



*Growing Plants in Space:
Feeding People on Earth*

**CIPAC-AIP Workshop
Panamá City, Panamá
2-3 May 2022**

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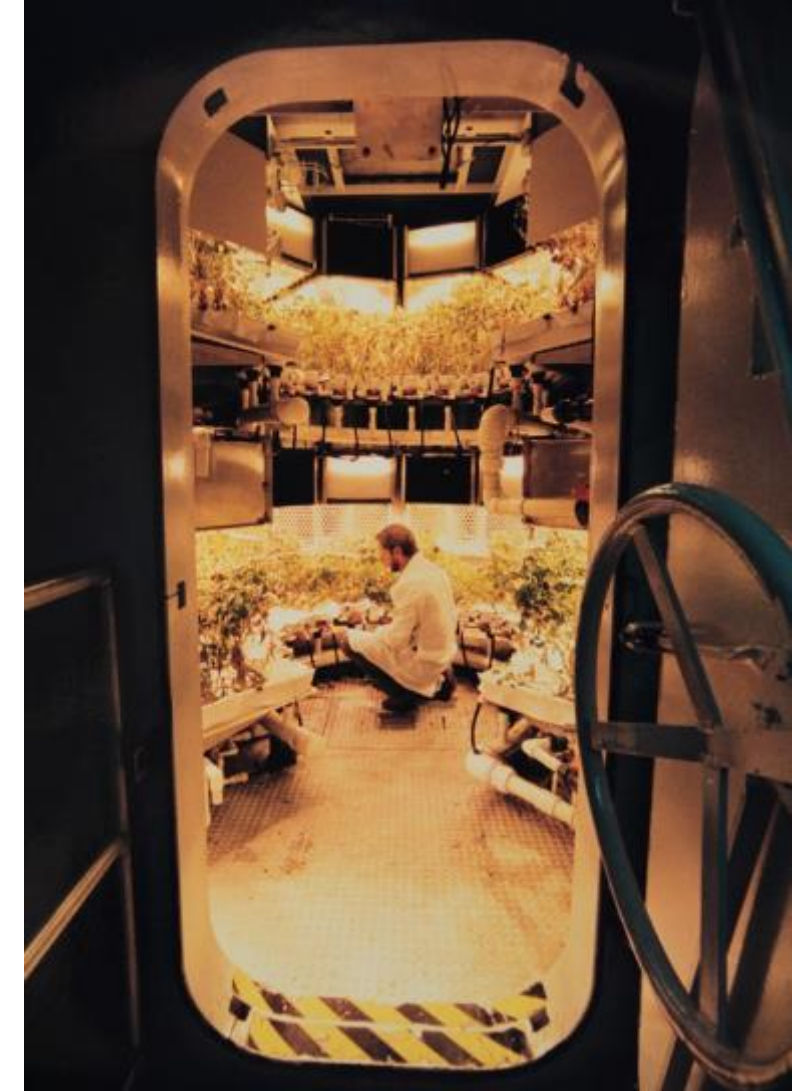


