Molecular Approach to Visual Impairment and Intracranial Pressure (VIIP)

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Molecular Biology

SPACE LIFE SCIENCES
SUMMER INSTITUTE

Current Work

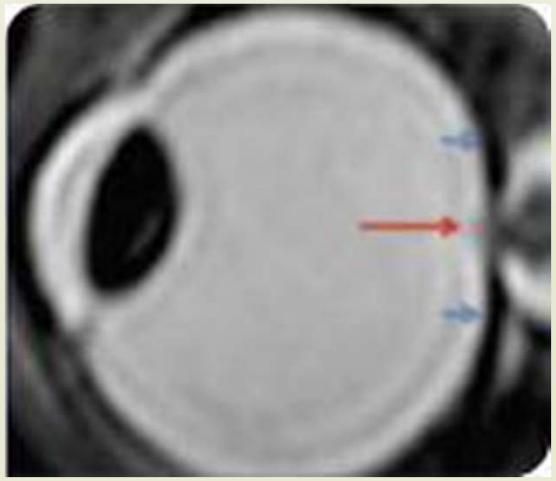
- Cell and Molecular Biology major
- I work in a nutritional ecology lab at Auburn University

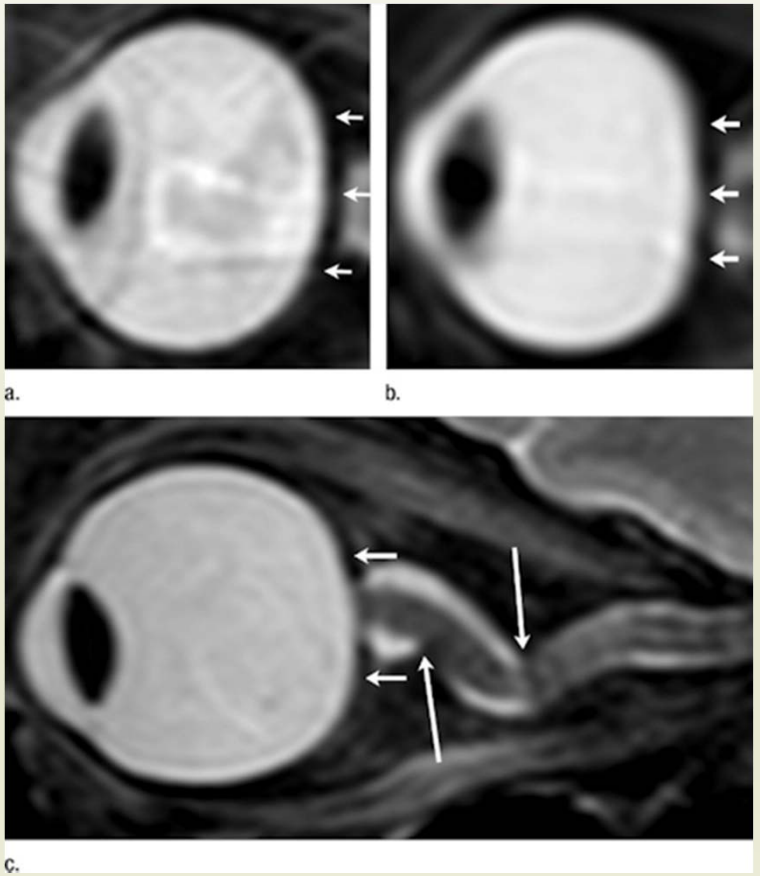
Hopeful Future

- I hope to attend medical school
- I’m currently interested in internal medicine specializing in Endocrinology or Rheumatology
- However, I really enjoy conducting research

