Local Bioprospecting for Oleaginous Algae

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National Algae Association Mid-South Chapter

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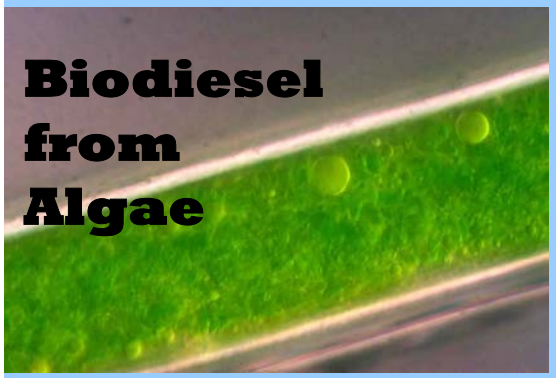
Dr. Ann C. Wilkie
Bioenergy & Sustainable Technology

Research:
Anaerobic digestion technology for renewable energy production from biomass and organic residues, including livestock waste, bioethanol and biodiesel by-products, and energy crops.



Expertise:
Biogas technology and waste-to-bioenergy systems, with US and international patents awarded.

The Dimensions of Sustainability

Human Health

Energy

Natural Resources

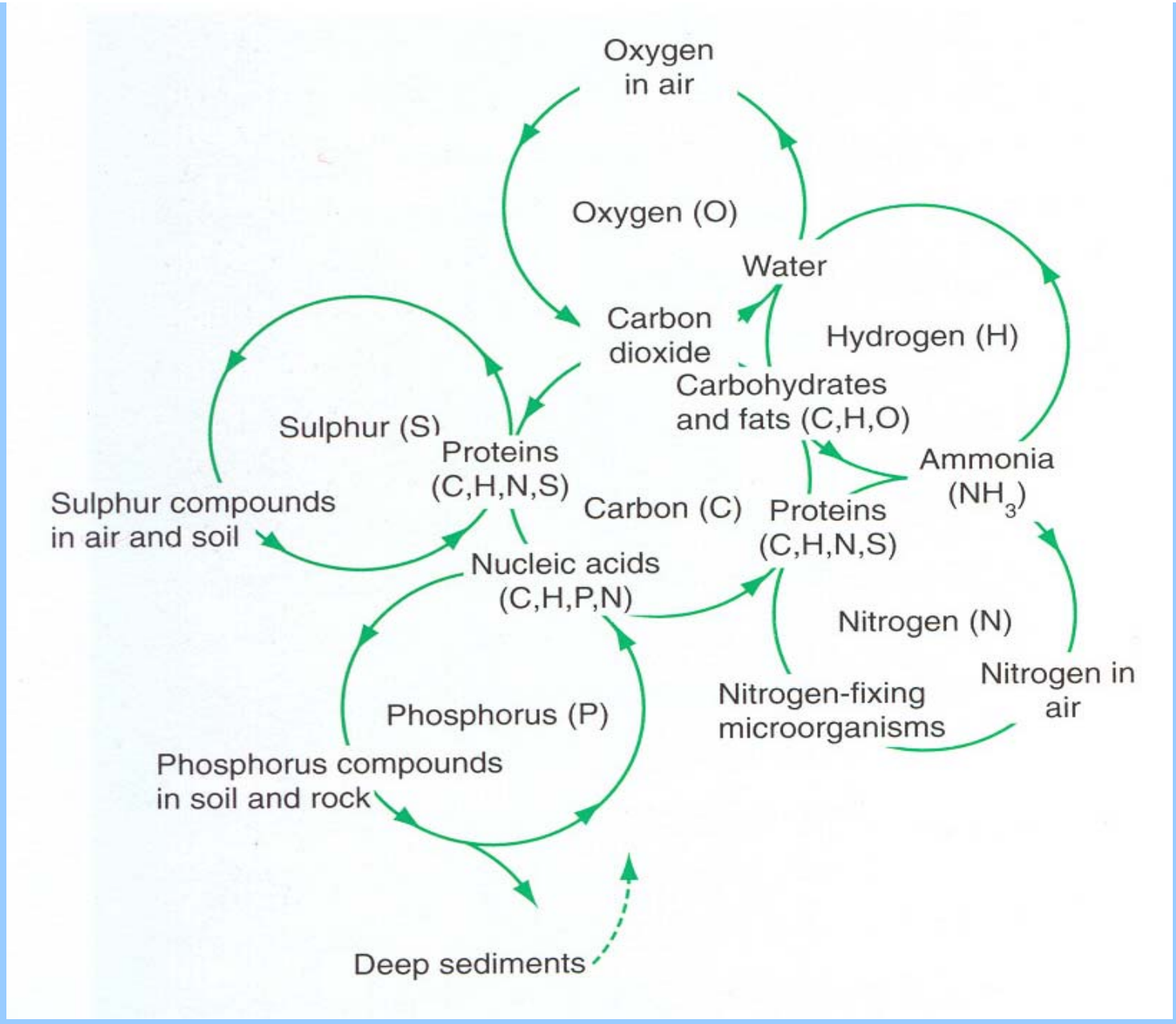
Water

Greenhouse Gases

Biodiversity

Community

Waste



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BioEnergy from Algae

Sustainable energy for future generations

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Algae as an Energy Crop

- **Land Use** – Marginal lands, Vertical potential, small footprint

  +

- **Water Use** – Municipal/Agricultural wastewaters, Saline water, Conserves freshwater use

