Team 7: Microalgae Photobioreactor Midterm II (Spring Presentation)

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Presentation Outline

- Background and Project Scope
- Microalgae Growth
- Airlift Photobioreactor Design and Construction
- Control Design
- Addition/Extraction Unit Design
- Budget and Flow Chart Schedule
- Conclusion and Questions

Background and Project Scope

Goal: Microalgae → Biofuel

The customer needs a way to transform an airlift photobioreactors' current "batch" growth systems into a "semi-continuous growth systems."

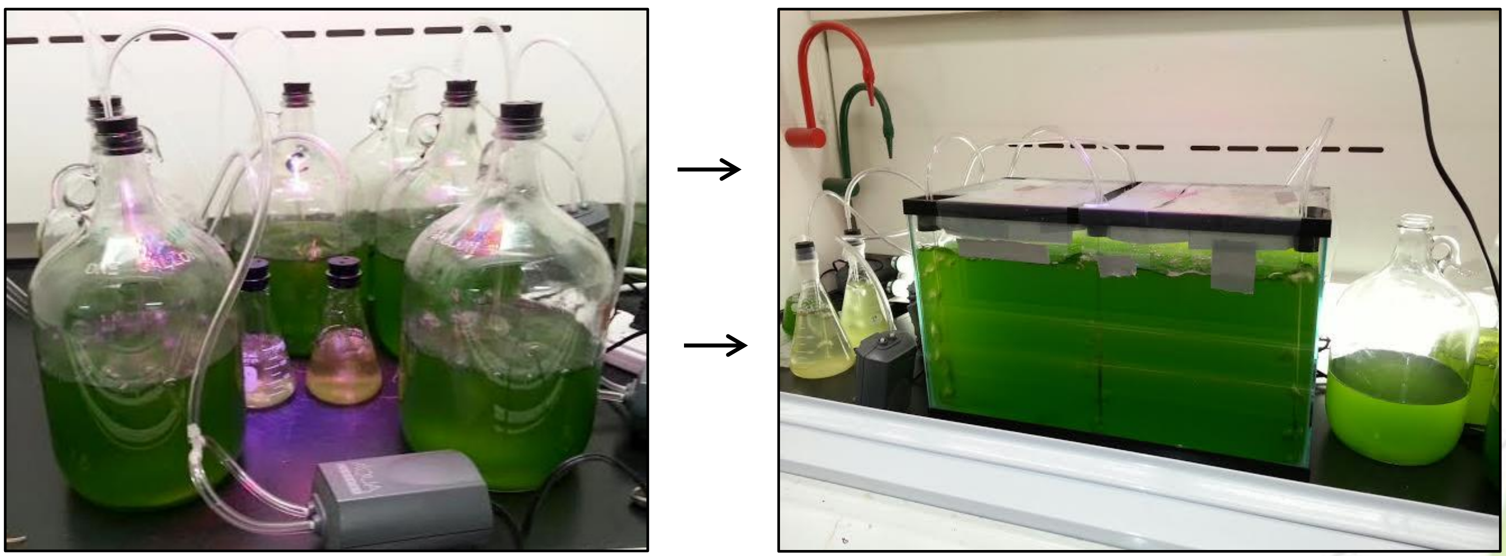
To accomplish this team 7 must:

- ✓ Find an effective and efficient way to grow microalgae
- ✓ Improve last semesters concentration and mass flow sensor
- ✓ Design an build a 35L Airlift Photobioreactor
- ✓ Design and develop fully automated addition/extraction units

