

# COVID-19 and Cancer Research

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**Paula J. Bates, PhD**

Longtime Cancer Researcher

Recent COVID-19 Researcher

Passionate About Innovation

**Brown Cancer Center, University of Louisville**

# About Me ...



## Researcher

cancer, drug discovery,  
translation

## Inventor

14 issued US  
patents

## Entrepreneur

Aptamera co-founder

## Collaborator

Antisoma, Transmed,  
Qualigen

## Mentor

students and faculty  
entrepreneurs

## Program Director

*ExcITE* – UofL product development  
*KYNETIC* – statewide innovation

# My Journey



Nantwich, Cheshire

Nantwich

high school (1988)



The Queen's College,  
Oxford

Oxford

BA, Chemistry (1992)

London

PhD, Biophysics (1996)



Birmingham, AL

postdoc, Molecular Biology (1999)



UAB, Birmingham

Louisville, KY

faculty (since 1999)

# My Research



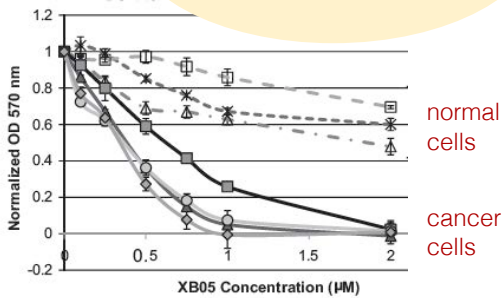
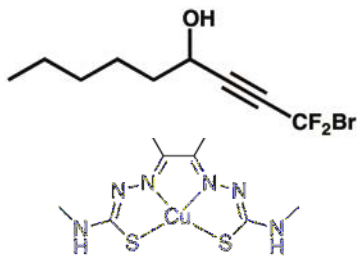
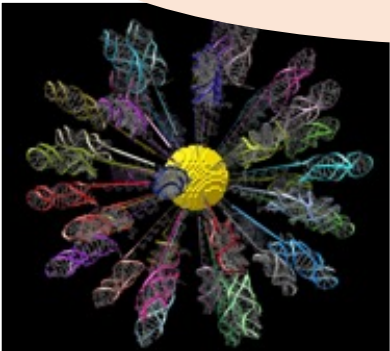
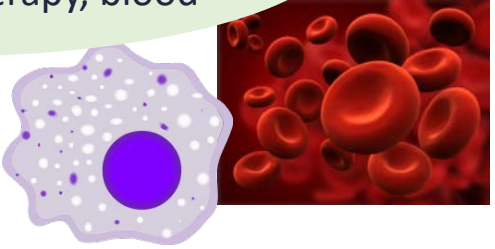
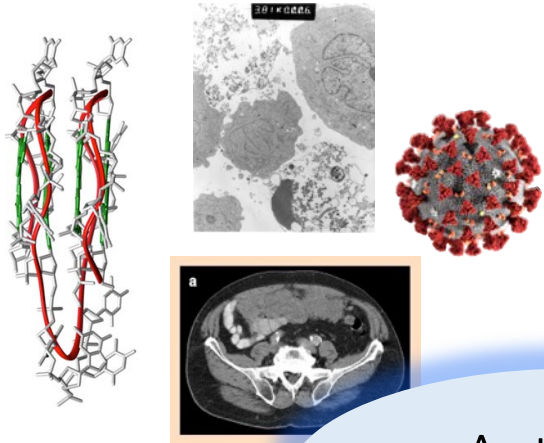
Aptamer  
cancer and COVID-19

Collaborative  
cancer immunotherapy, blood

Nanotechnology  
cancer

Therapies  
cancer

Innovation  
product development



# Why are cancer researchers studying COVID-19?

## **to overcome the virus**

- COVID-19 is making cancer care more challenging.

## **to protect cancer patients**

- Cancer patients are at increased risk of COVID-19.

## **to answer questions about cancer and COVID-19**

- Do cancer therapies affect COVID-19 outcomes?
- Understand immune responses to cancer & virus.