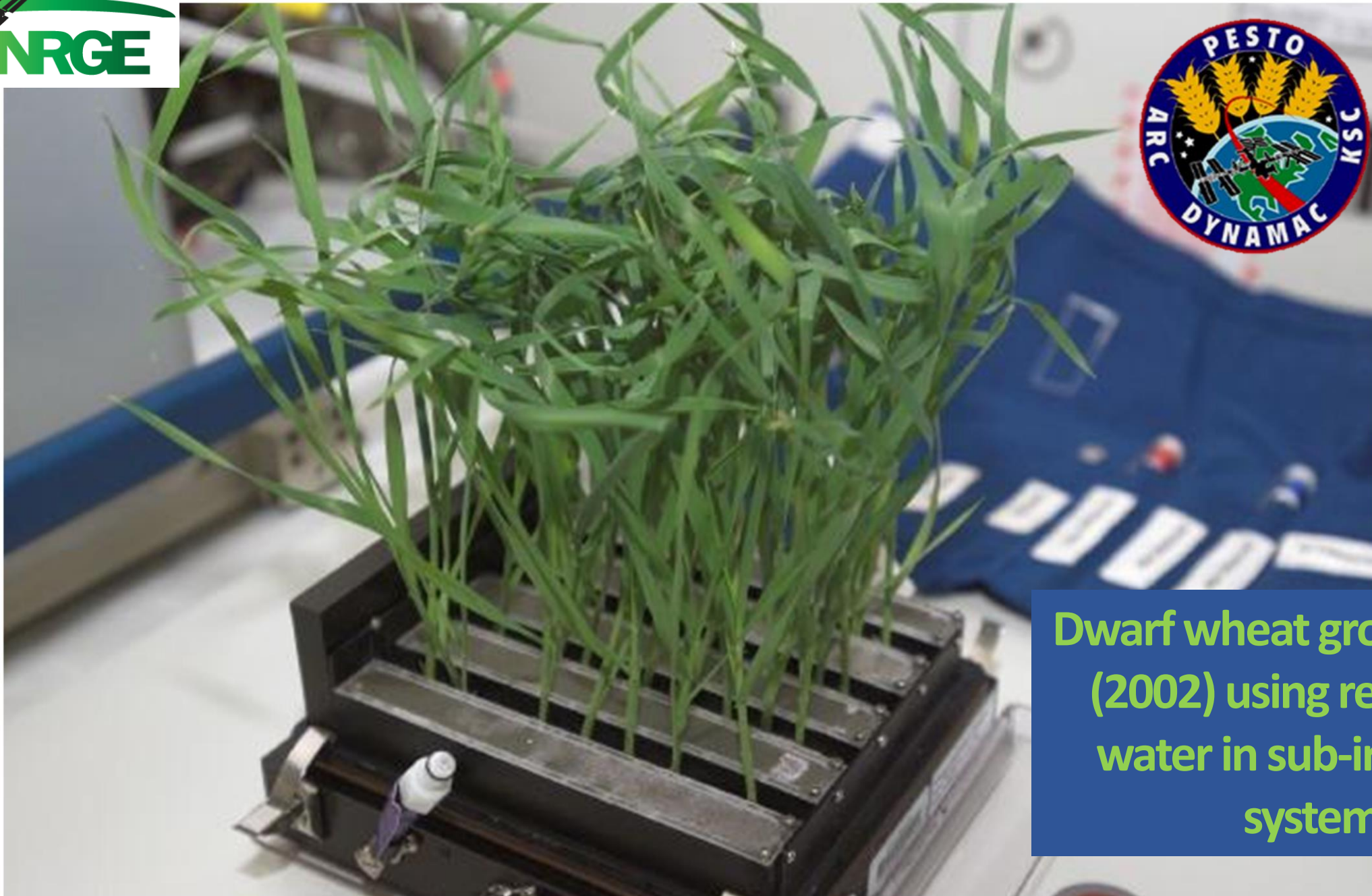
I develop, design and test technology to grow plants in space, and use that technology to support sustainable food production systems on Earth.

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Vertical Farming at NASA in the 1990's





**Dwarf wheat grown on ISS
(2002) using recovered
water in sub-irrigation
system**



LED lighting :
Prime example of how imagination, innovation in space has HUGE impact on growing plants on Earth.



NASA funded research with goal of developing plant lighting systems to improved safety, increase efficiency, and enhance longevity.



Impact: Enabled the Emergence of Vertical Farming for Intensive Production of Food