Algae Growth

- Microalgae has been cultured this semester from 10L to 35L
  - Enough to fill the photobioreactor with some reserves leftover.
- Algae growth curves have been produced this semester to log the cell concentration
- A simple formula has been used to get the desired cell concentration (C) with known volumes (V)

$$C_1V_1 = C_2V_2 \qquad C_2 = \frac{C_1V_1}{V_2}$$



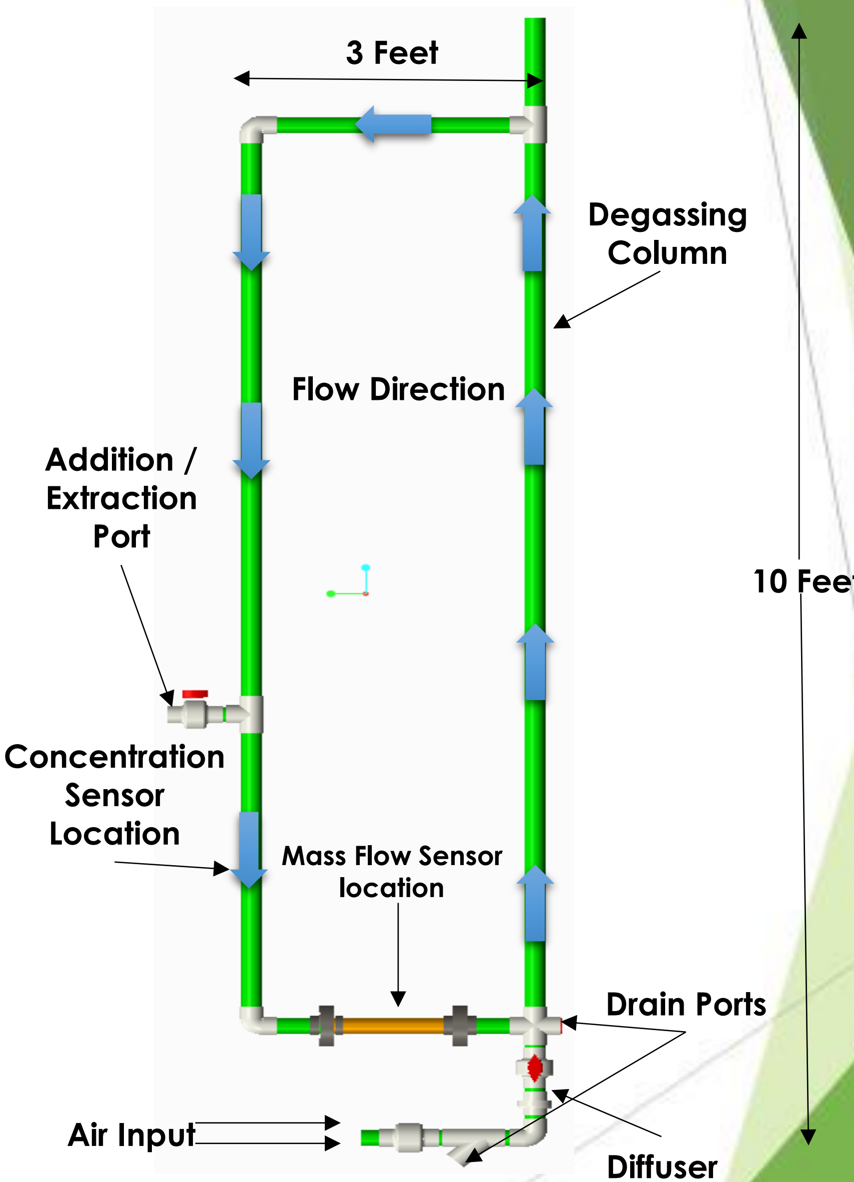
Microalgae before and after sub-culture

Airlift Photobioreactor

- What is an airlift photobioreactor?
  - A photobioreactor is container that grows living organisms using light.
  - An airlift operated photobioreactor circulates the water using compressed air input and requires no pump operation.

- Why are we building a new unit?
  - Successful operation from Brazil.
  - Less water hammering.
  - Allows us to perform testing on a smaller scale.

- What do current airlift photobioreactors look like?