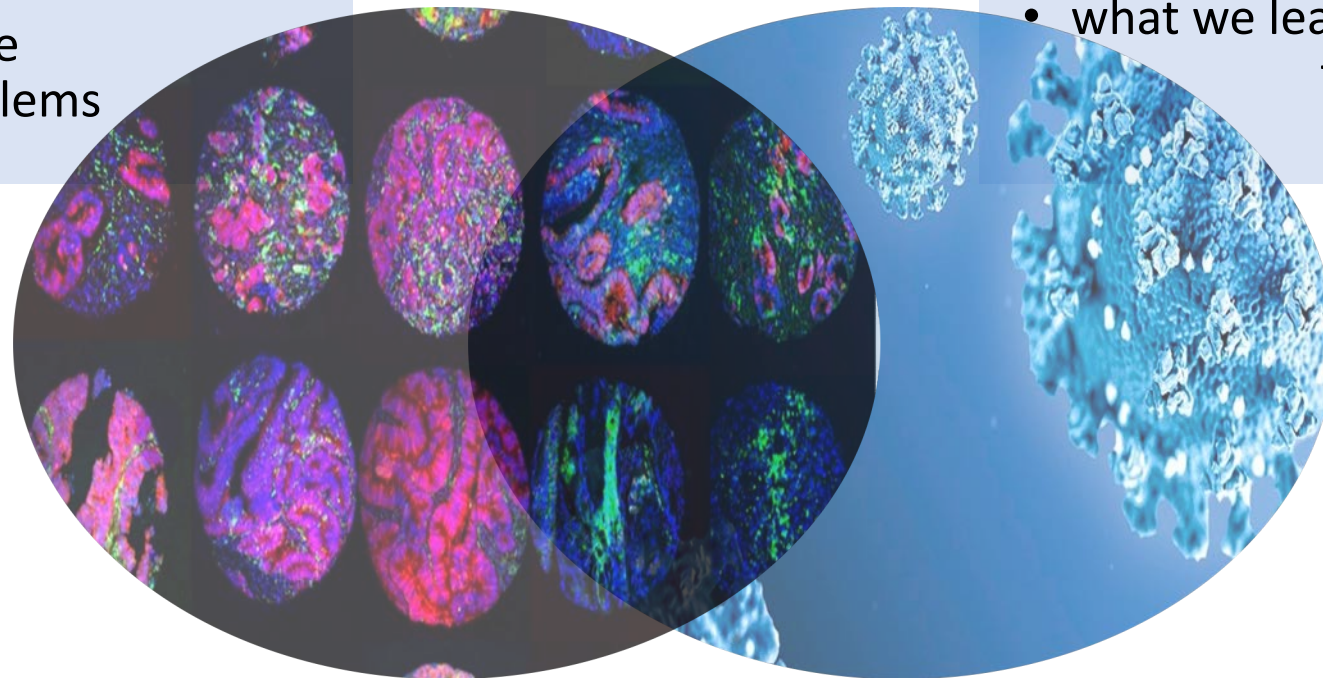
# Overlaps between cancer and COVID-19?

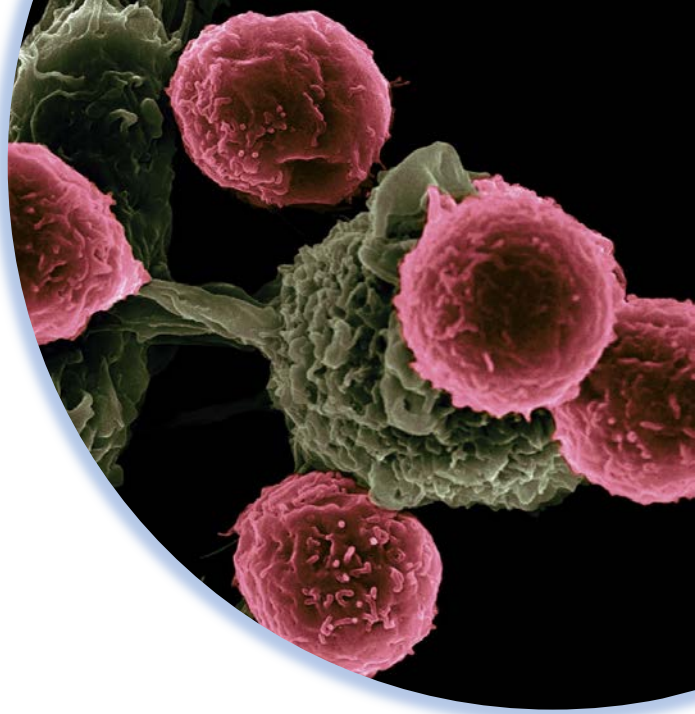
## Our immune system

- can detect virus/abnormal cells
- protects us against COVID/cancer
- active evasion by virus/cancer cells
- inappropriate immune response causes problems