  +

- **Nutrient Resource** – Utilization of abundant, nutrient-rich wastes replaces expensive synthetic nutrient inputs

  +

- **Carbon Capture** – Greenhouse gas mitigation, potential sequestration

  =

- **Sustainable Energy Production**

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Diverse Energy Options

- **Lipids** – Petroleum alternatives
- **Carbohydrates/Fibers** – Biogas or Alcohol production, Animal feed
- **Proteins –** Animal feed or Nitrogenous fertilizers
- **Residual/Total Biomass** – co-fired in existing coal boilers, anaerobically digested, or gasified for use in combined-cycle systems

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Abundant Growth

- **Aquatic Advantage**
  - **Efficient exchange**
  - **No complex support structures**
- **Cellular Multiplicity**
  - **Daily doublings**
- **Biomass Production Potential**
  - **Daily Biomass Harvesting**

Strain	Genus	Family	Growth Rate (doublings•day^{-1})
OSCIL2	*Oscillatoria*	Cyanophyceae	**4.23**
OSCIL3	*Oscillatoria*	Cyanophyceae	**3.50**
AMPHO46	*Amphora*	Bacillariophyceae	**2.81**
NANNO13	*Nannochloris*	Chlorophyceae	**2.78**
CHLOR23	*Chlorella*	Chlorophyceae	**2.66**
SYNEC3	*Synechococcus*	Cyanophyceae	**2.51**

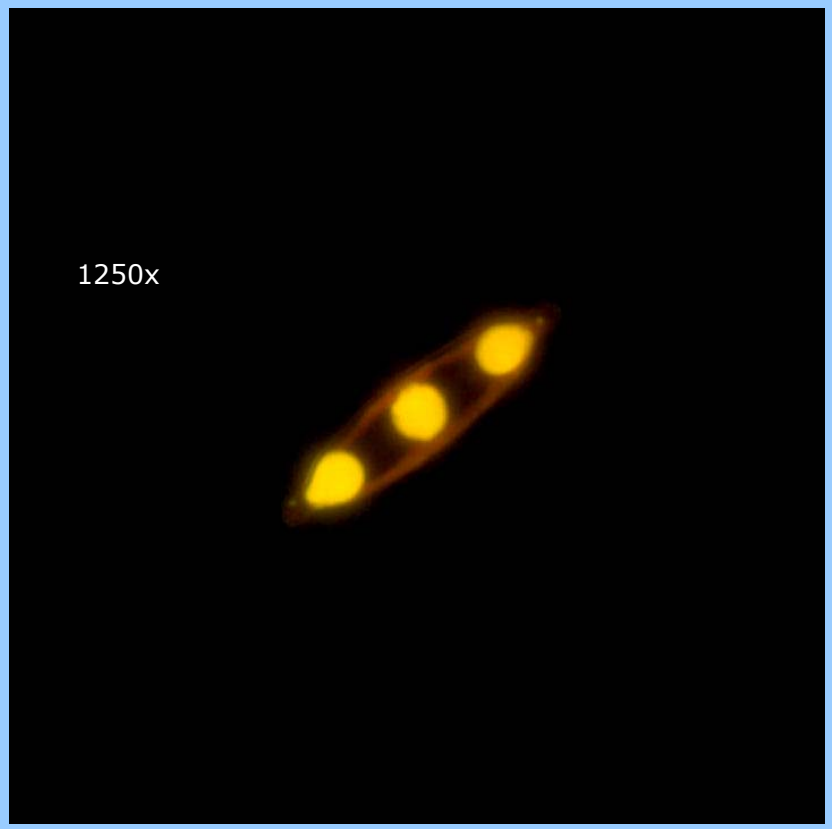
Adapted from: Sheehan J, Dunahay T, Benemann J, Roessler P (1998). A Look Back at the U.S. Department of Energy's Aquatic Species Program—Biodiesel from Algae. U.S. Department of Energy's Office of Fuels Development Prepared by: the National Renewable Energy Laboratory

Bioprospecting for Indigenous species

- Establishing a biological base
  - Species/Strain Discovery
- Culture stability
  - Robust organisms adapted to local climatic conditions
- Lipid productivity
  - Metabolic machinery to produce and store lipids

