Healthcare spending in the United States in 2012



We thank sponsors of iCons and our research:



Thanks to members of the Hardy Lab:
Bay Serrano, Scott Egan, Kevin Dugay,
Derek Macpherson, Maureen Hill, Alecia
Vallechia, Yifan Pei, Ishani Sori,
Francesca Anson, and Narasimha Mehta



- Future Work:**
- Finish the inhibition as a result of phosphorylation experiment.
 - Determine location of phosphorylation site using Mass Spectrometry
 - Crystallize phosphorylated or phosphomimetic caspase-3 to determine structural mechanism of inhibition

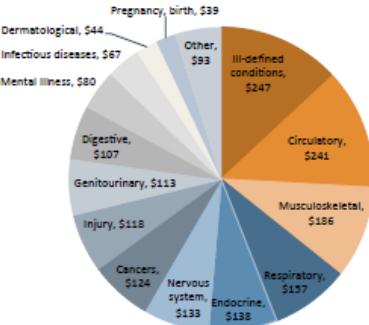
Set the Stakes



Societal Problem: Dysregulation of Apoptosis

- Neurodegenerative and proliferative diseases take a huge economic and human toll both globally and within the United States
- Cancer treatments could cost a total of \$173 billion by 2020 and kill over 500,000 a year in the US alone
- Alzheimer's is projected to cost \$253 billion by 2050, and impacts an estimated 5.2 million people in the US today
- As our society ages these two diseases will have an increasing impact

Healthcare spending in the United States in 2012

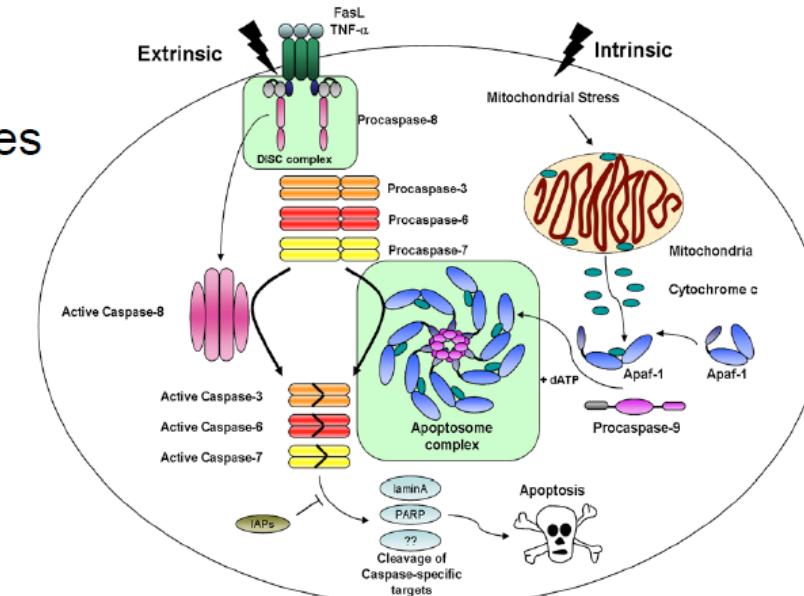
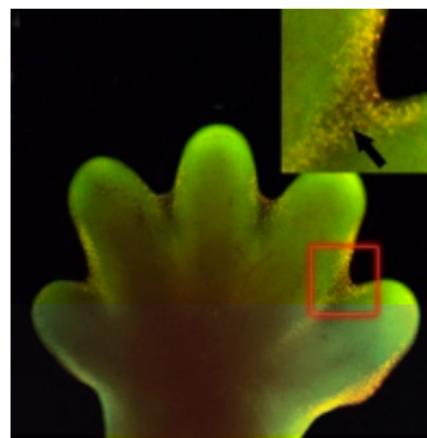