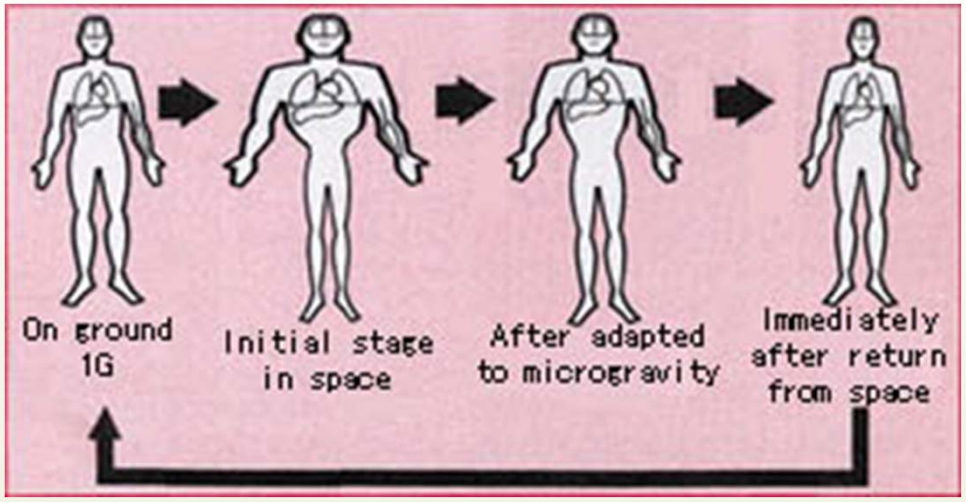
Visual Impairment & Intracranial Pressure (VIIP)

- Changes in astronaut vision after space flight
  - Globe flattening
    - » Torsion in the optic nerve
  - Concerns for the astronauts well being