Biochemical Investigation

- **Lipid Biosynthesis**
  - **Metabolic capacity**
- **Lipid Bio-amplification**
  - **Environmental stimuli**



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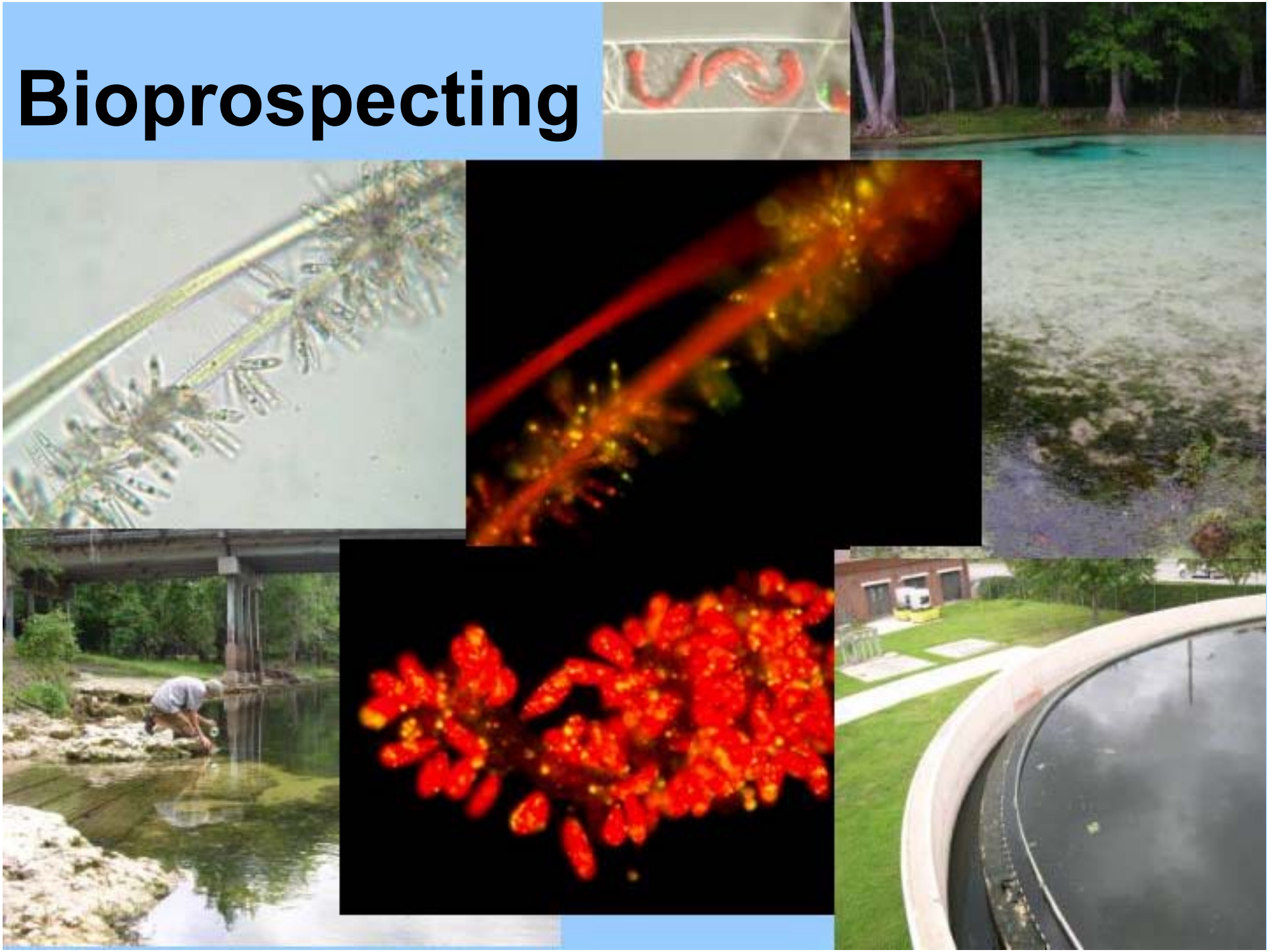
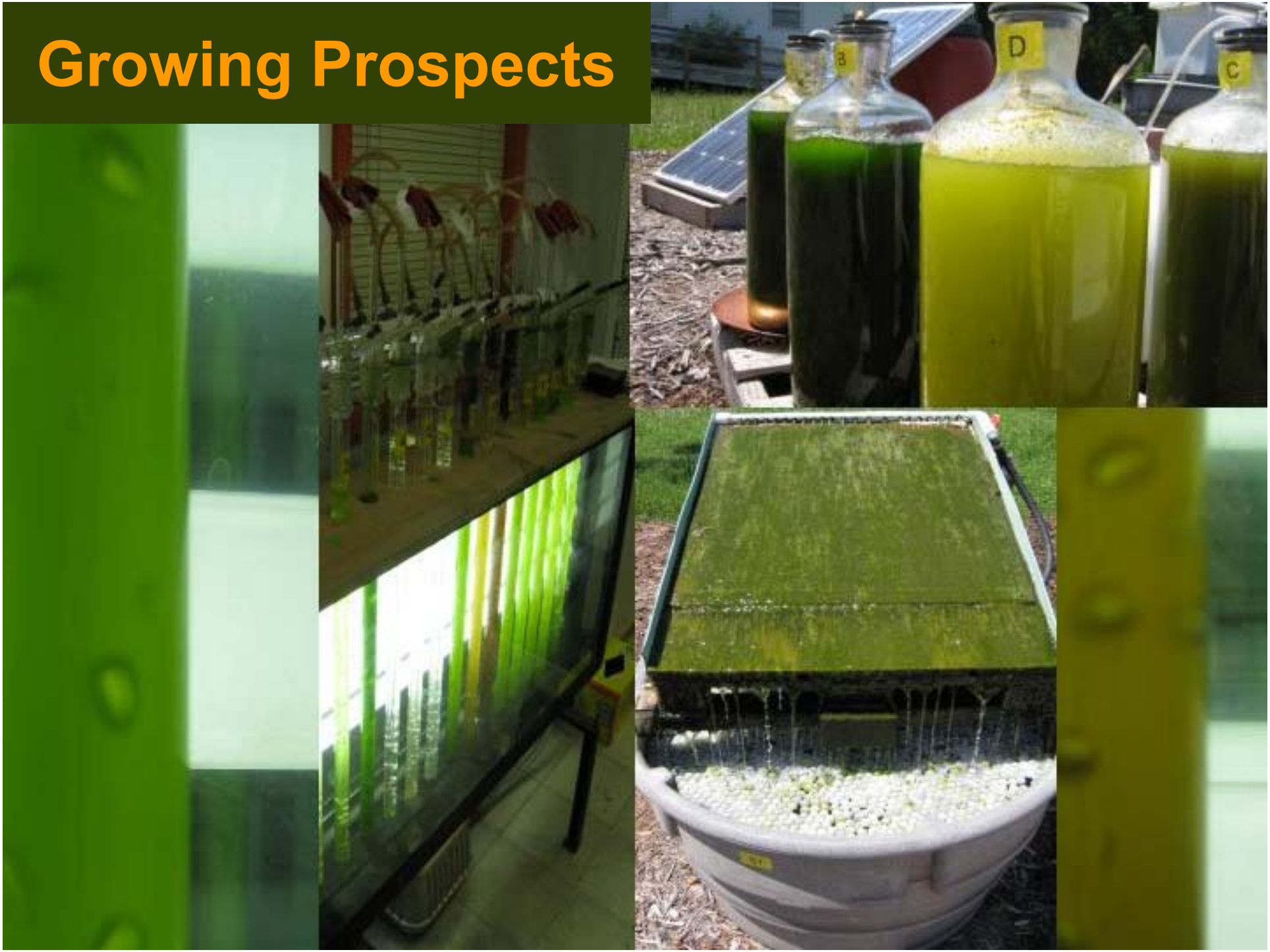
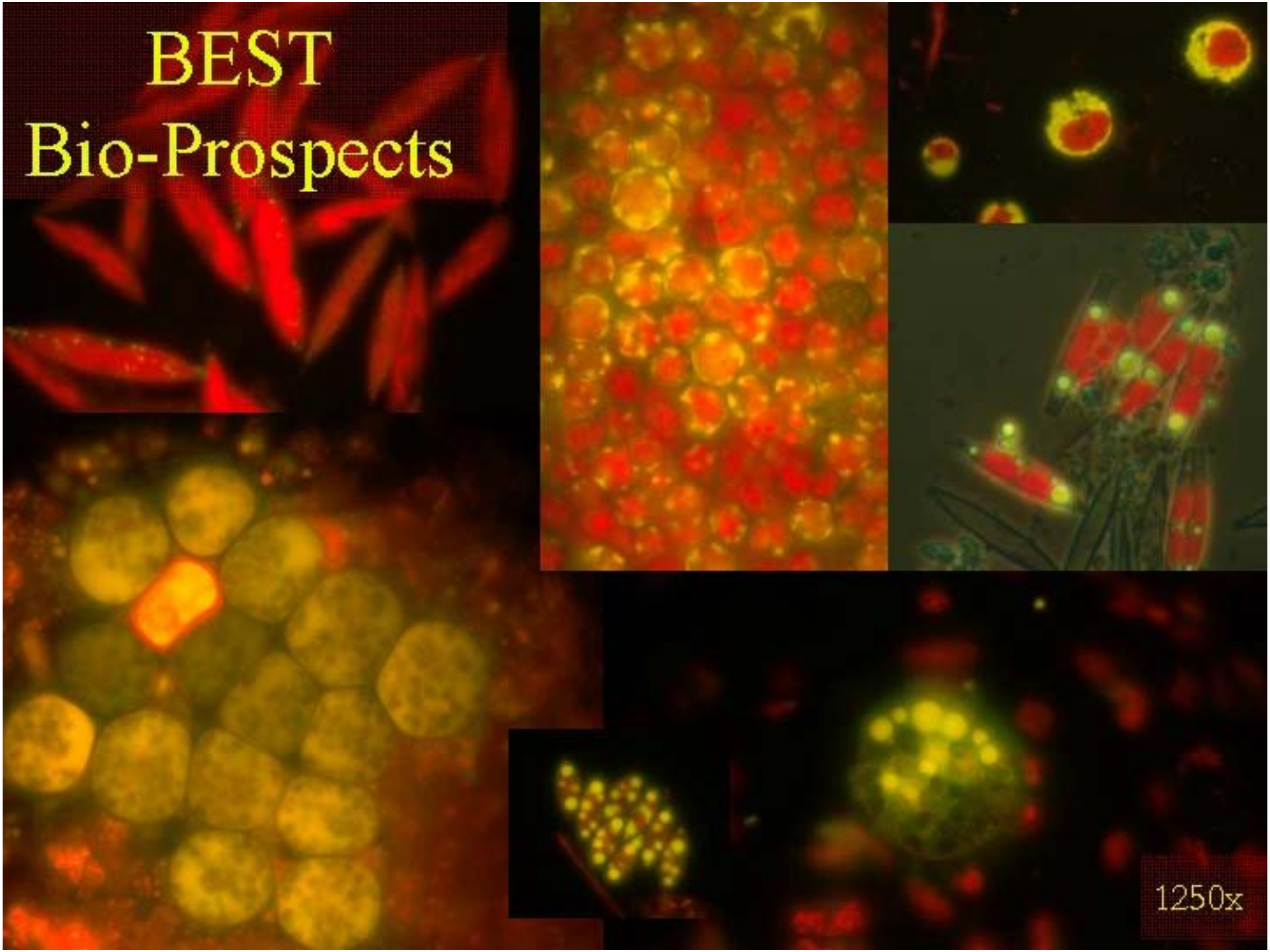
SWET Laboratory