Introduce the world/tools

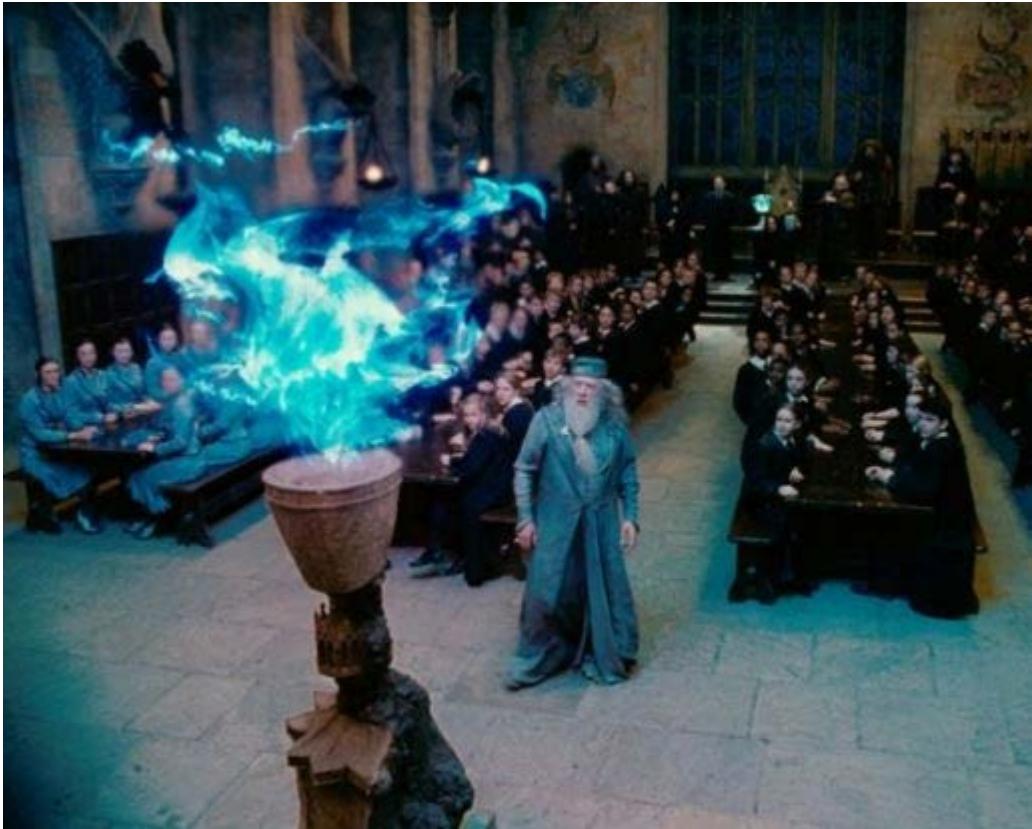


Scientific Basis of the Problem: Apoptosis

- Regulated cell death
- Two pathways, extrinsic and intrinsic
- Intrinsic pathway activated by oncogenes, DNA damage
- Extrinsic pathway activated by external stimuli, embryonic development
- Mediated by caspases