Other Existing Photobioreactors

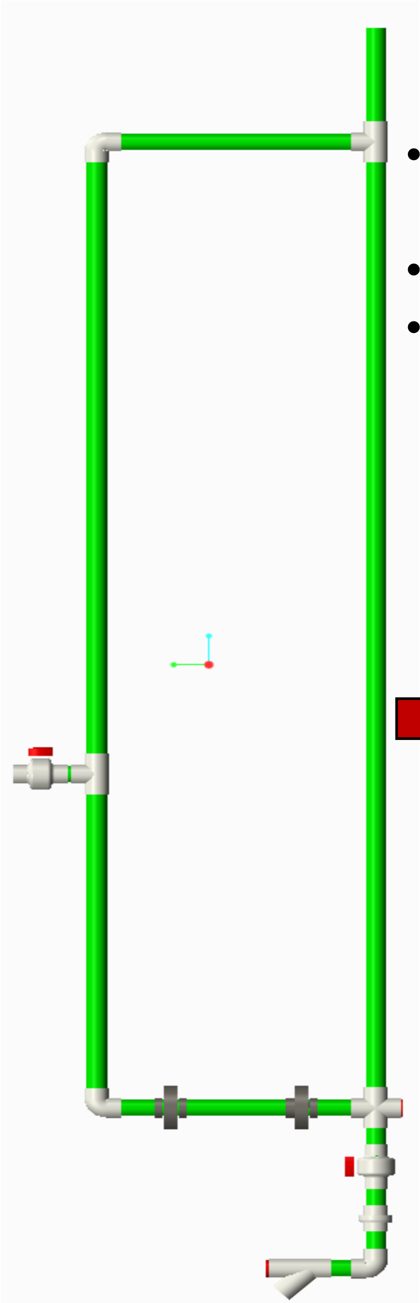
- Main Airlift photobioreactor, ~25L in Brazil

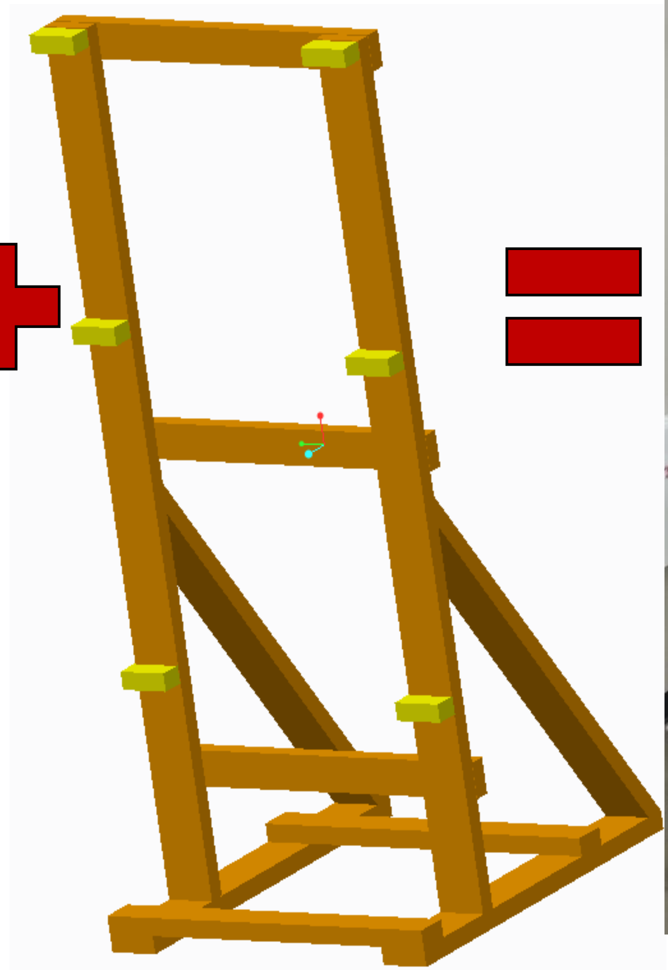
- Main Commercial 10,000L photobioreactor in Brazil (optional airlift operation)

Markus Dillman

Current Airlift Design

- What does our photobioreactor look like today?
- Current design is airlift operated.
- Has been built to maximize area exposed to sunlight.