Trends: New Technology Is Enabling New Solutions

Automation



Robotics



Crops



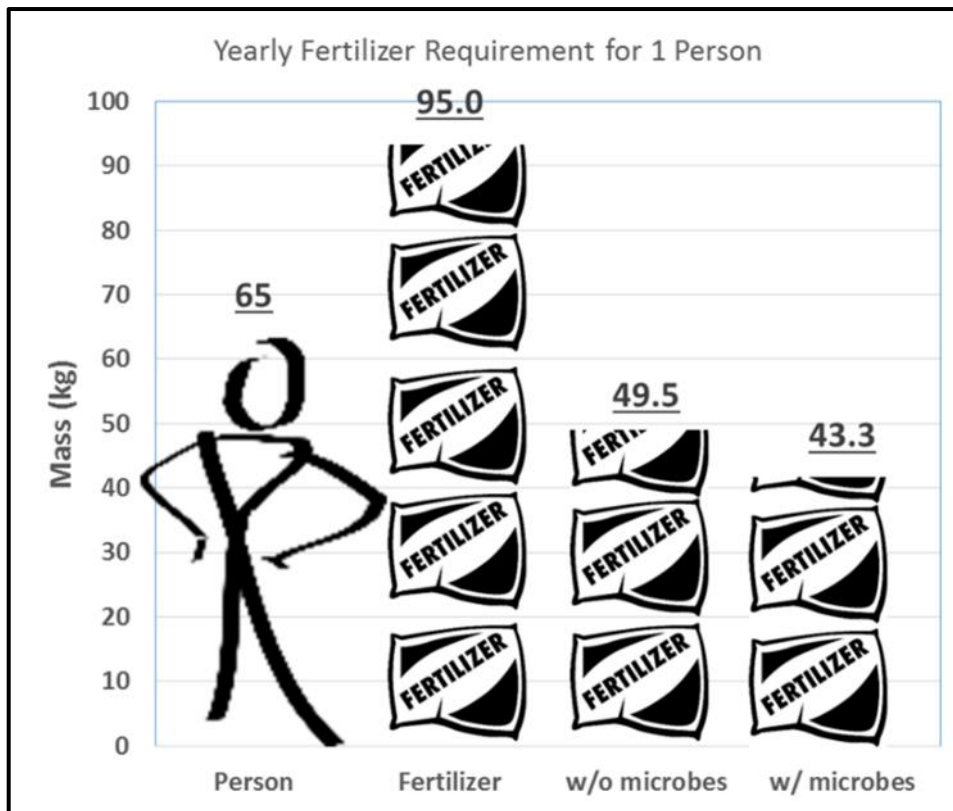
Enabled by Genetics, Information Technology, and Artificial Intelligence



Developing Biological Solutions to Ensure Sustainable Food Supply on Earth and in Space.



Food Security and Sustainability



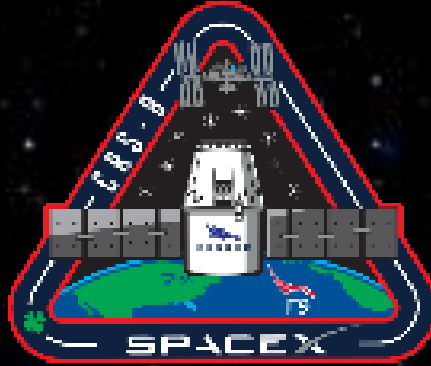
Resource Sustainability



Health and Nutrition



SyNRGE Case Study: Microbes in Space



Lettuce cv. Monte Carlo



Control



Hollis 2B



MM 41x71



Development and Testing





Case Study: Biological Processing Martian Regolith



University of North Dakota Inflatable Lunar/Mars Habitat (UND ILMH) Grand Fork, ND





Biological processing of regolith allow crops to grow in Martian soil!