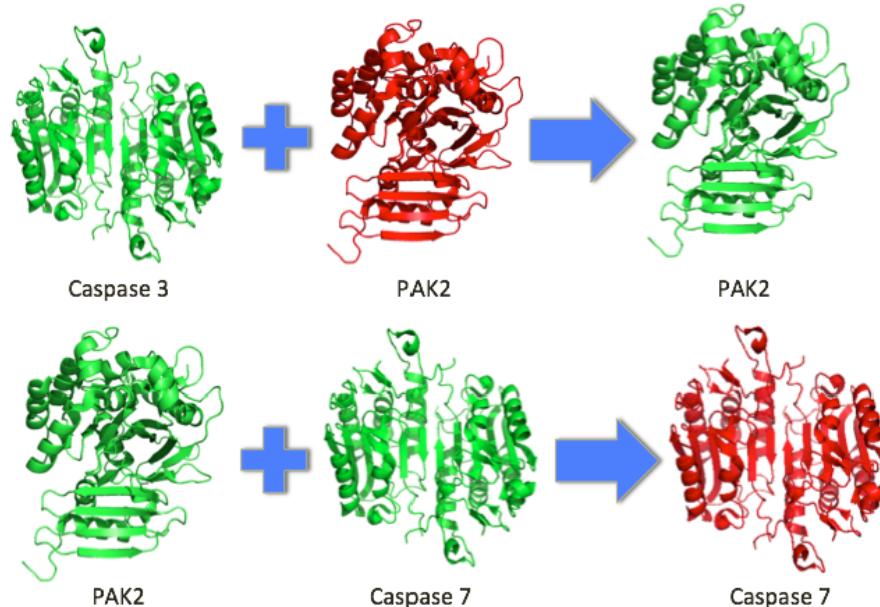
Introduce the world/tools



System Studied: PAK2 and Caspases

- “Death-grip” between kinases and caspases
- PAK2 is cleaved by caspase-3, an activating event
- Caspase-7 is phosphorylated by PAK2

PAK2 and caspase interactions



Set Up Obstacles

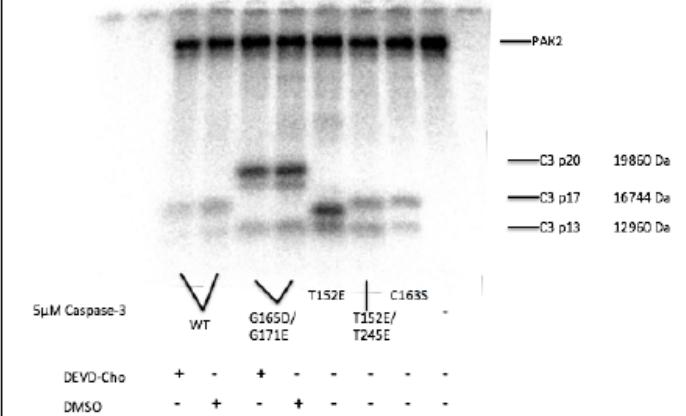


Results: Putative PAK2 Sites in Caspase-3:

- Three sites reported, T77, T152, T245
Putative site locations
Two molecular models of the Caspase-3 protein structure. The left model shows residues T245, L2, and T152 highlighted in yellow. The right model shows residue S150E highlighted in blue. These sites are located on the N-terminal lobe of the enzyme.

	K_M (μM)	k_{cat} (s^{-1})	k_{cat}/K_M ($\mu\text{M} \text{ s}^{-1}$)
WT	47 (7)	15 (0.8)	0.31
T152E	121 (3)	4.3 (0.05)	0.036
CT T152E/T245E	248 (59)	2 (0.3)	0.0081
ΔC170-D175	>500	ND	ND
- Determined if these could have an effect on activity with phosphomimetic activity assay
- Using radioactively labeled ATP, determine if these sites are actually being phosphorylated

