Building an Innovation Workforce in Biotechnology to Address Climate Change

Introducing Claflin University's Online Degree Program for a Master's of Science in Biotechnology to address Climate Change

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We have some Big Problems ahead of us…

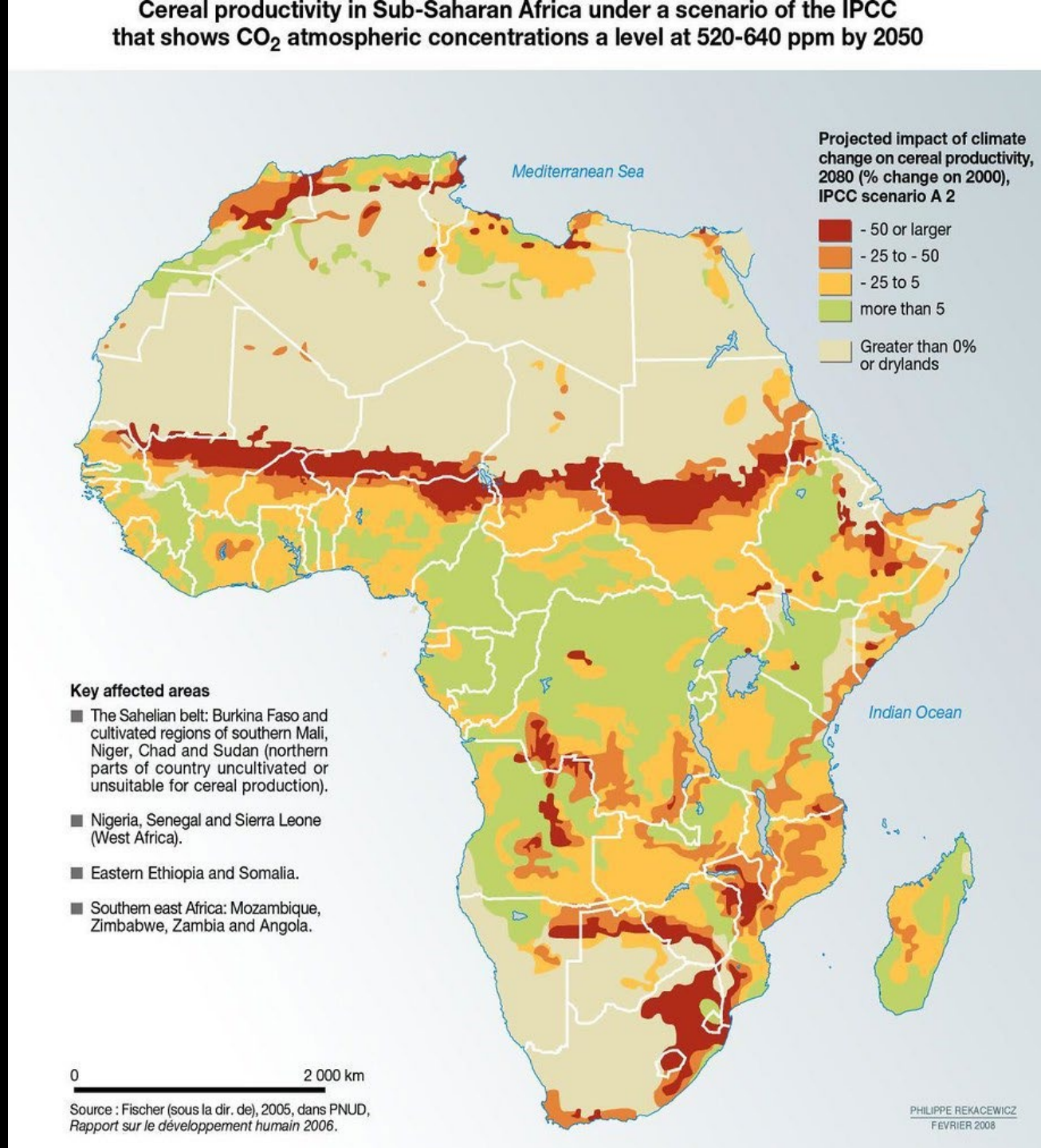
Expected evolution of drought differs by region in Africa, with the most affected areas in the north and south.