## Therapeutics

- some cell surface molecules play a role in both cancer and virus
- repurposed cancer drugs -> COVID
- what we learn from COVID may lead to new cancer therapies





## UofL's Brown Cancer Center

- state-of-the-art multidisciplinary cancer care
- national leader in cancer immunotherapy clinical trials
- new \$11.5 M grant for cancer immunology research

*harnessing the power of the immune system  
to eradicate cancer*



# UofL's "Lab-to-Life" Innovation Programs



## Coulter Translational Partnership

2012 1 of 16 sites in a national network

## NIH REACH

2015 1 of 3 initial hubs in a national network



## NIH REACH

2019 1 of 5 new hubs added to the national network



2015 NSF I-Corps



2016 NSF AWARE:ACCESS

2018 NIH Regional Accelerator



*a national leader in translational research and entrepreneurial education*

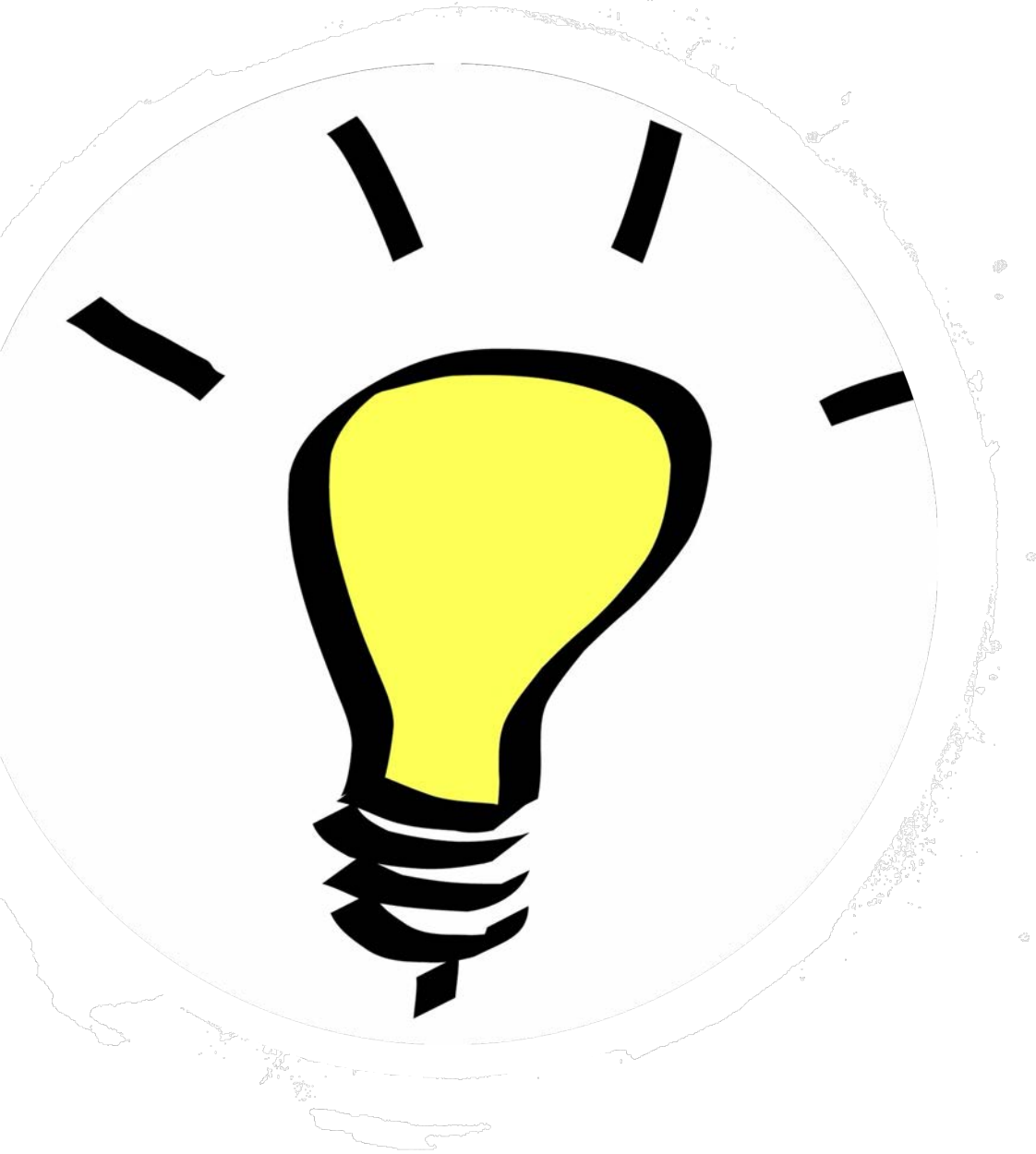
## Program Goals:

- Accelerate the successful translation of ideas into products
- Improve health, education, and the economy in Kentucky
- Encourage multidisciplinary, product-focused research
- Increase the involvement of underrepresented groups in innovation
- Identify and share best practices for research commercialization

## Unique Features:

- A focus on changing mindsets (of researchers and institutions)
- We provide funding + training/coaching/mentoring + a network
- Access to and review by industry and federal experts
- Upfront business case review and industry-style project management
- "Fail fast" philosophy – milestones; go/no go; tranced funding





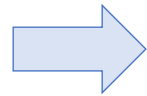
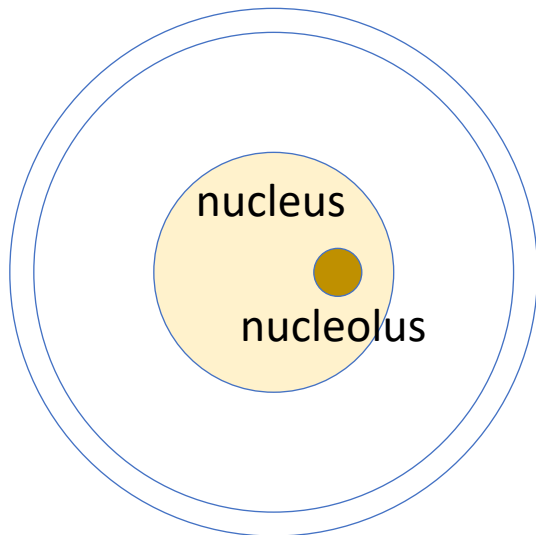
## How did I become a COVID-19 researcher?

- **January 2020:** Start to worry about “the new coronavirus” ...
- **February 2020:** Hatch an idea to inhibit SARS-CoV-2 based on previous research related to **nucleolin**

# Nucleolin and Cancer

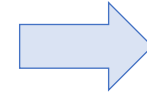
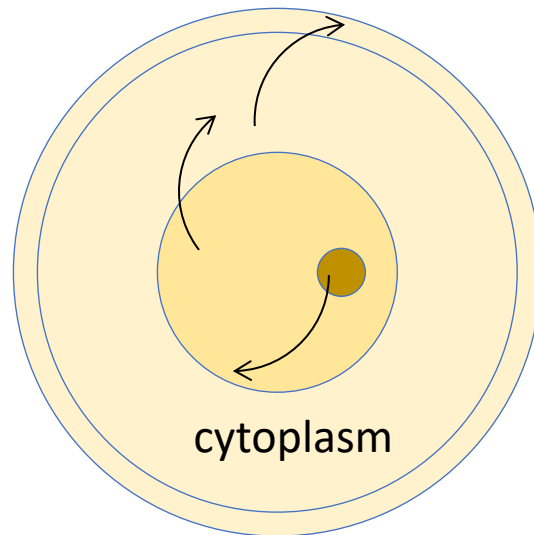
## Normal Cell