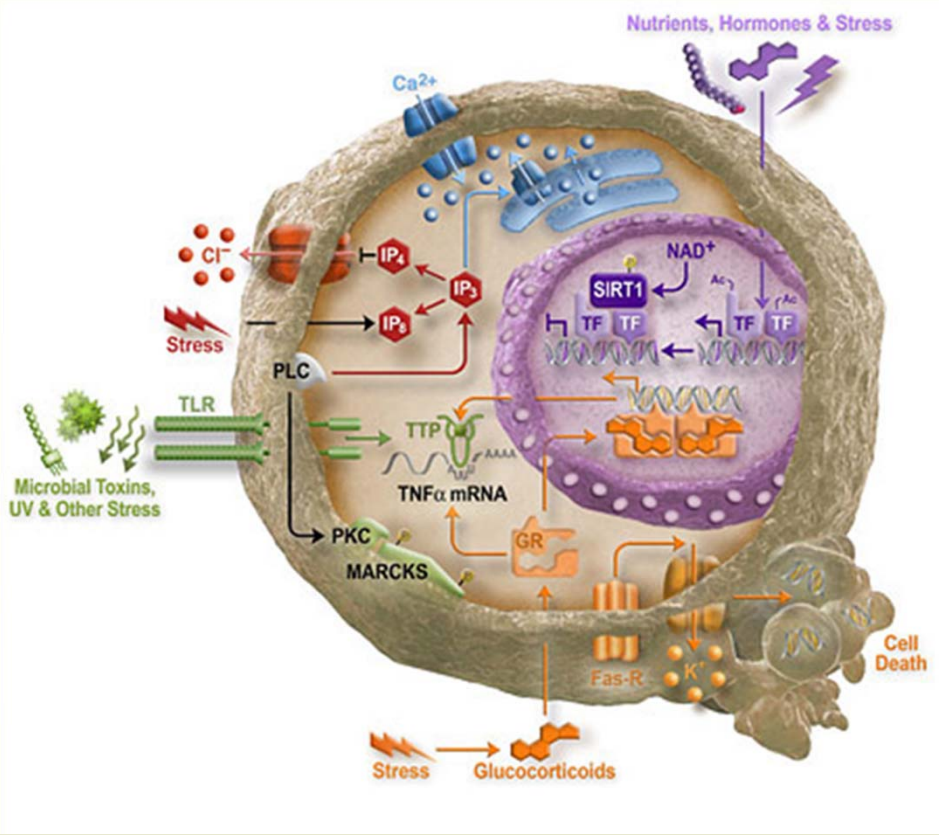
Theories on VIIP

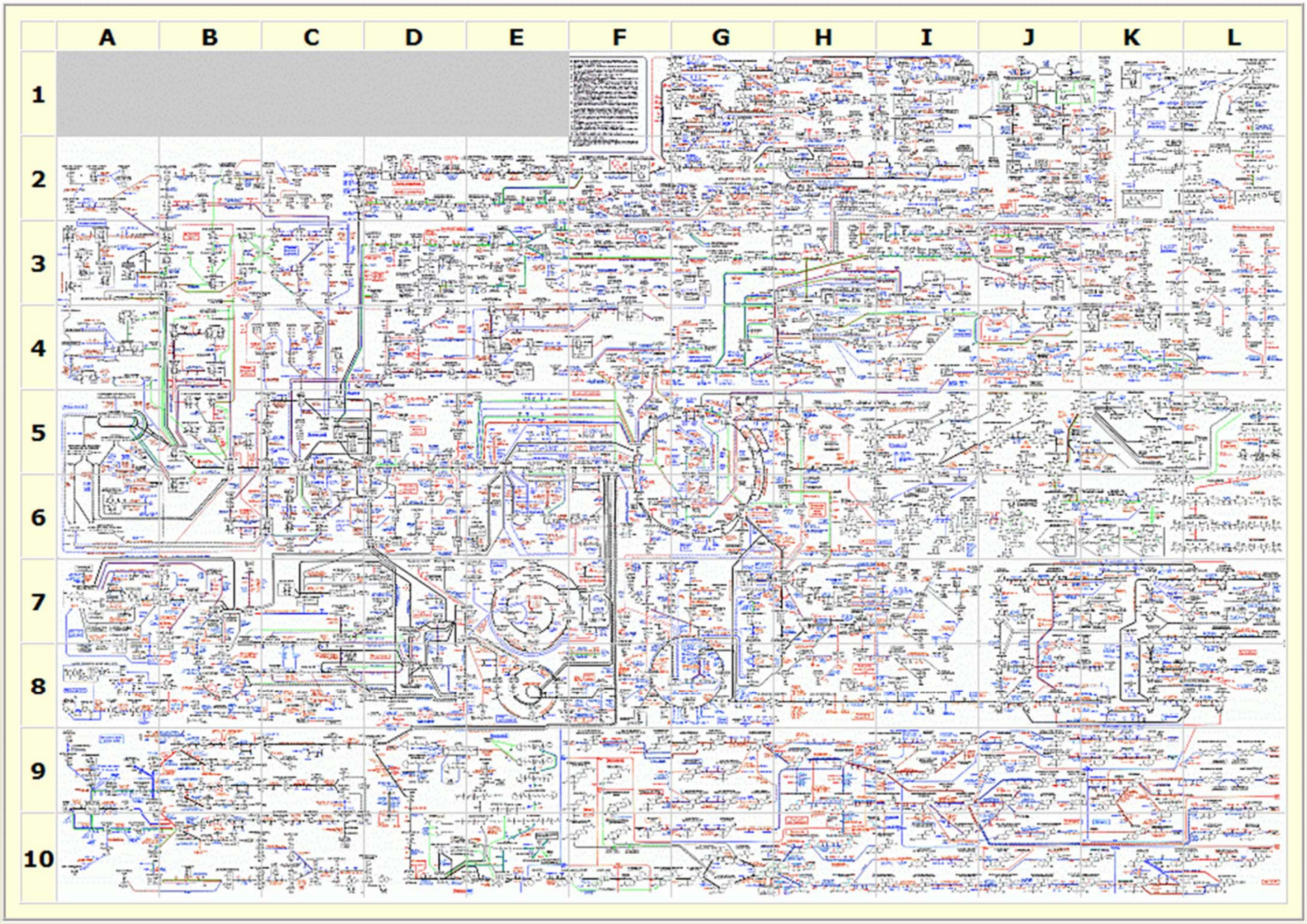


- Several Proposed Theories
  - Fluid Shift
  - Increased CO_2 exposure
  - Diet
  - Exercise- ARED
    - » Mostly discounted now
  - Molecular Mechanisms

Molecular Genetics

- Cell signaling and molecular pathways are fascinating
  - Stimulation through many mechanisms
    - » Environment
      - Diet, sleep, stress, etc.
      - Physiological changes and imbalances
      - Such as fluid shifts in microgravity
    - » Endocrine system regulation