--- drought will affect food supply

Increasing Food Insecurity

Drop in cereal productivity

- Models predict 30% rise in price



Studies show that higher CO_2 reduces zinc content of crops

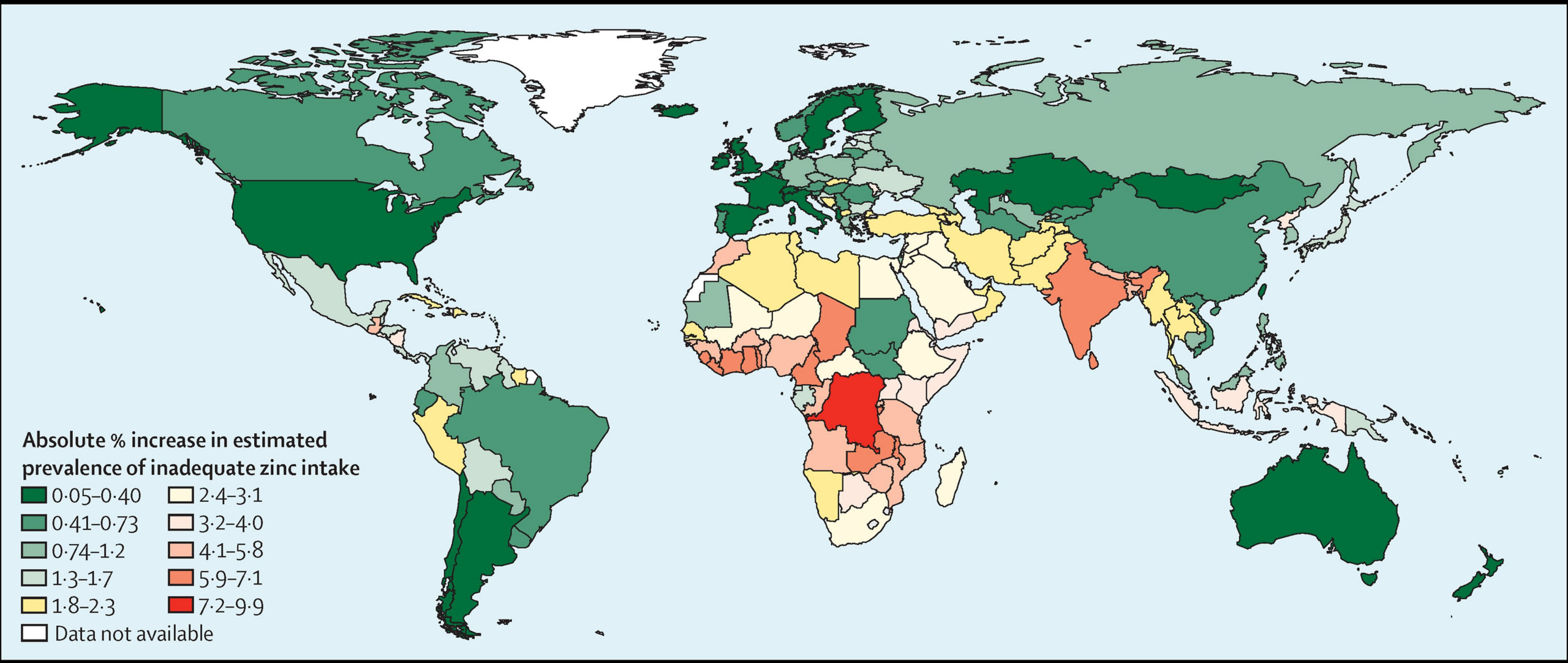
By 2050:

~175 million more people could have zinc deficiencies (more susceptible to illnesses)

~122 million more people could be protein deficient.