Nucleolin found only inside the cell



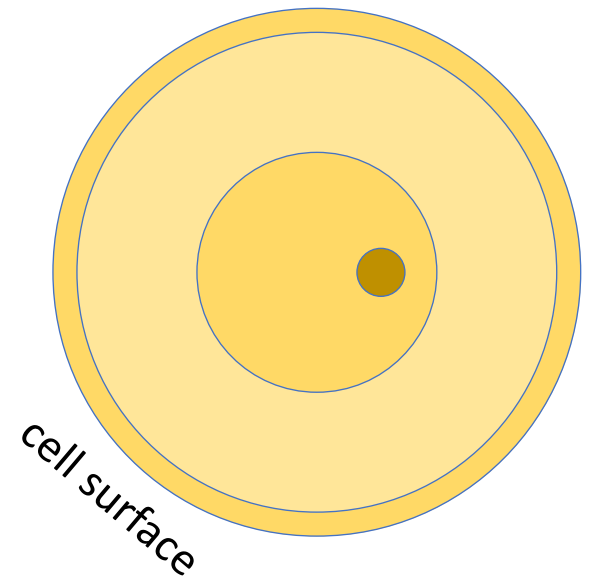
## Stressed Cell

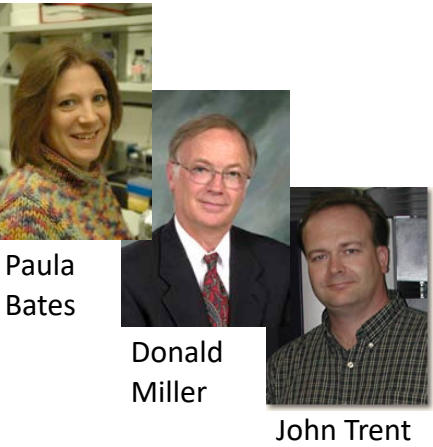
Nucleolin moves to cell surface in response to stress or signals



## Cancer Cell

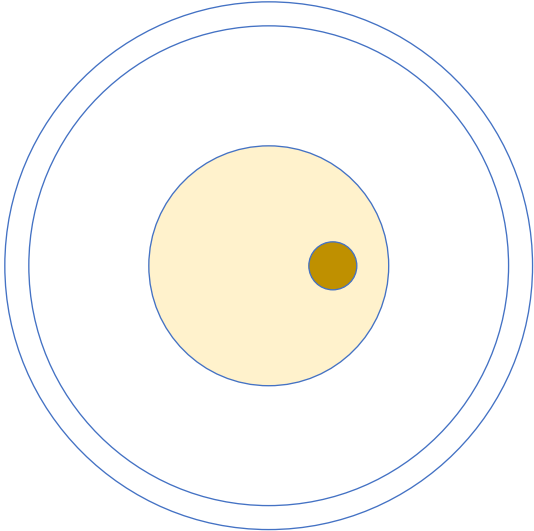
Nucleolin present at high levels throughout the cell.



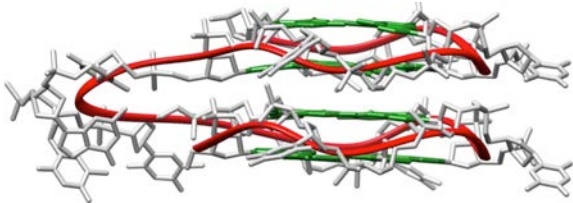


# AS1411: A Nucleolin Aptamer

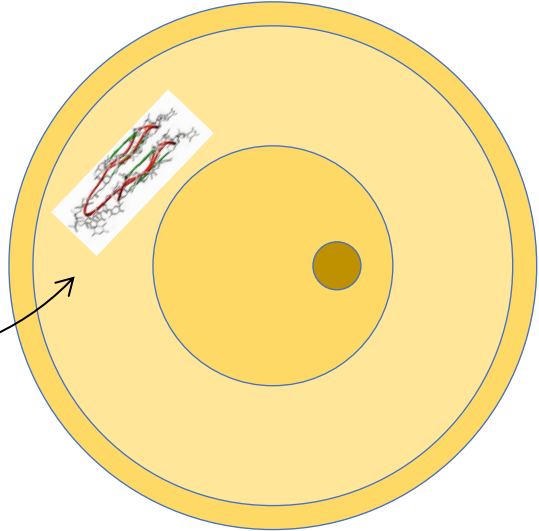
- A
- 
- **Binds specifically to nucleolin protein**
- 