Markus Dillman

Controls – Overview

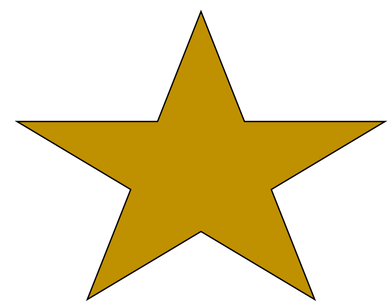
Batch operation: manual labor is reasonable

Semi-continuous operation: manual labor is not viable

Conclusion: Automated control systems needed

Concentration

Mass Flow



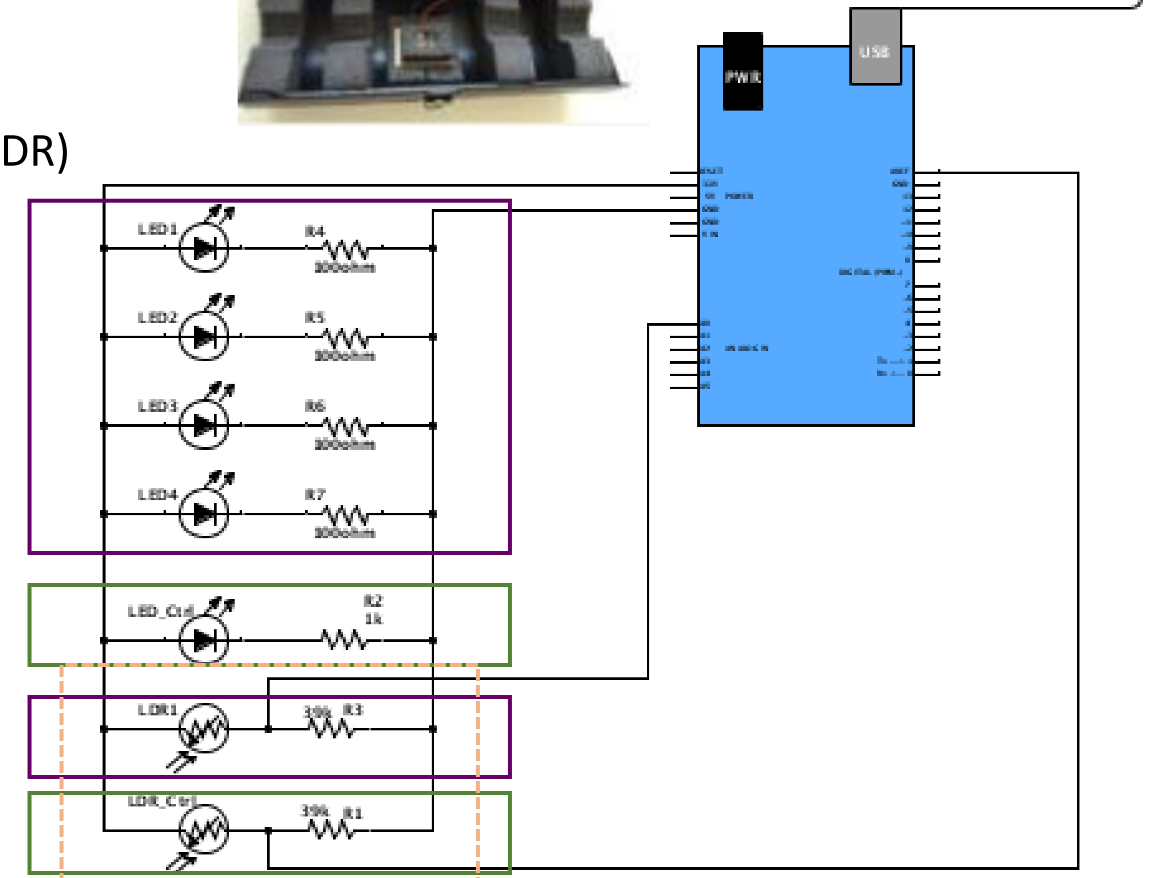
Addition/Extraction

Controls – Concentration Sensor

Current Design

Electrical Components:

- Light Emitting Diode (LED)
- Light Dependent Resistor (LDR)