Phosphorylation of caspase-3 variants



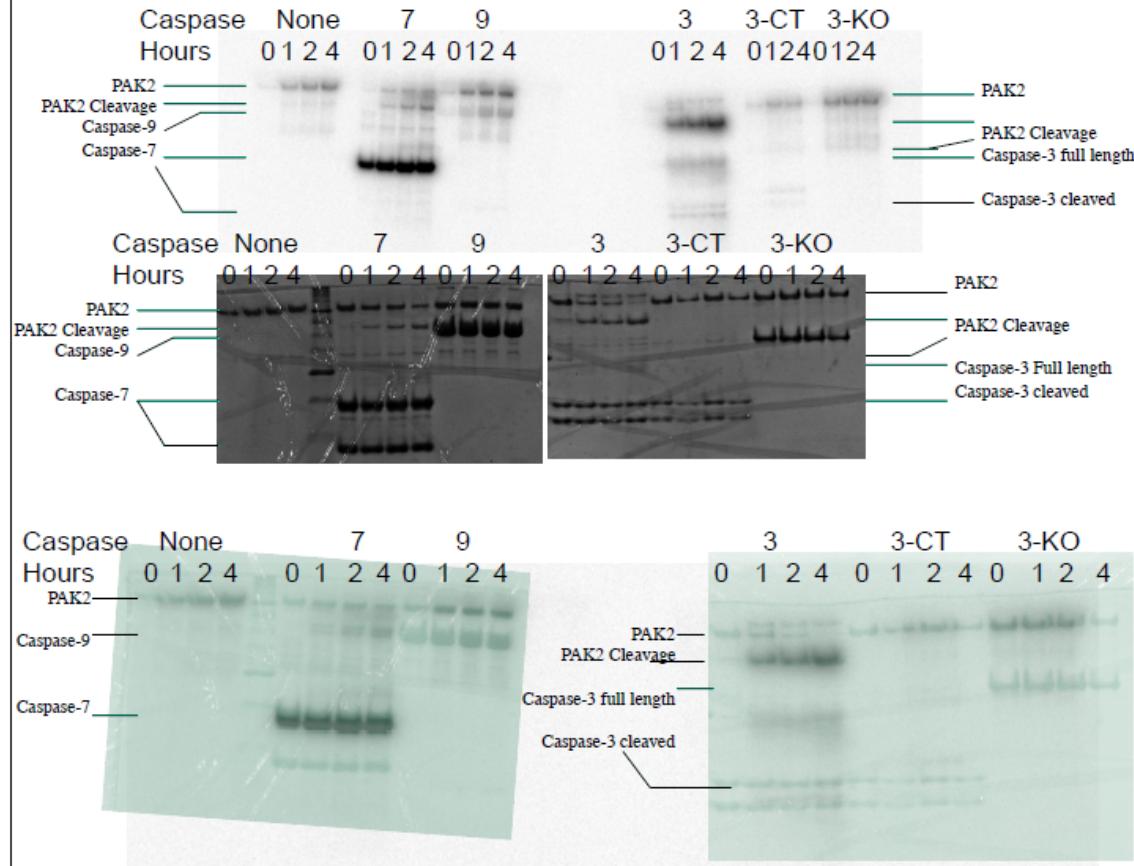
Overcome Obstacles



Results: PAK2 Differentially Phosphorylates Cleaved and Uncleaved Caspase-3

- PAK2 incubated with a caspase, radioactive ATP
 - Time points taken at 0, 1, 2, and 4 hours
 - Both a Coomasie and an Autorad image are taken

PAK2 and caspase phosphorylation assay

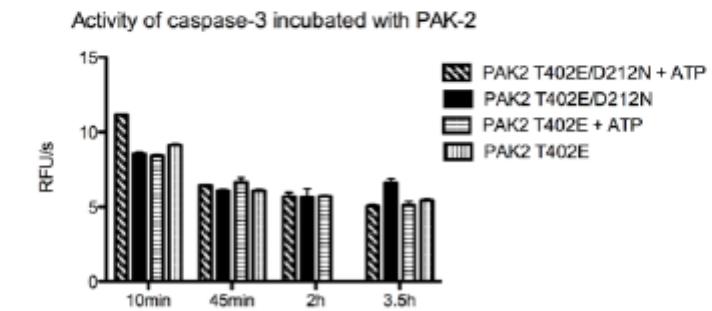


Summarized what has been achieved



Ongoing experiment: Inhibition as a Result of Phosphorylation

- Phosphorylate caspase-3 to a variety of degrees. Different ratios of casase:kinase can achieve this effect
- Perform activity assay on these different levels of phosphorylation to determine the degree of inhibition



Preview the Challenges to come



Future Work:

- Finish the inhibition as a result of phosphorylation experiment.
- Determine location of phosphorylation site using Mass Spectrometry
- Crystalize phosphorylated or phosphomimetic caspase-3 to determine structural mechanism of inhibition

Surviving i3: Renewable Energy

Sean McGrath • 12.02.2017

Overview

1. What to Expect
 2. Behavioral Tips
 3. Tech Tips
-

What to Expect

What is iCons 3?