**Normal Cell**  
Nucleolin inside the cell.  
Invisible to AS1411.



- **Completed Phase 1 & 2 clinical trials**
- 
- 
- 
- A

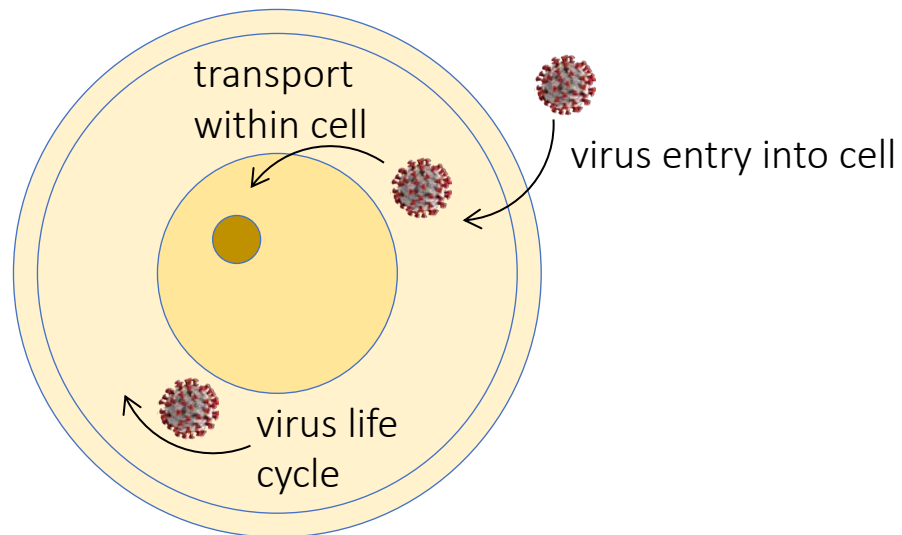


**Cancer Cell**  
Nucleolin present at high levels on the cell surface.

# Nucleolin and Viruses

## In response to stress or **viruses**:

Nucleolin moves to the cell surface when cells are infected by some **viruses**. It has been shown to play important roles in virus infectivity:



## Nucleolin implicated in the biology of ...

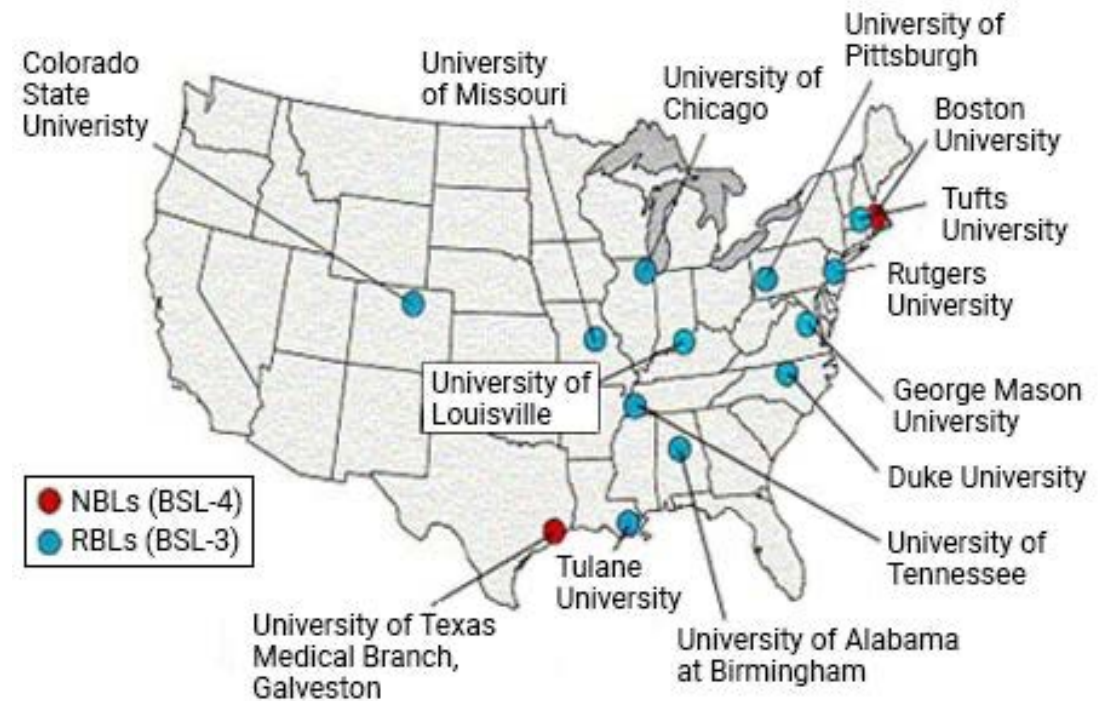
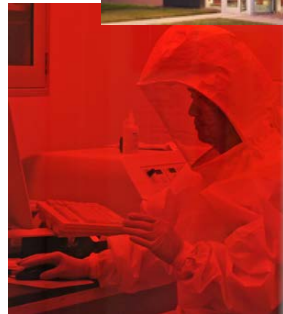
- HIV-1
- influenza A
- hepatitis C virus
- respiratory syncytial virus (RSV)
- herpes simplex virus 1 (HSV-1)
- human cytomegalovirus (CMV)
- dengue virus
- Epstein-Barr virus (EBV)
- human papilloma viruses (HPV)
- rabies virus
- coxsackie B virus
- enterovirus 71 (EV71)
- parainfluenza virus
- Crimean-Congo hemorrhagic fever virus
- **avian IBV coronavirus**
- **SARS coronavirus (predicted)**