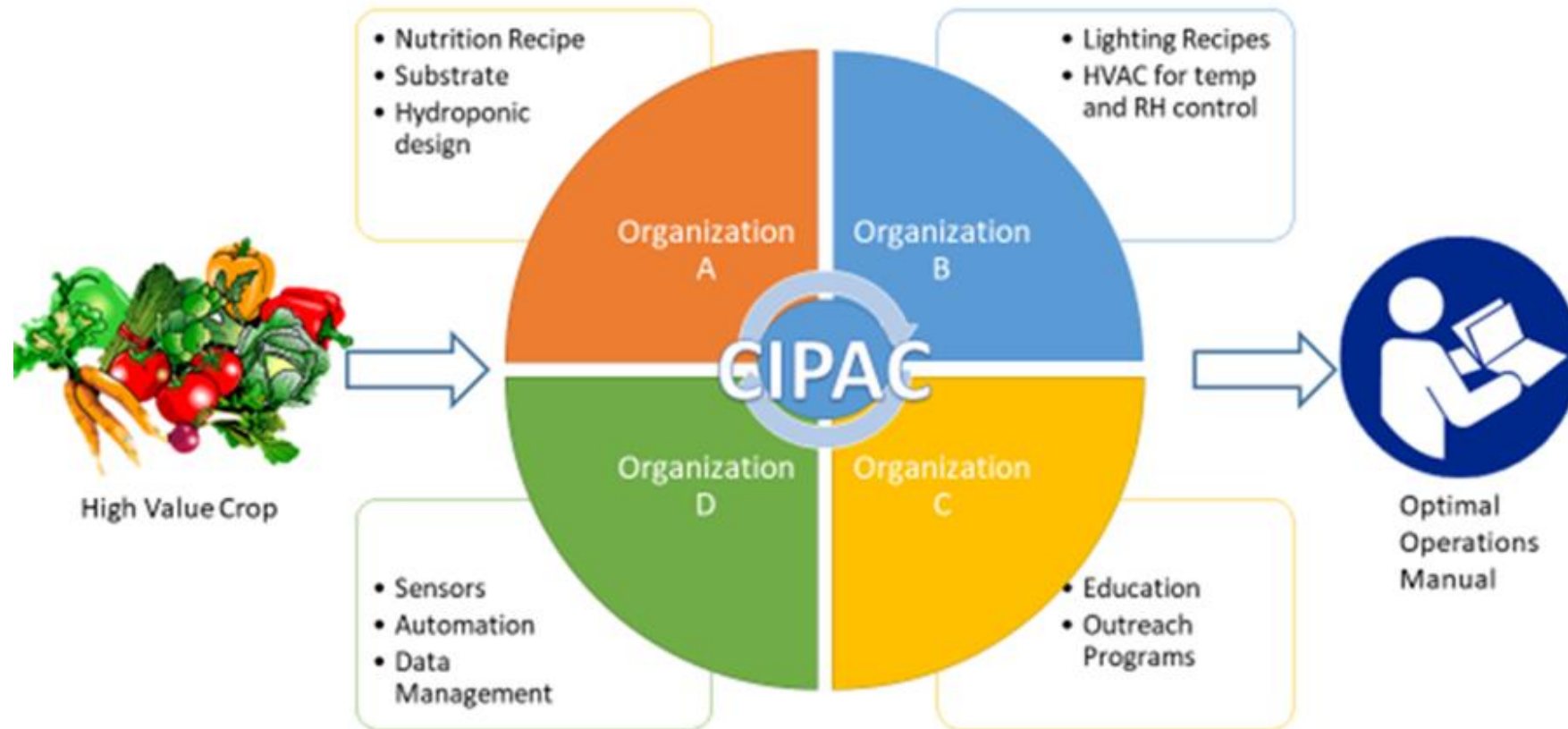
**Martian Regolith
No Treatment
Plants Die!**

**Martian Regolith
Biological Treatment
Plants Grow!**

**Potting Mix
Fertilizer
Plants Thrive**



CIPAC: Collaboration and Cooperation



- Center for Investigation and Production in Controlled Environment (CIPAC, Centro de Investigación y Producción en Ambiente Controlado) will be the Center of Excellence for Controlled Environment and Indoor Vertical Farming for Latin America.



NASA: VEGGIE on International Space Station



Astronaut Serena Auñón-Chancellor





ESA: EDEN ISS- Plant Cultivation Technologies for Space



Horizon 2020
European Union funding
for Research & Innovation





Grand Farm: Empowering Community Food Security

HOUSTON CHRONICLE

SUNDAY, JANUARY 2, 2022 • HOUSTONCHRONICLE.COM • VOL. 111, NO. 8 • \$4.00

SUSTAINABILITY

Food independence soon may grow from NASA tech



Eden Grow Systems CEO Bart Womack tends a plant he is growing with an aeroponics system in Houston.

Houston company developing system for any environment

By Andrea Leinfelder
PHOTO BY WALTER

As disrupted global supply chains have made clear, reliable food sources are more important than ever. A trendy grow system powered by wind and sun that pulls steam out of the air and recycles that steam waste and that of humans and fish.

A Houston company is selling precursors while it develops the full-blown system. "The idea was to make a system that you could literally drop on Mars, drop in the desert or drop in Antarctica and it would be able to generate its own resources," said Bart Womack, CEO of Eden Grow Systems. "It's a life-support system. You can even look everyone inside of it, and it produces enough oxygen for them to breathe."

It would allow a family of four to survive should a freeze or hurricane cause disruption.

The company is drawing on NASA's food-growing technology and adapting it for extreme areas of Earth — as well as

"Drop it in any environment ... and within four to six weeks it's producing enough food for a family, or for four people, to live off indefinitely."