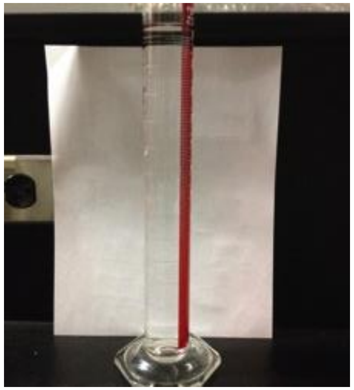


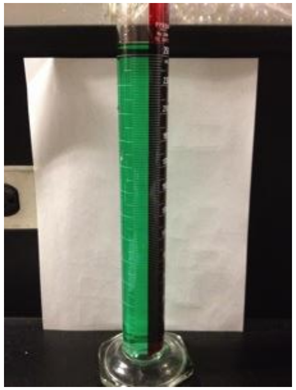
Main Sections:

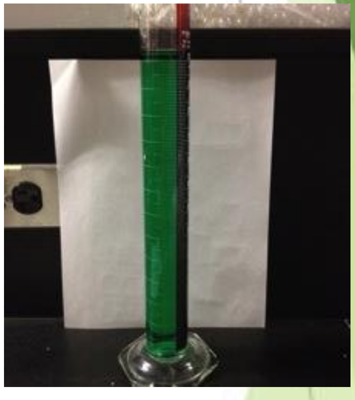
- Control
  - Full Light
- Test
  - Variable Light
- Wheatstone Bridge
  - Control & Test LDR's
  - Noise & Sensitivity