**Can the nucleolin aptamer (AS1411) block SARS-CoV-2?**

# Luckily, I'm in Louisville

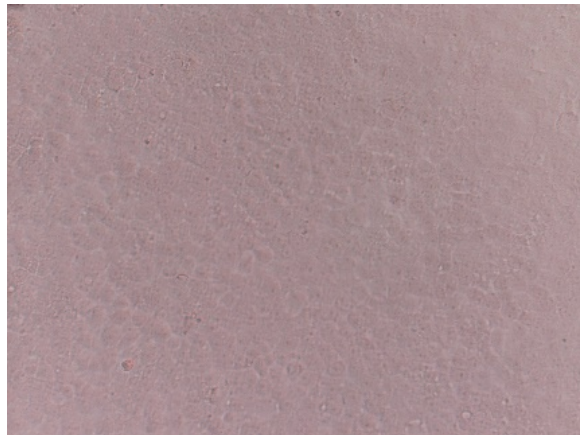


February 2020: Discuss idea with Kenneth Palmer, head of UofL's Center for Predictive Medicine and Regional Biocontainment Lab (RBL)

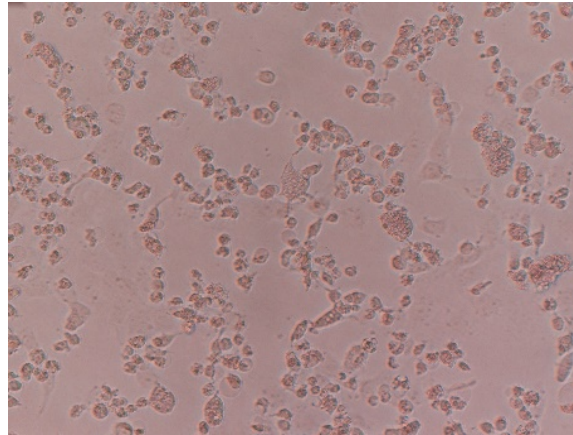


# A Eureka Moment ...

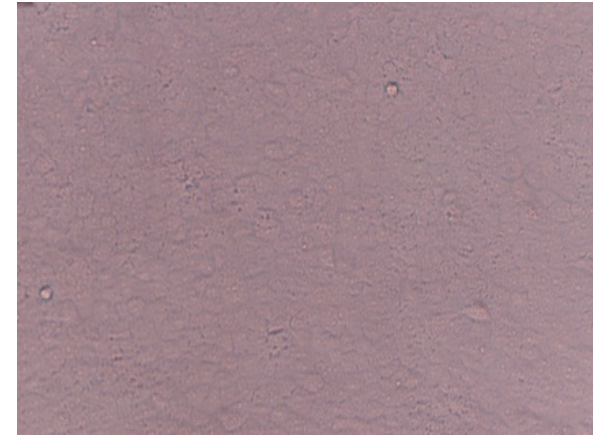
March 2020: First evidence that AS1411 inhibits infection by the COVID coronavirus (SARS-CoV-2)\*



Without SARS-CoV-2



Infected with SARS-CoV-2



Infected with SARS-CoV-2  
+ treated with AS1411

\* Thanks to Kenneth Palmer, Divya Saxena, Jennifer DeMarco, Bill Severson, and all the faculty and staff at the CPM

# What's Next for AS1411?

- ✓ Experimental drug, expected to be safe based on cancer clinical trials
- ✓ Evidence of inhibitory activity against SARS-CoV-2 in multiple assays
- Scale up drug manufacture, additional studies
- FDA authorization for human studies
- Human clinical trials in COVID-19 patients
- Developing new AS1411 formulations for cancer



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