Bart Womack, CEO of Eden Grow Systems

backyards and community organizations. Eden Grow Systems recently landed a Department of Defense contract to help the Air Force develop farming systems for its bases and has been selling aeroponics towers, including a recent sale to a church in Washington state.

Eden Grow Systems was incorporated in 2017, but the idea began in 2014 when Womack was researching investment trends for a family office (a private financial advisory firm for very wealthy individuals). He kept coming

across articles explaining how the global food supply chain was just one hiccup away from a massive cascading disruption.

"I said to the family office, 'You need to get into farming.' And that's when I realized I need to get into farming," Womack said. "I couldn't see COVID happening, but I knew by the very nature of the way things were being set up, I knew there was only an amount of time where 'X' would happen."

Eden Grow Systems has raised \$1.2 million from angel investors, family offices and venture capital firms. This month, it will open a 42,000-square-foot manufacturing facility in Houston where it will build its products and use its systems to grow food that can be sold at local farmers' markets.

Thus far, the 8-person company has sold roughly 35 of its aeroponics towers, a precursor to the systems that create their own power and water those systems will be available as products within the next two years. Each tower costs between \$2,000

Eden continues on A7

In 2021, Texas took sharp turn to the right

By Jeremy Wallace
ARTIST BY KEVIN

The upswing of Texas Democrats over the last few years spurred a bipartisan reaction in 2021 that resulted in some of the most extreme state GOP legislation in decades. Abortions were essentially banned.

Gun rights greatly expanded, even over the objections of many in law enforcement. And the state enacted new restrictions on how teachers can talk about race in classrooms.

If all come to Democrats continue to become more competitive — solidifying their hold on the biggest cities in Texas and coming closer to winning Texas in a presidential election than any time since the 1970s.

But when Democrats made an all-out push to win the Texas House of Representatives in 2020 and fell short, some Republicans see it as a green light from voters to push for the party's top priorities.

"The door was opened by the voters," state Sen. Matt Schneider, R-Dallas, said.

Politics continues on A10

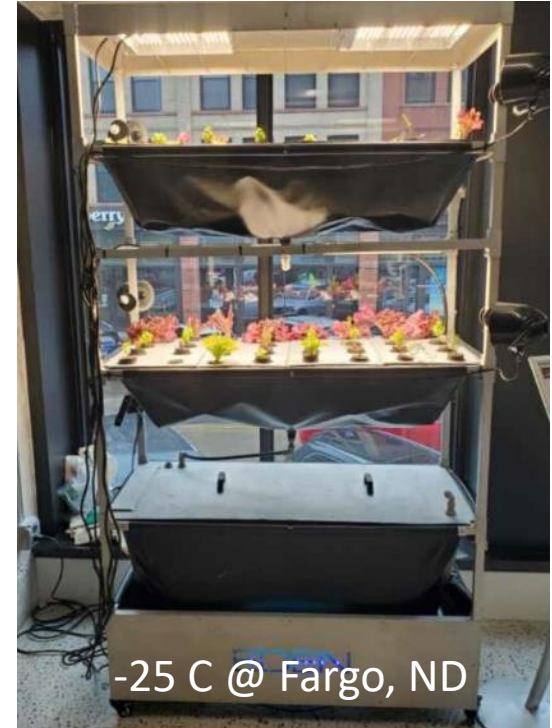
Omicron complicates return to work, class

By Andrea D.S. Burch,
Stephanie Saul,
Edgar Sandoval and
Mitch Smith
NEW YORK TIMES

In two short weeks, as the year closed out, the omicron variant drove commercial cases to record levels, upended air travel and left gaping staffing holes at police departments, firehouses and hospitals. And that was at a time many people were off for the holiday season, and no one is sure what comes next.