Controls – Concentration Sensor

Preliminary Tests – Food Dye





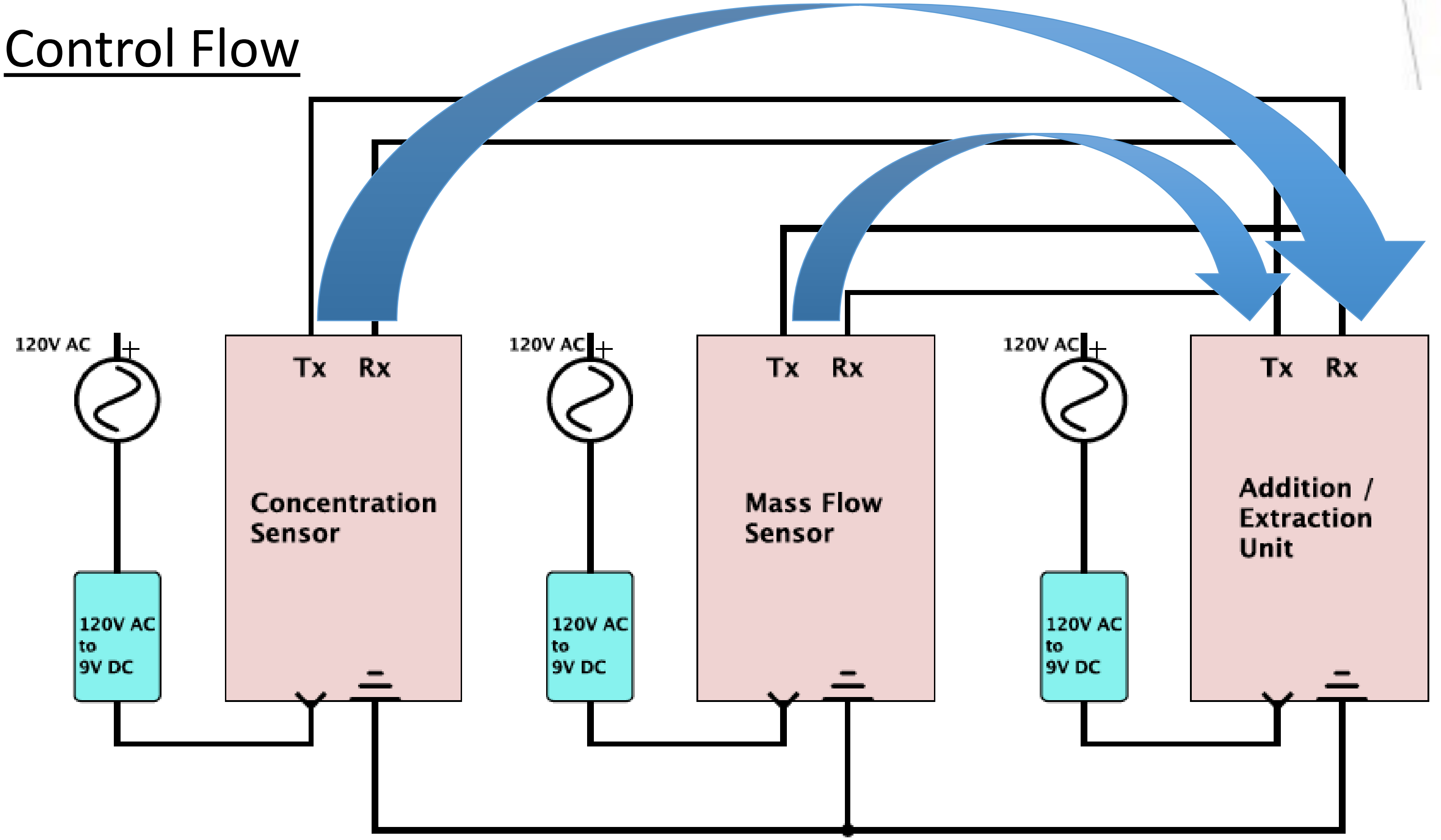


Number of Food Dye Drops	0	3	6
Light Sensor Reading (0-1023)	1023	950	915
	1023	600	200