A
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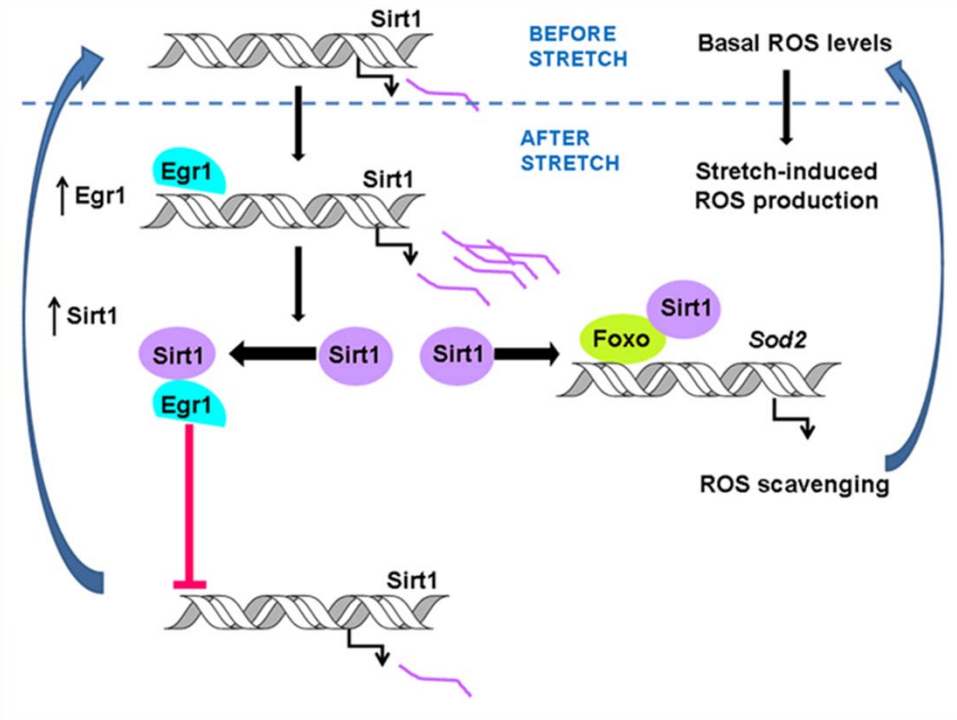
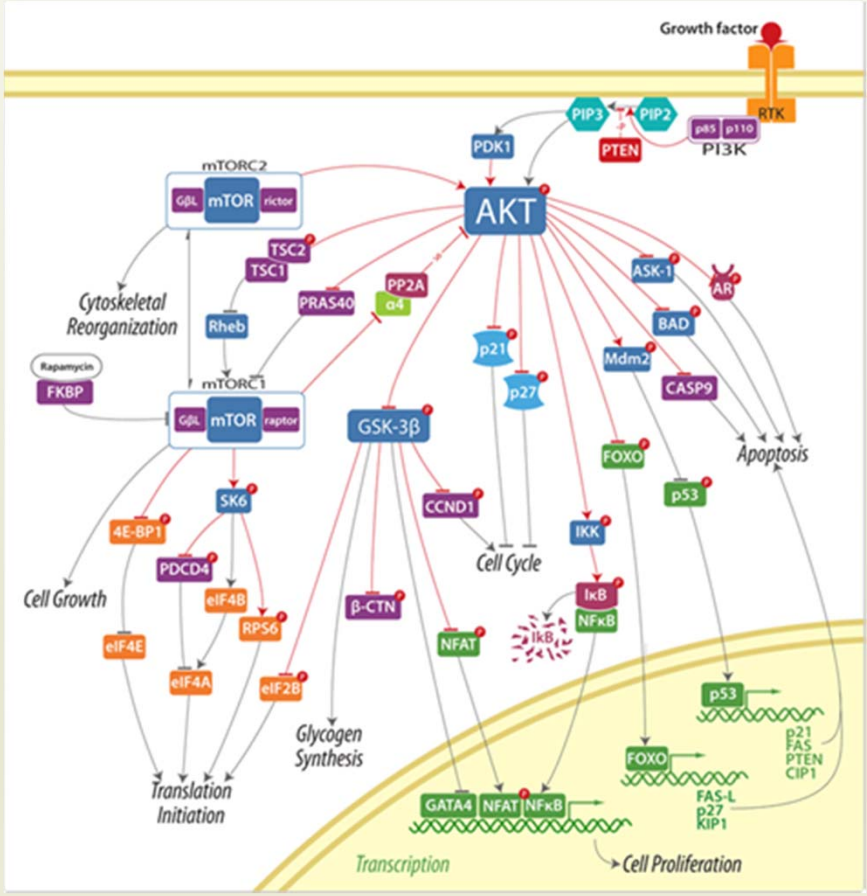
Early Growth Response Protein-1 (EGR1)