Most of the nation's largest school districts have decided to forge ahead and remain open, at least for the time being, citing the toll that remote learning has taken on students' mental health and academic success. And the rising number of cases has not yet been followed by a proportionate increase in hospitalizations — and

Omicron continues on A11

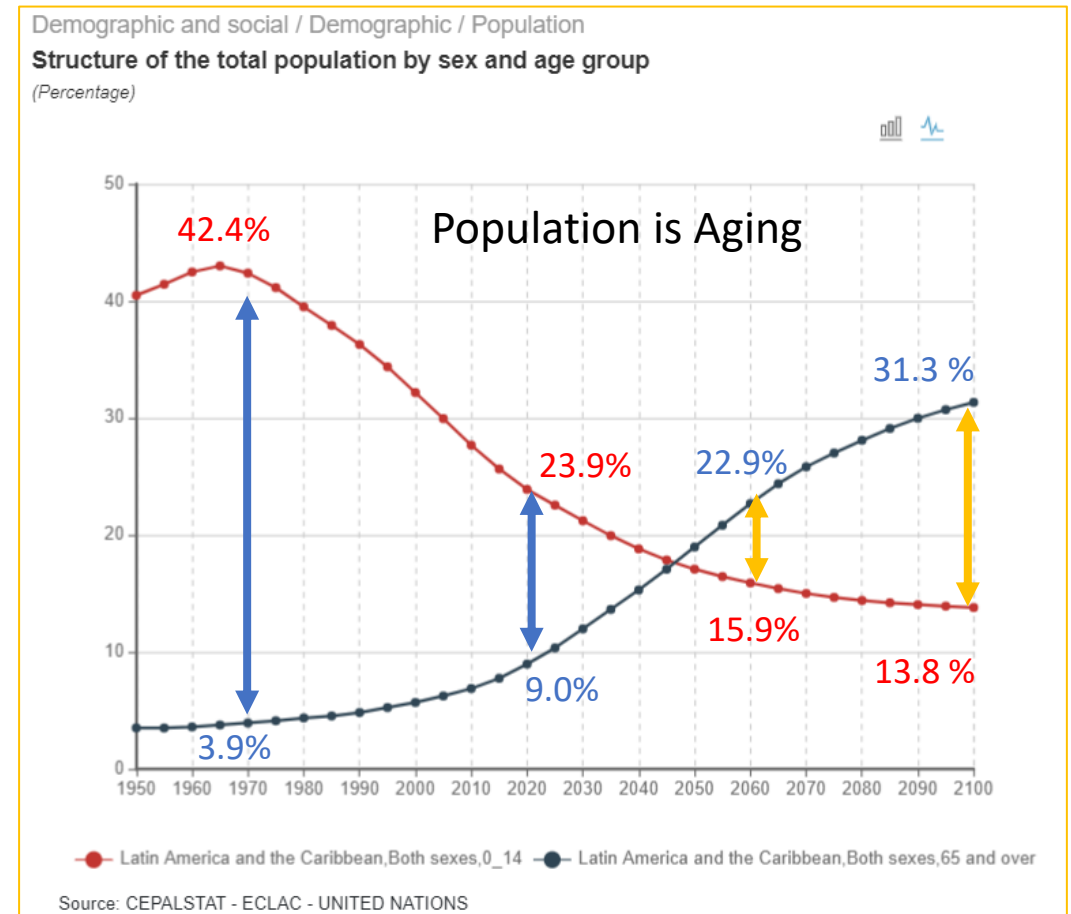
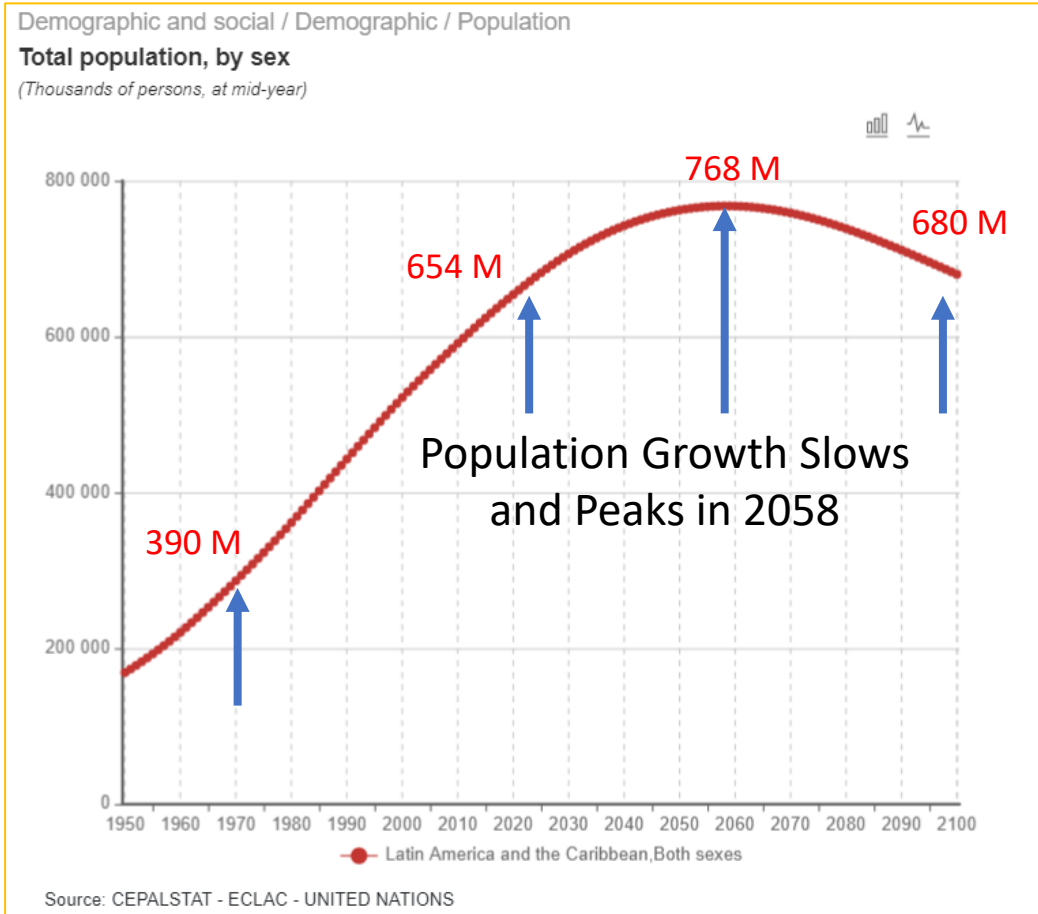