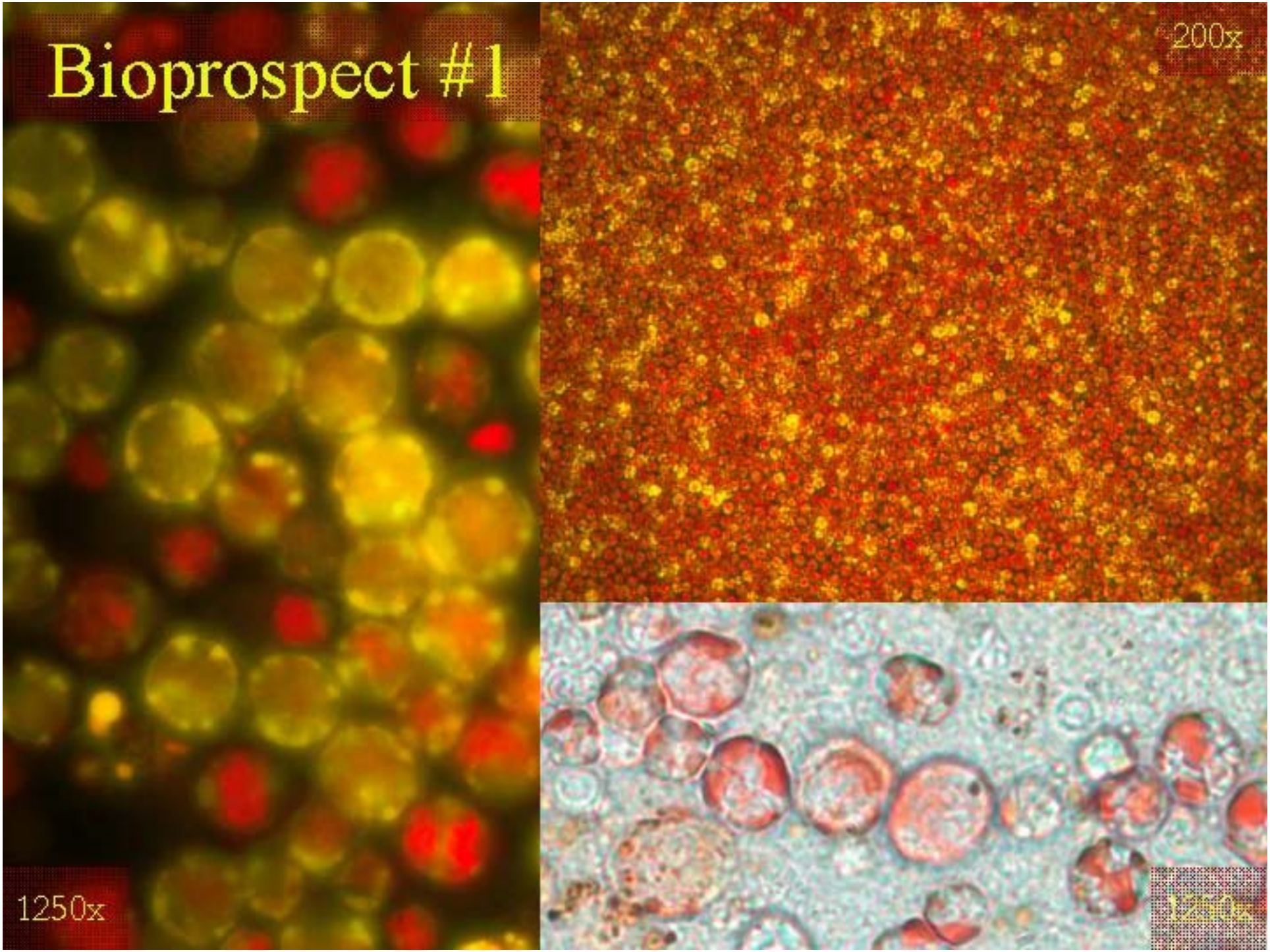
Bioprospecting

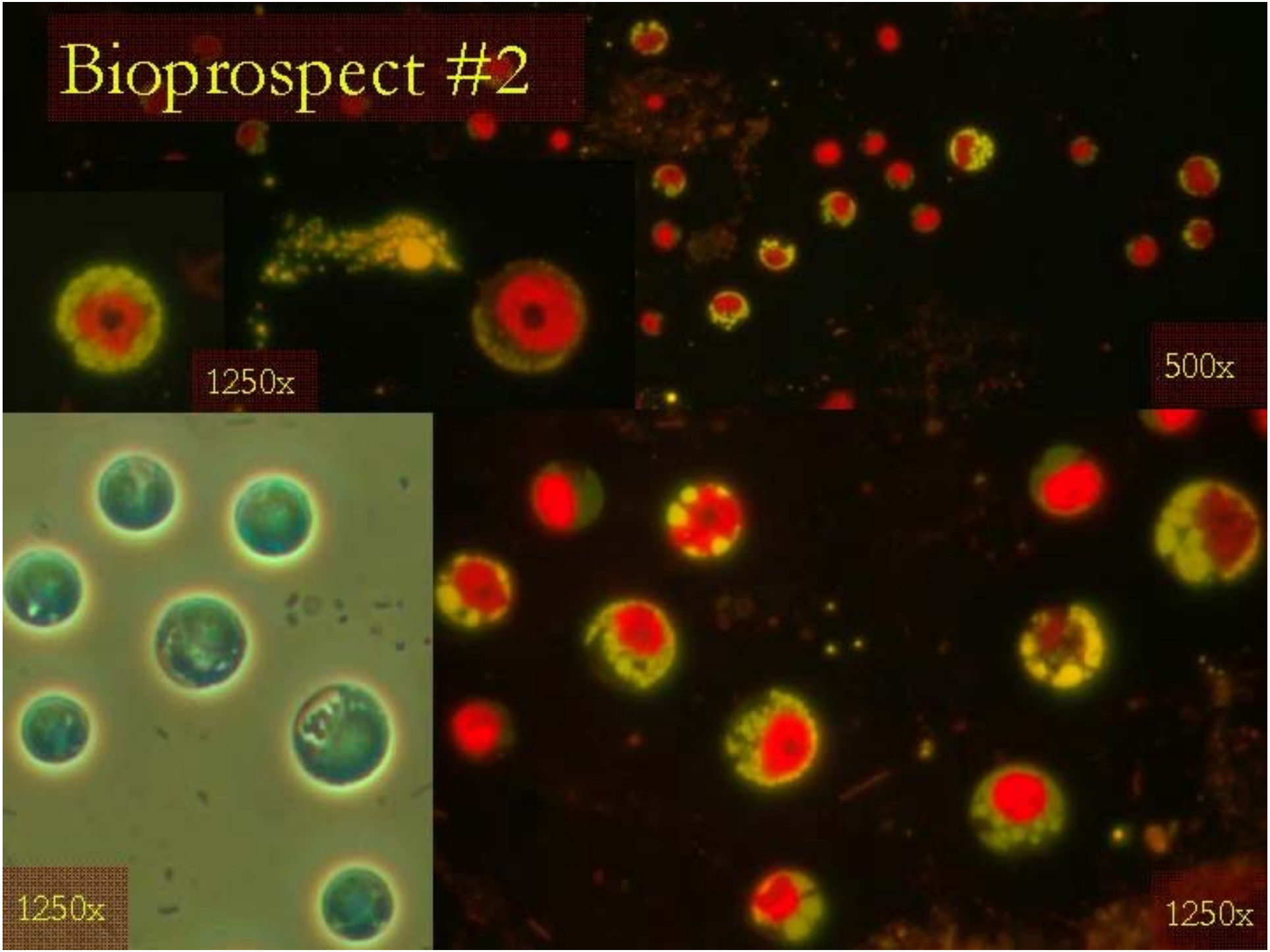


Growing Prospects



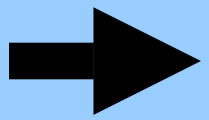

BEST
Bio-Prospects
1250x


Bioprospect #1
1250x
200x


Bioprospect #2
1250x
500x
1250x
1250x

Biochemical Investigations

An Example of Lipid Bio-Amplification in a collected *Chlorella* culture, when exposed to certain environmental conditions