- EGR1 is a transcription factor

  Describes as stretch and pressure activated

  » Ex. mechanical stretch in muscle induces EGR1 expression





Proposed Theory

Microgravity → Cephalad Fluid Shift → Upregulation of EGR1 → Ocular Changes → Vision Deterioration

Determination of Upregulation

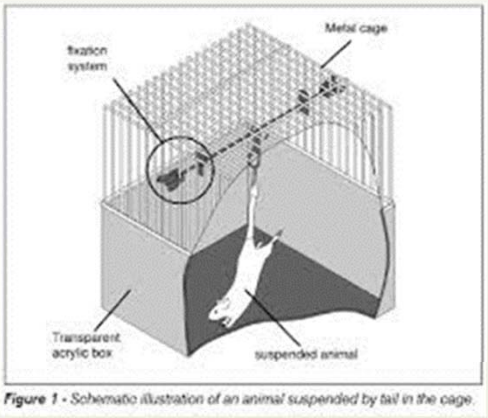
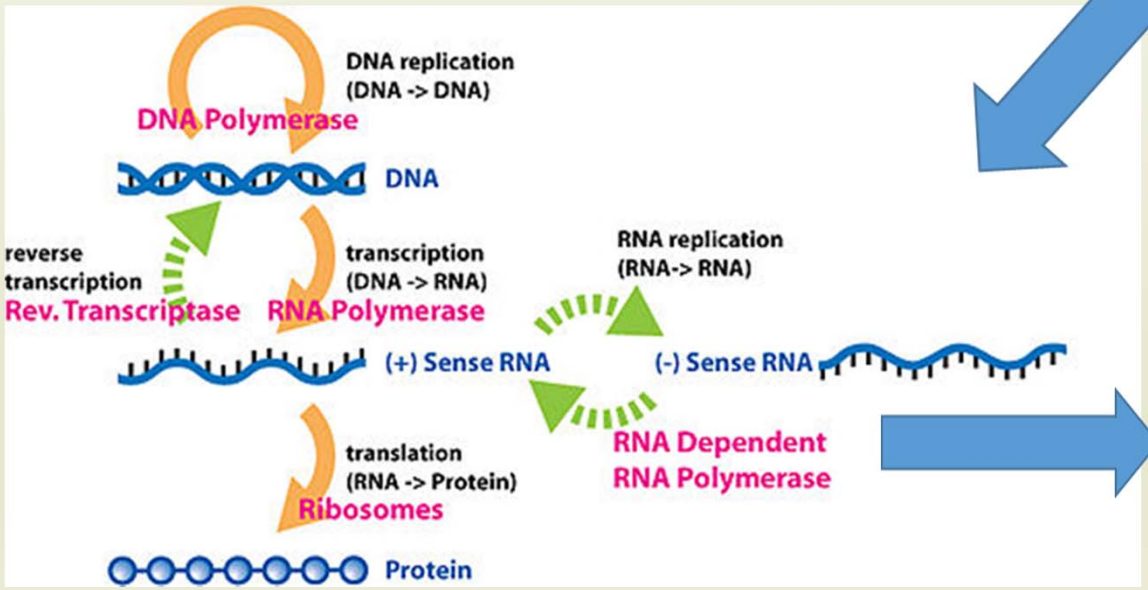
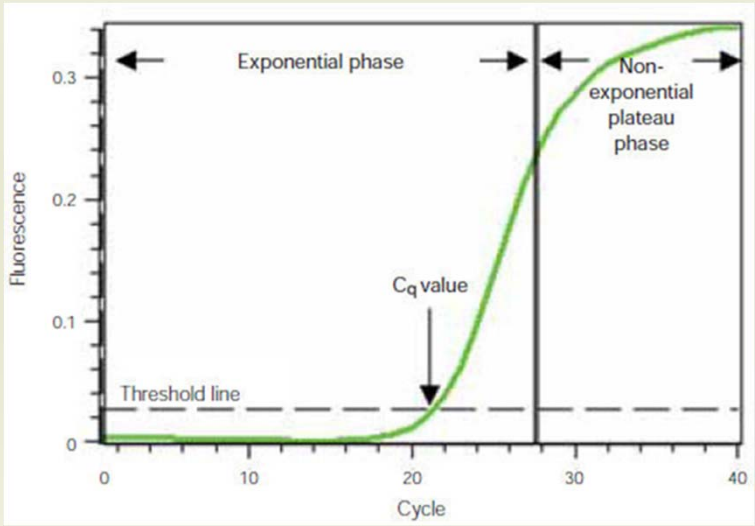