Communities relying largely on plant harvests for their nutrition will feel this most acutely.

Projections on Zinc deficiencies worldwide:



- *Hits African countries hardest*

Climate Change Impacts:

Crops grown in high-drought areas that are then moved into humid storage facilities are vulnerable to fungal infections or pests

-These are Targetable by Biotechnology

Nutritional Quality of Food Decreases

Cereal and forage crops show lower protein concentrations under elevated CO_2 conditions

→ *This is targetable by Biotechnology*

Benefits of Biotechnology

- increase the crops yield through introducing high-yielding varieties resistant to stresses
- reduce pest– associated losses
- increase the nutritional values of foods

Biotechnology landscape controlled almost exclusively by:

- the private sector
- large corporations / agribusiness
- defined by patent protection

Plan for Biotech Workforce Development

We Need to Train those Scientists now

In Africa…

In Asia…

Everywhere…

Plan for Biotech Workforce Development

We Need to Train those Scientists now

Build a Biotechnology workforce

That has the skills to meet the challenges in 20 years

Develop local expertise and Intellectual Property

Target Skills for Workforce Development

- Genetic engineering of crops to withstand drought & pests
- *Development of Bio-fuels & sustainable energy production*
- *Vaccine & therapeutics development, drug design*

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Master of Science In Biotechnology for Climate Change

A Masters of Science Degree Program specifically designed to teach how to *use* the science of *Biotechnology* to *mitigate/adapt to the impacts of Climate Change*

ONLINE

→ Is the only Biotechnology Program that targets climate change!

Claflin University

U.S. News and World Report **Best Colleges 2022** Rankings

Visionary Leadership

Mentoring leaders, problem solvers, & agents of change

What Sets Claflin Apart

As an HBCU We Excel in Pedagogy

- Especially for non-traditional learning styles
- Research based methods in Teaching & Learning
- Know How to foster inclusive environments
- Social justice
- Experience with a worldwide audience

Claflin's Great Track Record

- 101 graduates over 18 years
- 93% graduation rate

  32% International; Home countries include:

  Kenya, Nigeria, South Africa, Ghana, Ethiopia, Malawi, Zimbabwe, India, Pakistan

- 20% continued to Ph.D.s
- 11% progressed to Ed.D. M.D., PharmD, J.D.
- Claflin invested $736,000 USD over 18 YRS in Stipends/Tuition

Course Delivery

- Fully Online
  - available *EVERYWHERE*
  - 10 courses over 2 years

Pre-Requisites:

Bachelors of Science Degrees in

Biology,
Chemistry,
Environmental Science
or related fields

From a Range of Locations

Mutare, Zimbabwe (Brenda)

Taraba State, Nigeria (Glory)

Nakuru, Kenya (Shepard)

Manilla, Philippines (Desire)

Mozambique (Zaqueu)

Nairobi, Kenya (Nyamongo)