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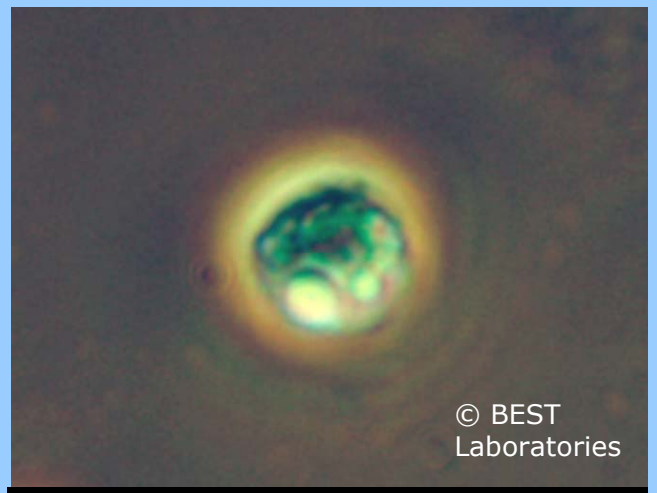
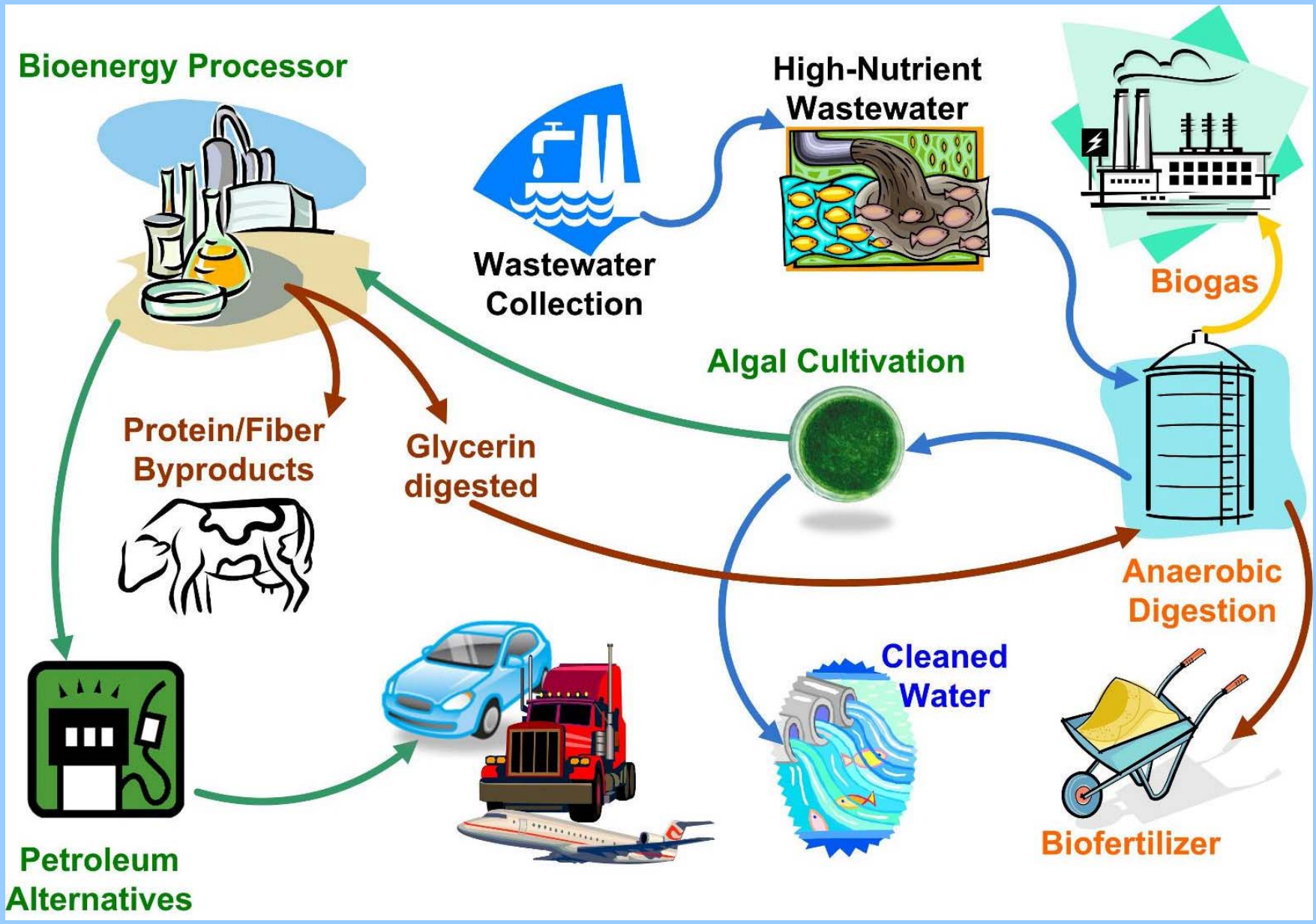