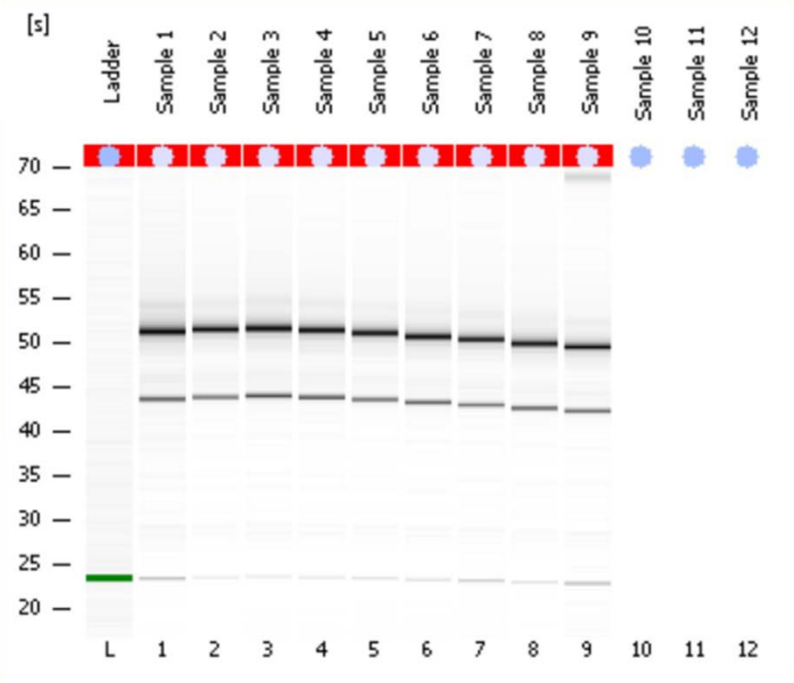
Figure 1 - Schematic illustration of an animal suspended by tail in the cage.