-25 C @ Fargo, ND





Why am I here??: Two Graphs





CIPAC: Enabling Food Security for Latin America

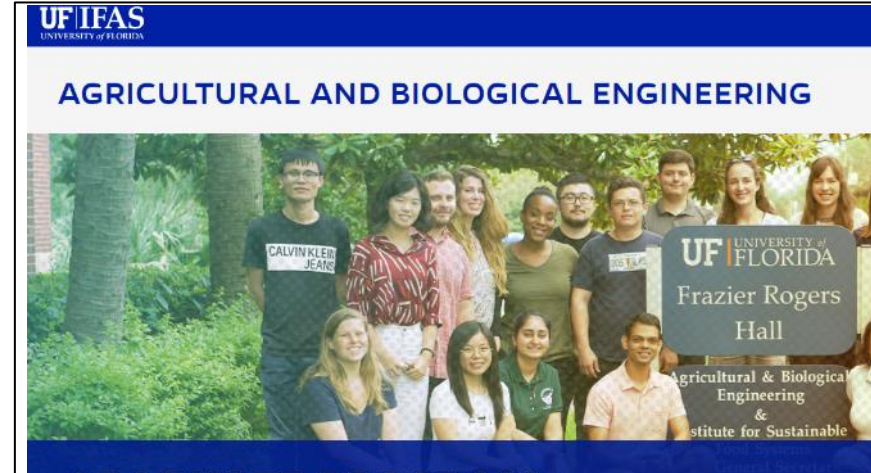




SyNRGE: Associate with Excellence



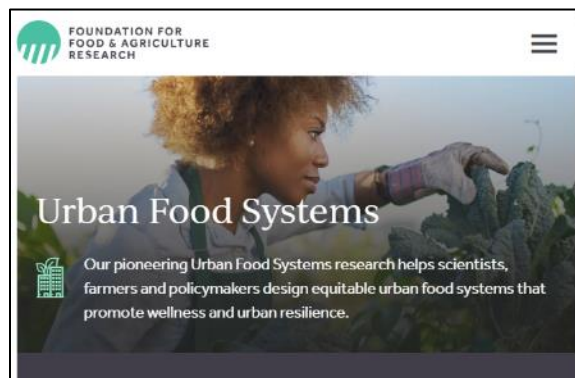
Founder and Interim Director



Advisory Board



Honoree



Advisory Board



Advisory Board



Plants in Space Education
Hydroponic System for Classroom Use

SyNRGE, LLC, Exploration Park, FL
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São José dos Campos, Brazil

Feed The World



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