Most of us hope that when the real climate crisis comes,

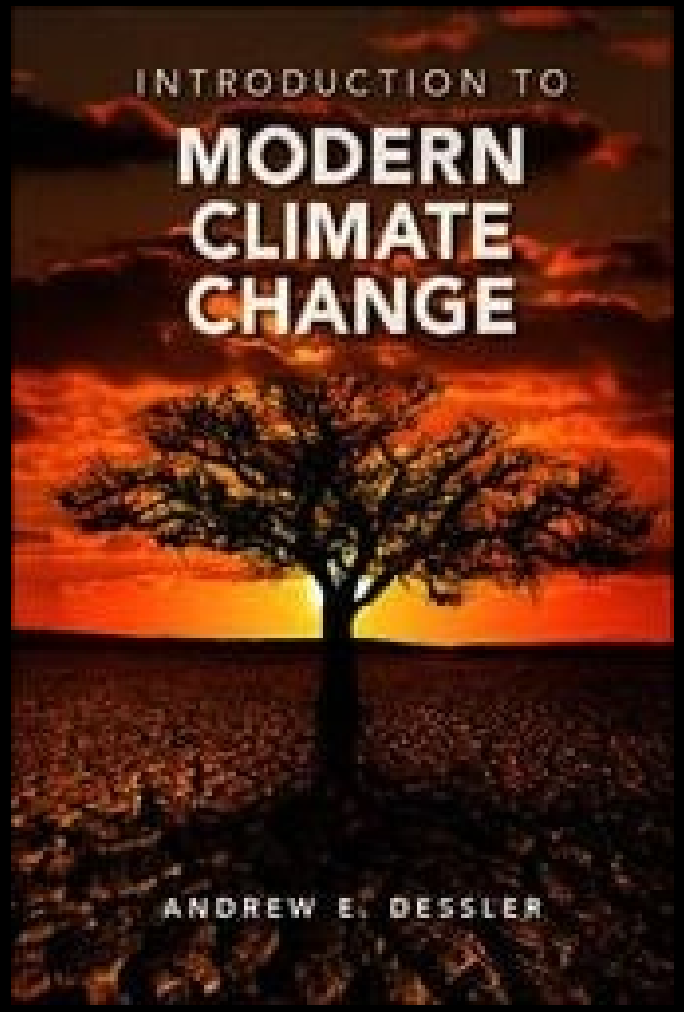
Some Scientific Discovery Will Save Us

We are Training the scientists of the future

Curriculum

Semester	Title	Credits
Fall I	Introduction to Climate Change	3
Fall I	Genetic Engineering	3
Fall I	Research Ethics	2
Spring I	Emerging Diseases	3
Spring I	Protein Structure, Function, & Design	3
Spring I	Plant Biotechnology	3
Fall II	Mitigation of Climate Change	3
Fall II	Data Science	3
Spring II	Environmental Policy & Management	3
Spring II	Food Security & Safety	3
Spring II	Capstone Experience	1