Practical

- Enough learning - let's do things!
- Lots of engineering
- Hands-on

Student-driven

- No real curriculum
- You call the shots
- No one to tell you what to do
- No one to blame if you fail

iCons: the Startup

Company, not class

- Early-stage renewable energy startup
- Design, implement and measure new green tech

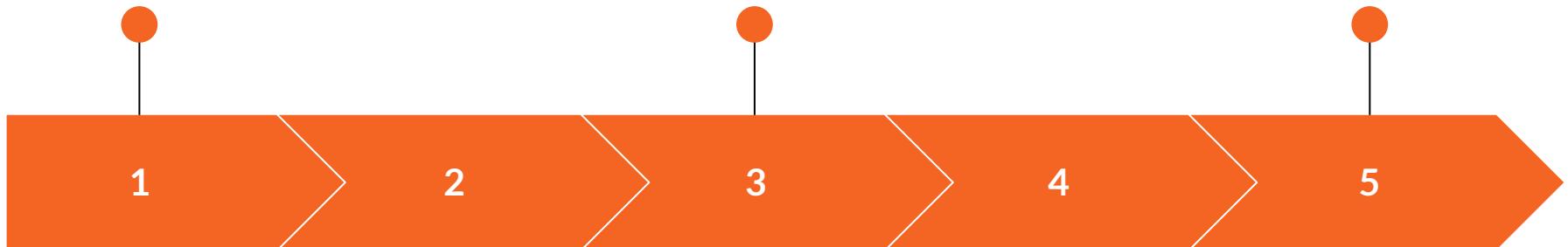
Employee, not student

- Work as a team to develop and (if possible) deliver a product to investors

Brainstorm/Design

Test, get feedback

Report



Prototype

Redesign, improve,
iterate

Resources

Faculty

Not just the teacher - anyone on campus who might know/have what you need

Other Teams

It's not a competition - one company

Budget \$\$\$

You can actually buy some stuff

Behavioral Tips

Work together!

No one person has the skills to do
this by themselves.

Document!

If you don't write down what you did, or the numbers you got, you will be sad :((((

Use your resources

This is what most of the researchers around here do all day. They can help.

Tech Tips



LATEX

LaTeX



Overleaf



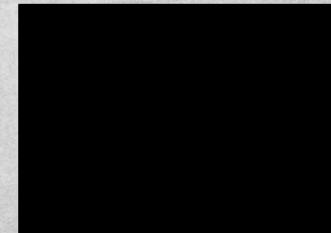
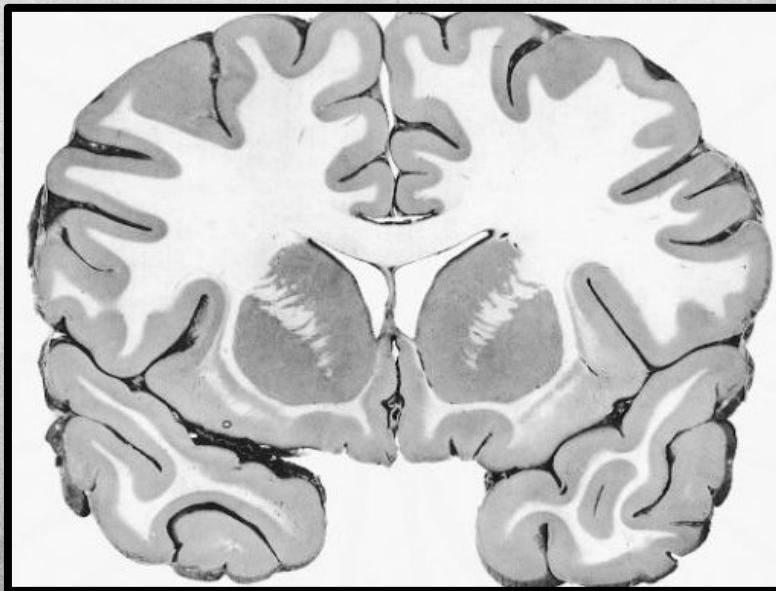
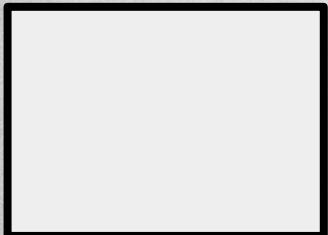