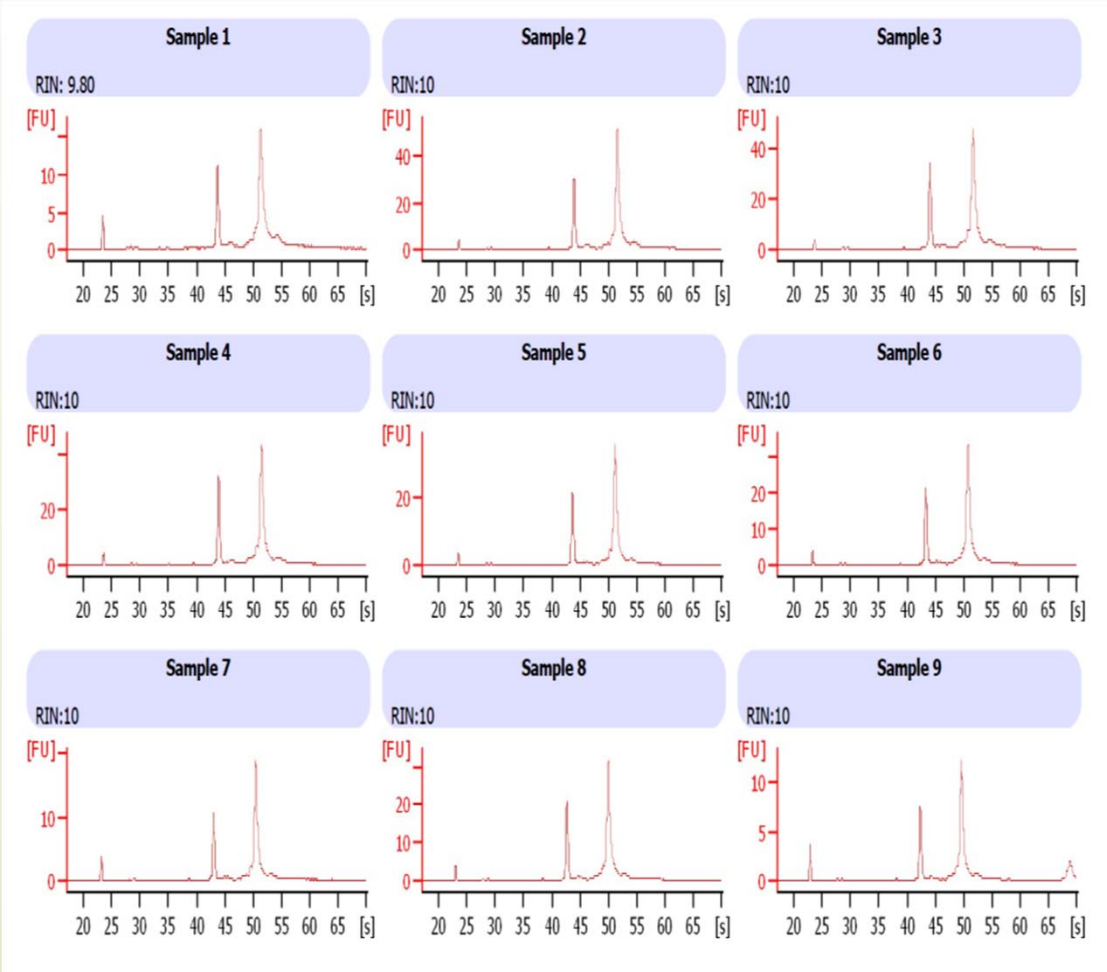




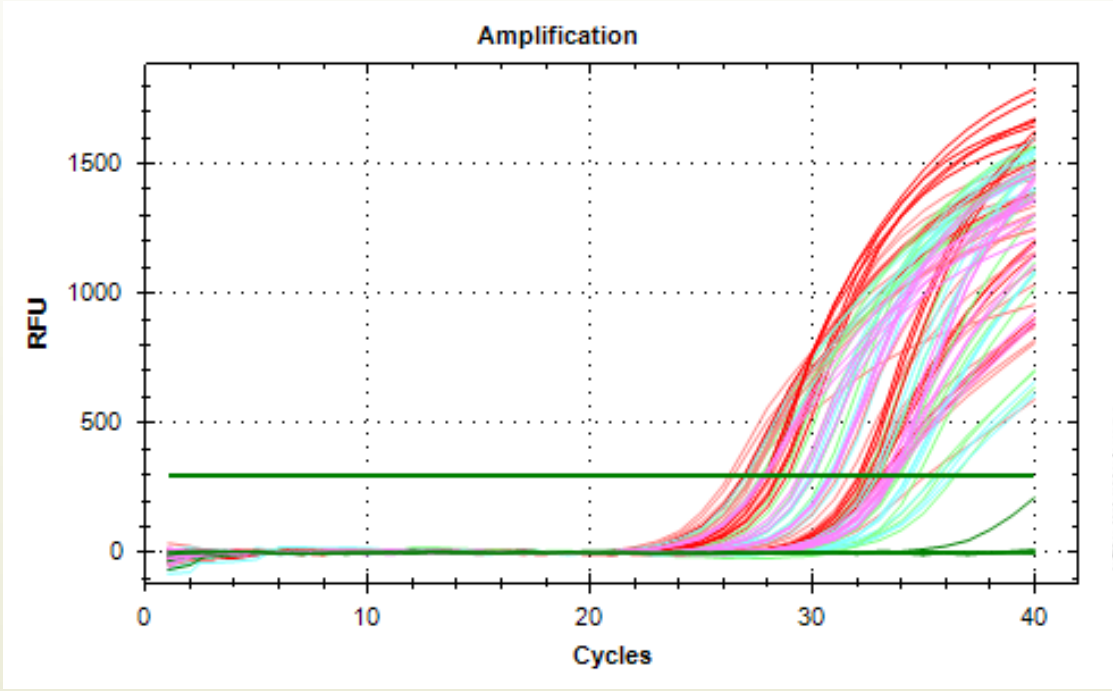
RNA Quality

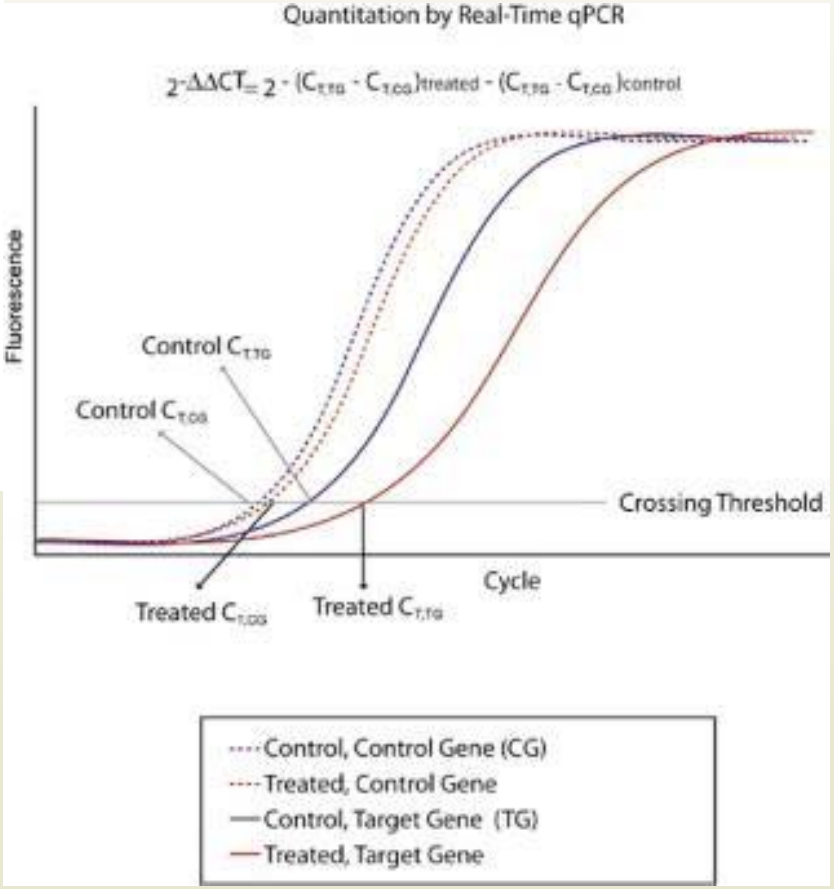
- Agilent RNA 6000 Pico kit





qPCR


Amplification
RFU
1500
1000
500
0
0
10
20
30
40
Cycles

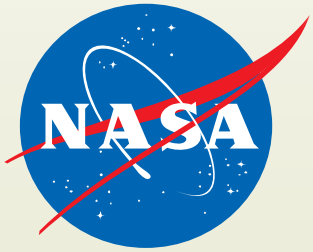

Quantitation by Real-Time qPCR
$2^{-\Delta\Delta CT} = 2^{-(C_{T,TG} - C_{T,CG})treated - (C_{T,TG} - C_{T,CG})control}$
Fluorescence
Control $C_{T,TG}$
Control $C_{T,CG}$
Crossing Threshold
Cycle
Treated $C_{T,CG}$
Treated $C_{T,TG}$
Control, Control Gene (CG)
Treated, Control Gene
Control, Target Gene (TG)
Treated, Target Gene

Future Work

- Finish analyzing data generated
  - Propose where to move from this point
- Collaborate with other departments and integrate findings for a more complete picture of the causes of VIIP
- Eventually treat or implement counter measures to the problem

Thank You

- Dr. Susi Zanello
- Dr. Corey Theriot
- Lauren Merkle, Ed.D.
- Ron McNeel, Dr.P.H
- Amanda Hackler, Ed.D.
- Fellow Interns


NASA