Introduction to Climate Change



Keystone course

taken in the 1st semester

3 Credit Hours

Create a common understanding of modern climate change

- Set the stage for each of the other courses

Genetic Engineering I Course

Advanced molecular biology techniques including

gene cloning

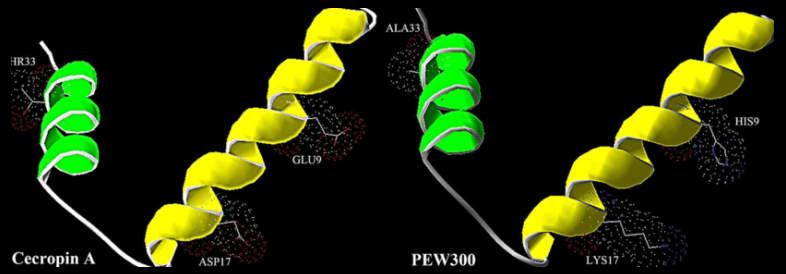
gene modification

CRISPR gene editing

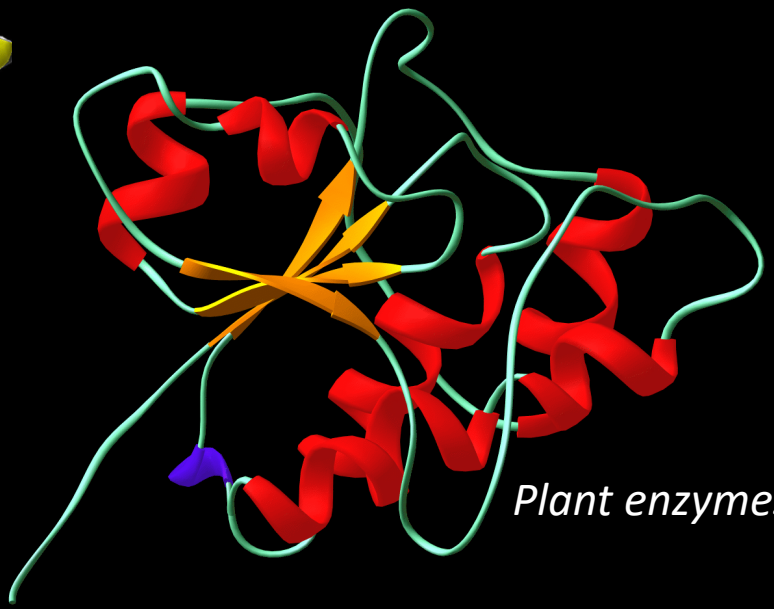
Protein Structure & Design Course

Biofuel enzymes

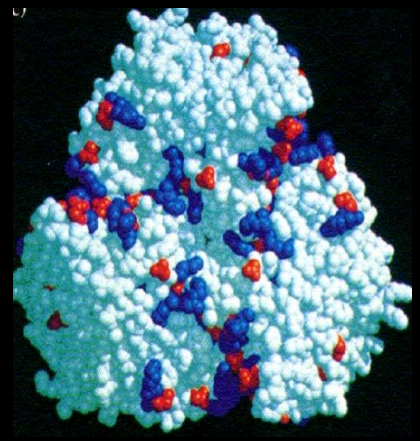
Throughout the course, various protein structures are explored
- active sites detailed
- structure-function relationships explored



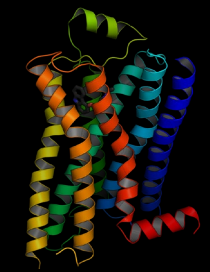
Mosquito Protein-Cecropin A CRSPR/CAS9 malaria resistant mutant