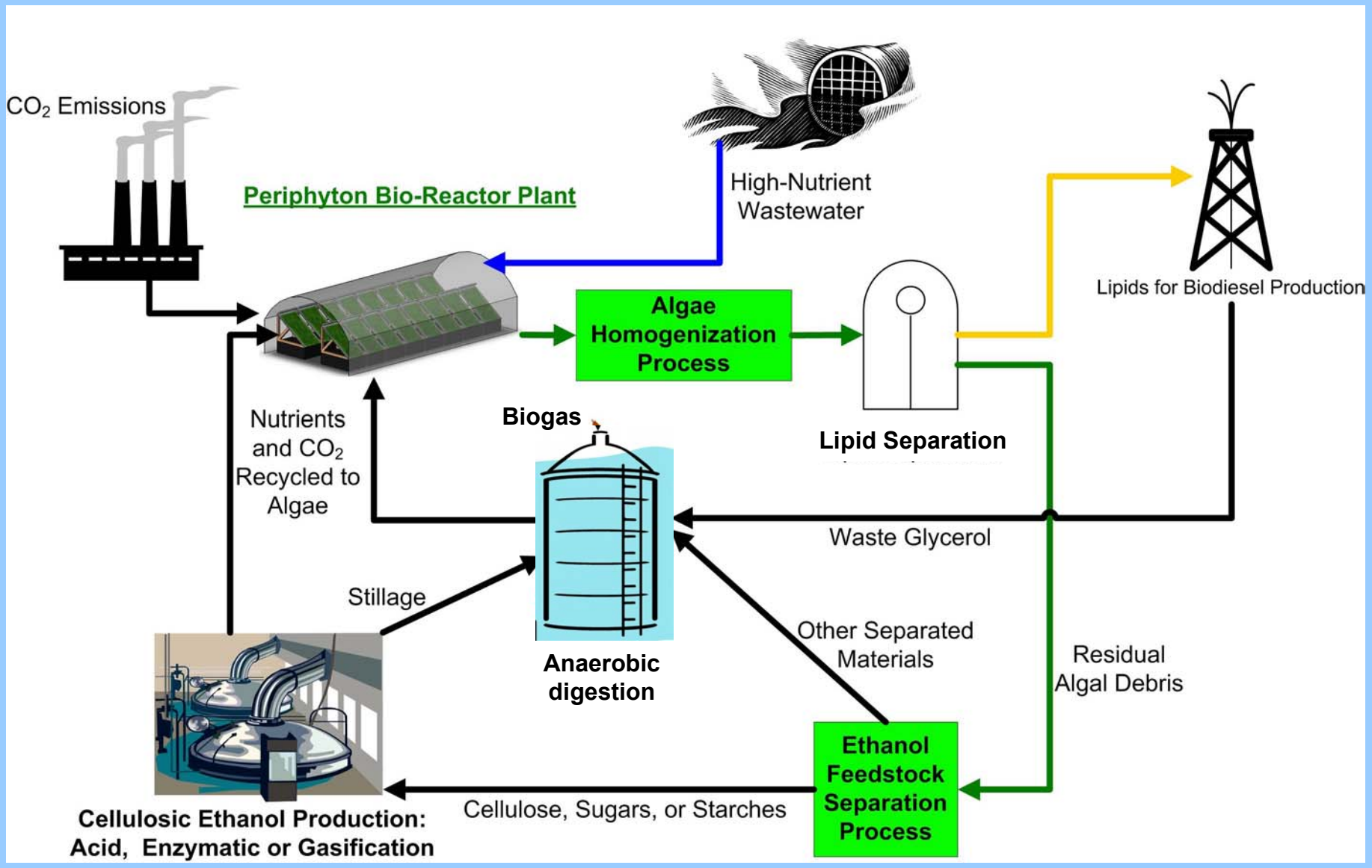


1250x

The Human Ecosystem



Biodiesel and Bioethanol from Algal Biomass



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