ANACONDA[®]

Surviving i3: Renewable Energy

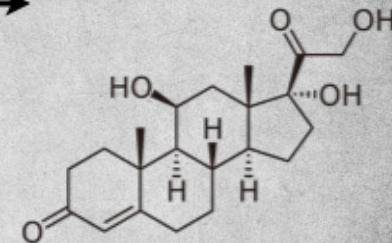
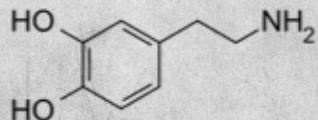
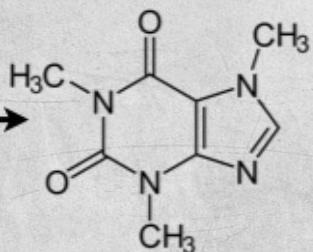
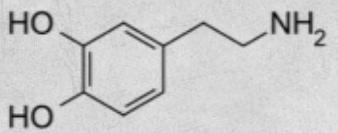
Sean McGrath • 12.02.2017

How to Navigate through the ‘Grey Matter’ of Science



Steps to Developing Your Own Project

1. Determine your passion
2. Brainstorm specific areas of interest within the field
3. Contact professors that are conducting research in that area
 - a. Email professors whose research aligns with your interests
 - b. Talk to your current professors during office hours
 - c. OURS office, 10th floor of library at the Learning Resource Center
4. Develop a research question**



How to Develop a Good Research Question

A good research question is:

Concise

Clear

Focused

Complex

Feasible

Arguable

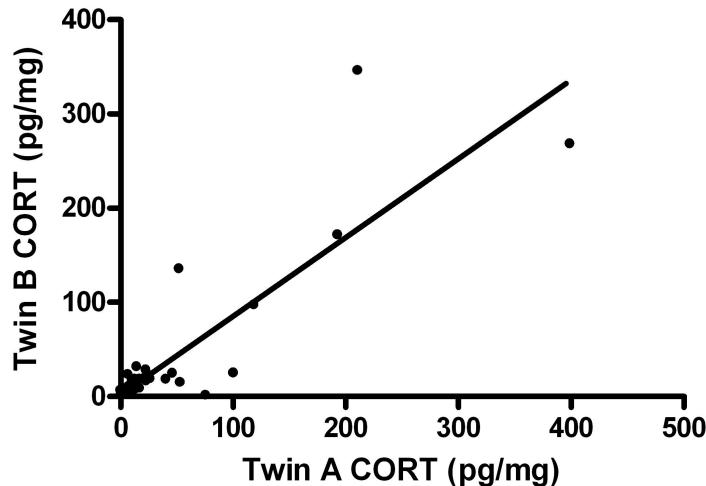


My Research Question:

Do genetic factors play a role in HPA axis activity
(and subsequent stress hormone production)?



Results - The Grey Area



Maybe genetics play a role in the human stress response activation, however, the degree to which genetics play a role is unknown. The correlation is likely due to both genetic factors AND environmental factors.

Correlation in cortisol concentration between individuals of the twin pairs, comparing cortisol values of one twin ($n=66$) to the other twin ($n=66$). $R=0.87$, $p<0.0001$.

The Bigger Picture

- Science is not black and white, there are grey areas. Even the most thorough and developed research questions do not have definitive answers, and that is **OKAY**.
- Allow your results and the data to tell a story and allow the data to navigate through the “uncertainty”
- **The answer to any research question is complex, do not let this discourage you. Use this to motivate you to ask another question in response to the uncertainty.**

Meet the Panel

Kevin Cavanaugh (Energy '14) is an actuarial analyst at Mercer, working in Retirement Consulting.

Erica Light (Energy '16) is the coordinator for the biochemistry undergraduate teaching labs here at UMass.

Sean McGrath (Energy '16) is a software engineer for the travel website KAYAK.com.