Plant enzymes



vaccines



Insect receptors

- Proteins may be selected from other courses in the curricula

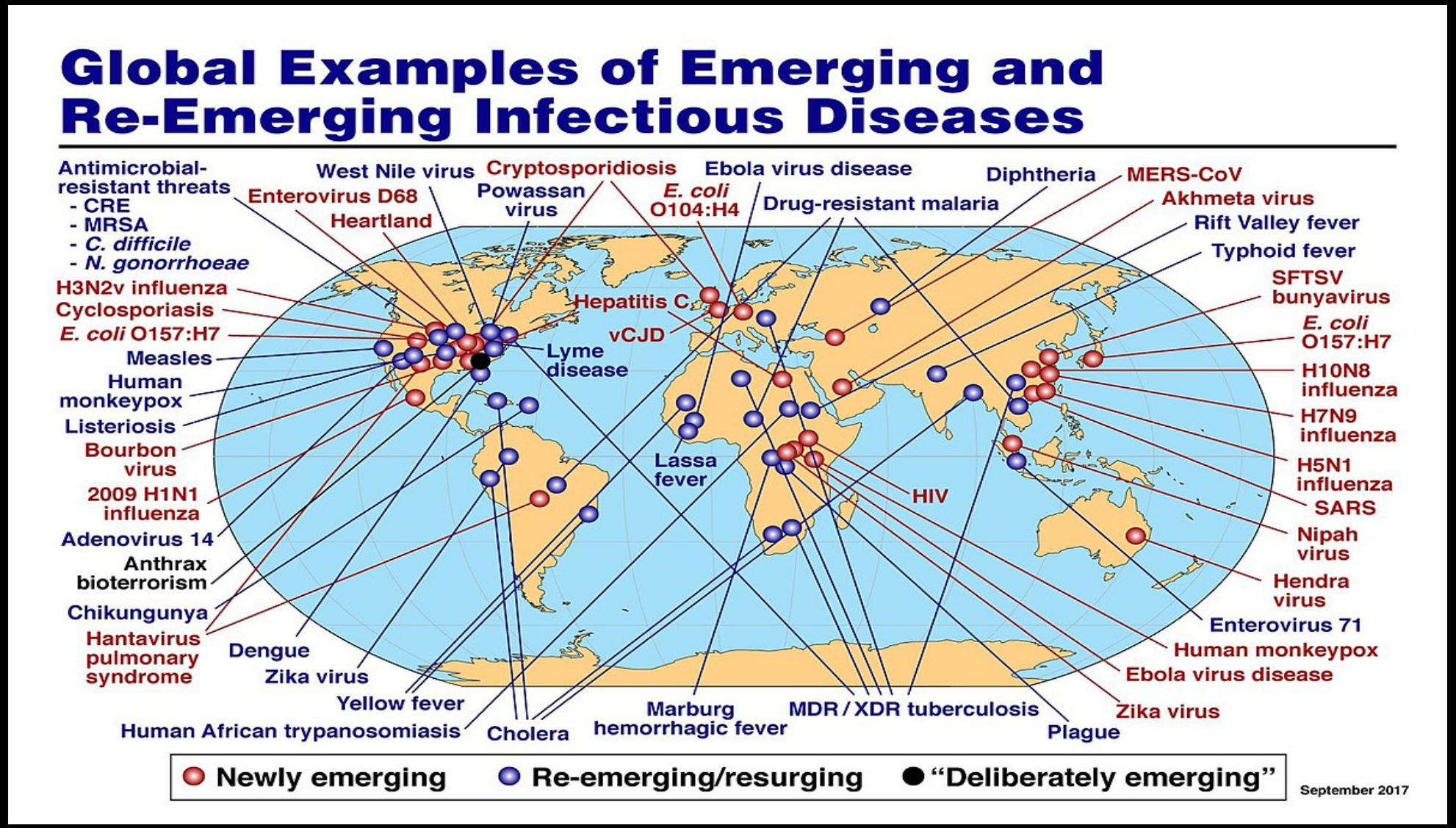
Plant Biotechnology Course

Measure	Biotechnology	Application	Reference
Climate change mitigation:	Engineering herbicide resistance to reduce spraying	GM soy beans GM canola	Fawcett and Towery, 2003; Brimner *et al.*, 2004; Kleter *et al.*, 2008
Reduced use of fertilizer	Engineering nitrogen fixation	Genetic improvement of *Rhizobium*; inducing N-fixation to non-legumes	Zahran, 2001; Yan *et al.*, 2008
Carbon sequestration	Green energy	GM energy crops	Lybert and Summer, 2010

	Nitrogen- efficient GM crops	N-efficient GM canola	Johnsona *et al.*, 2007
Adaptation to climate change:	Molecular marker assisted breeding for stress resistance	Drought resistant maize, wheat hybrids	Wang *et al.*, 2001, 2003
Adaptation to biotic and abiotic stresses	Engineering drought tolerance	GM Arabidopsis , Tobacco, maize, wheat, cotton, soybean	Hong *et al.*, 2000; Jaglo *et al.*, 2001; Yamanouchi *et al.*, 2002
	Engineering salt tolerance	Drought resistant Pearl millet GM tomato, rice	Hsieh *et al.*, 2002;
	Engineering heat tolerance	GM Arabidopsis, GM *Brassica* Sp.	Jaglo *et al.*, 2001; Zhu, 2001.

Food Security Course

Emerging Diseases Course



Capstone Project

Students present a detailed Scientific Proposal to use a biotechnological application to mitigate a specific Climate Change related problem.

Proposal must address indigenous regulations, policies, and politics

This proposal may be done independently or in partnership with a program professor, home institution, industry sponsor, or in conjunction with their current employer if applicable.

Why We Are Here Today

- We had to turn away >20 international applicants for lack of funds
- Modest tuition required (USD 15,000 total for 2 years)

WE NEED SUPPORTERS OF INTERNATIONAL SCHOLARSHIPS

Student testimonial: Zaqueu (Mozambique)

Student testimonial: Glory (Nigeria)

Student testimonial: Nyamongo (Kenya)

Thank You!

Questions?

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