Matthew Vedrin

Controls – Final Goal

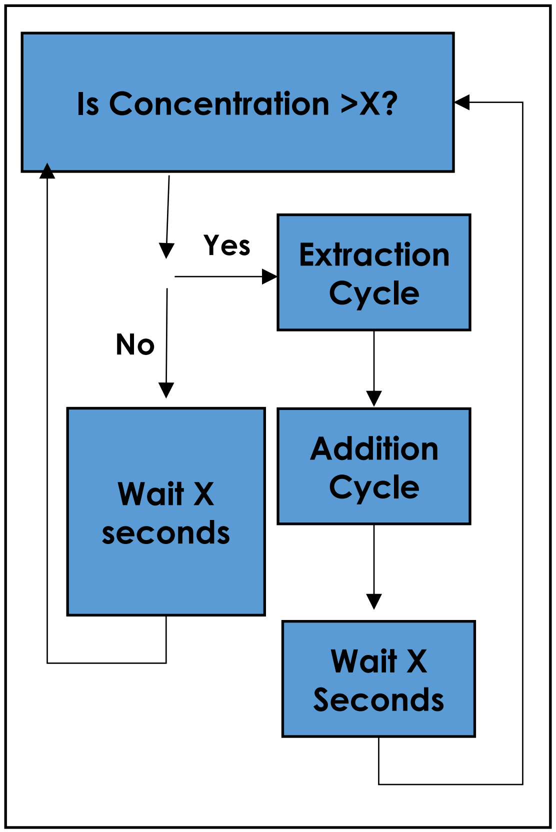
Control Flow

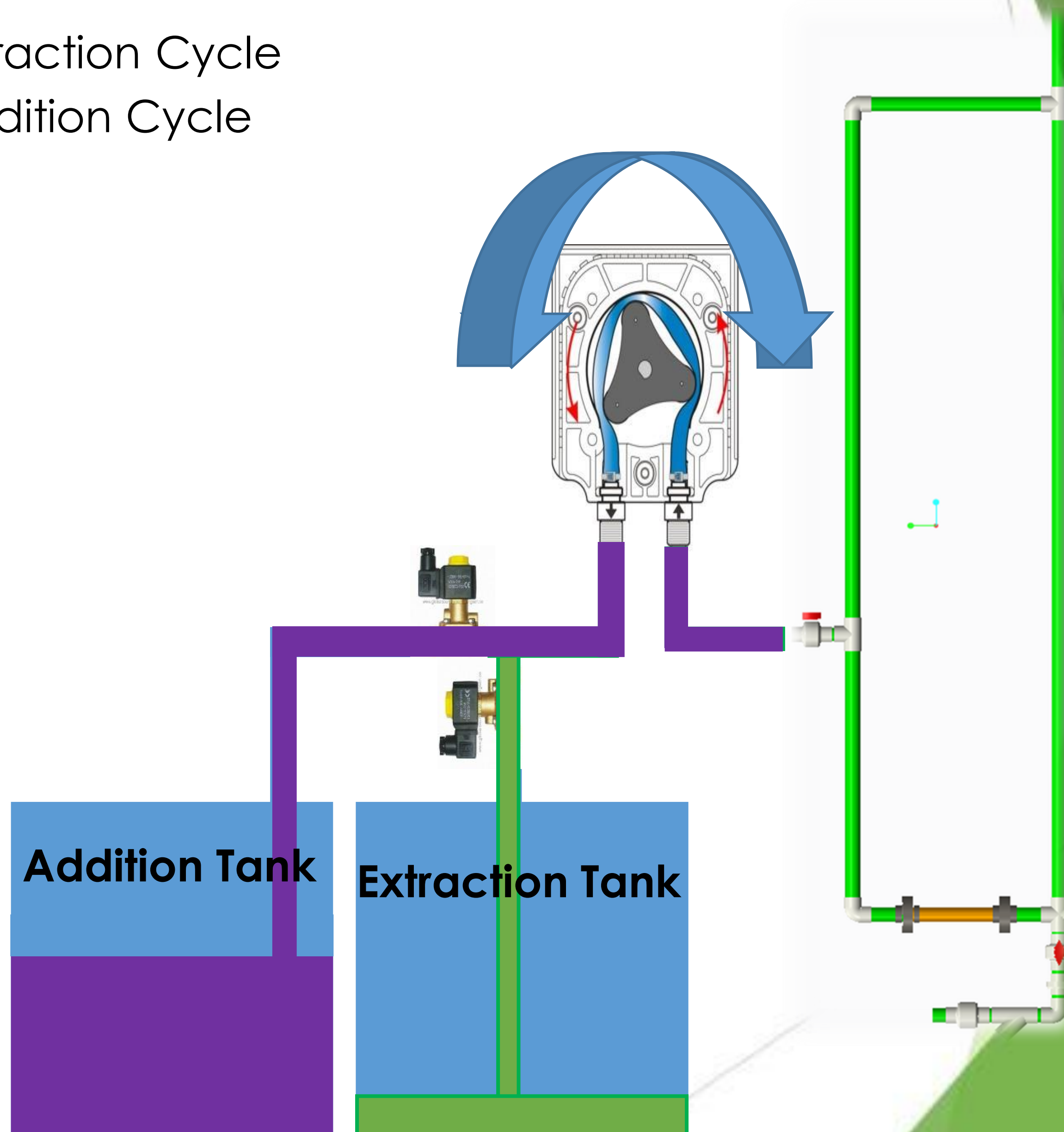


Addition and Extraction Design

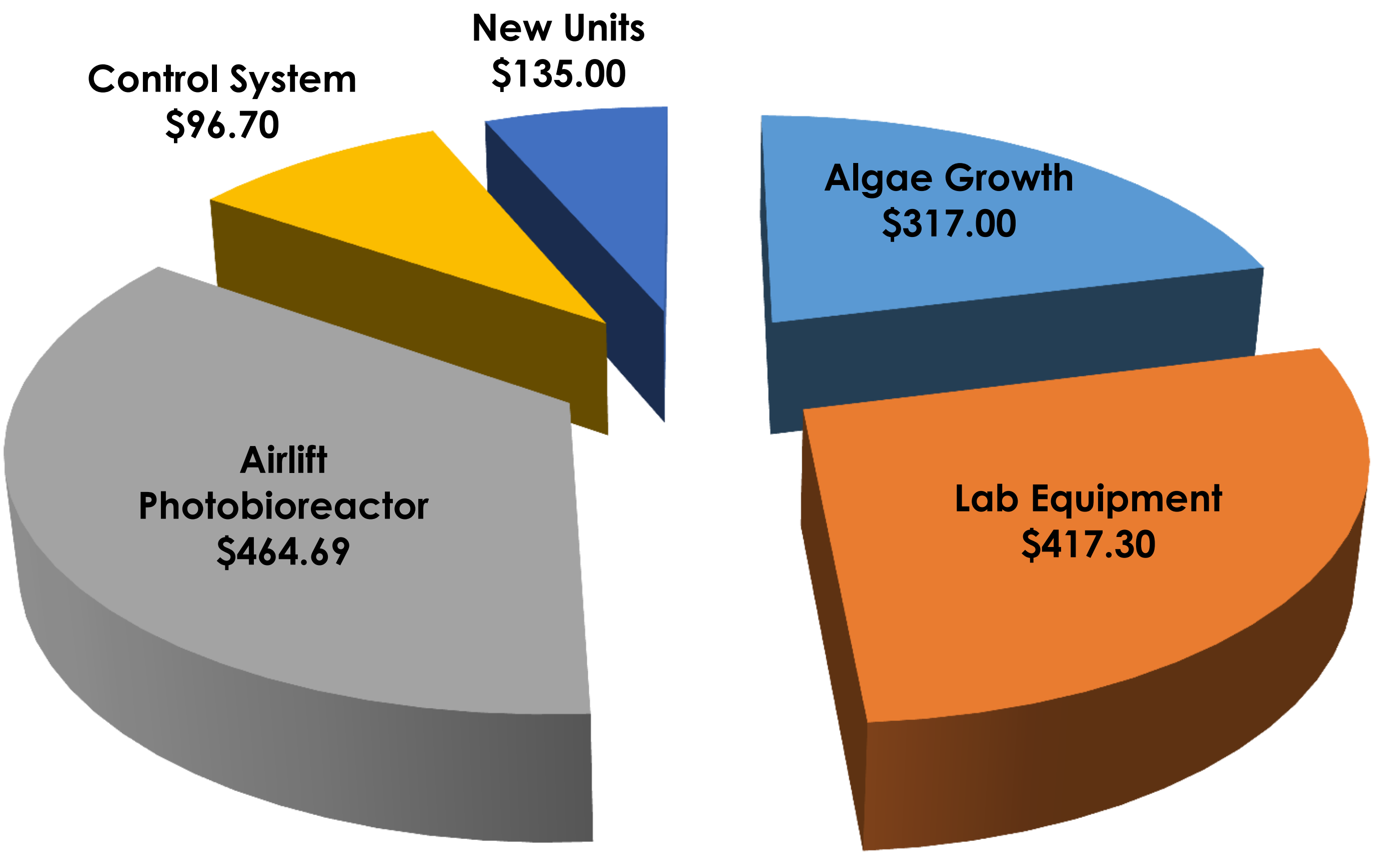
1- Extraction Cycle

2- Addition Cycle





Current Expenditures for Spring Semester



Flow Chart Schedule

WEEK 2 (Jan. 13-19)
- ✓ Create Pro-E CAD of new airlift photobioreactor
- ✓ Start counting cells to establish microalgae growth curve

WEEK 3 (Jan. 20-26)
- ✓ Complete bill of materials and procurement for airlift photobioreactor (not new units)
- ✓ Finalize CAD and order pipes and fittings for Airlift (not the new units)

WEEK 5 (Feb. 3-9)
- ✓ All Parts for airlift photobioreactor arrive at College of Engineering
- ✓ Perform Tests on Concentration Sensor
- ✓ Set up first meeting with chemical engineering students about counting algae

WEEK 6 (Feb. 10-16)
- ✓ Design I Presentation
- ✓ Assemble all parts and check water integrity of airlift (not including new sensors)
- ✓ Perform airlift flow test (not including new sensors)
- ✓ Create CAD with airlift and new addition/extraction units
- ✓ Order parts for addition and extraction units

WEEK 7 (Feb. 17-23)
- ✓ Start to assemble new addition and extraction units

Flow Chart Schedule Cont…

WEEK 9 (Mar. 3-7)

- ✓ Permanently attach Photobioreactor and start to assemble frame
- ✓ Culture microalgae to 35L

WEEK 11 (Mar. 17-21)

- ✓ Assemble photobioreactor with completed frame.
- ✓ Midterm presentation 2 (Spring)

Thank You

Any Questions?