Hannah French (Energy '15) is a paraprofessional at a public school in South Hadley. Her background is in elementary and science/environmental education.

Isaac Han (Biomed '13) is a research assistant in the Synthetic Biology platform at the Wyss Institute working on viral genetic engineering.

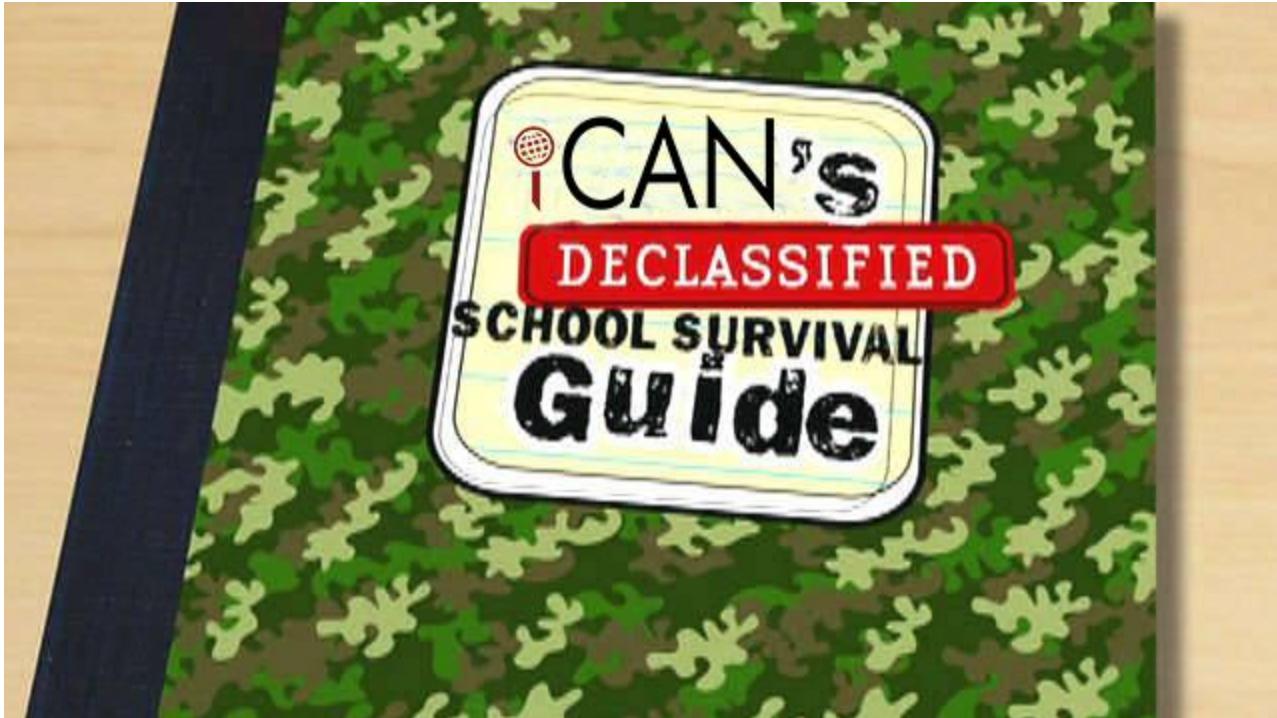
Jacob Lytle (Biomed '16) works at Waters Corporation, an iCons corporate partner. He runs the training labs that teach engineers how to repair Waters Instrumentation in the field..

Harli Weber (Biomed '17) is a Clinical Research Coordinator studying ALS in the Neurological Research Institute at Mass General Hospital.

Olivia Roberts-Sano (Biomed '15) is a research technician studying HIV at Brigham and Women's. She is attending Med School next year.

Balaj Rai (Biomed '14) is a 3rd year medical student at UMass Worcester planning on going into general surgery. His background is in biochemistry and molecular biology.

Matthew Richard (Biomed '15) is a research technician studying Eosinophilic Immunobiology and Disease at BIDMC.. His background is in Chemistry and Biochemistry/Molecular Biology.



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