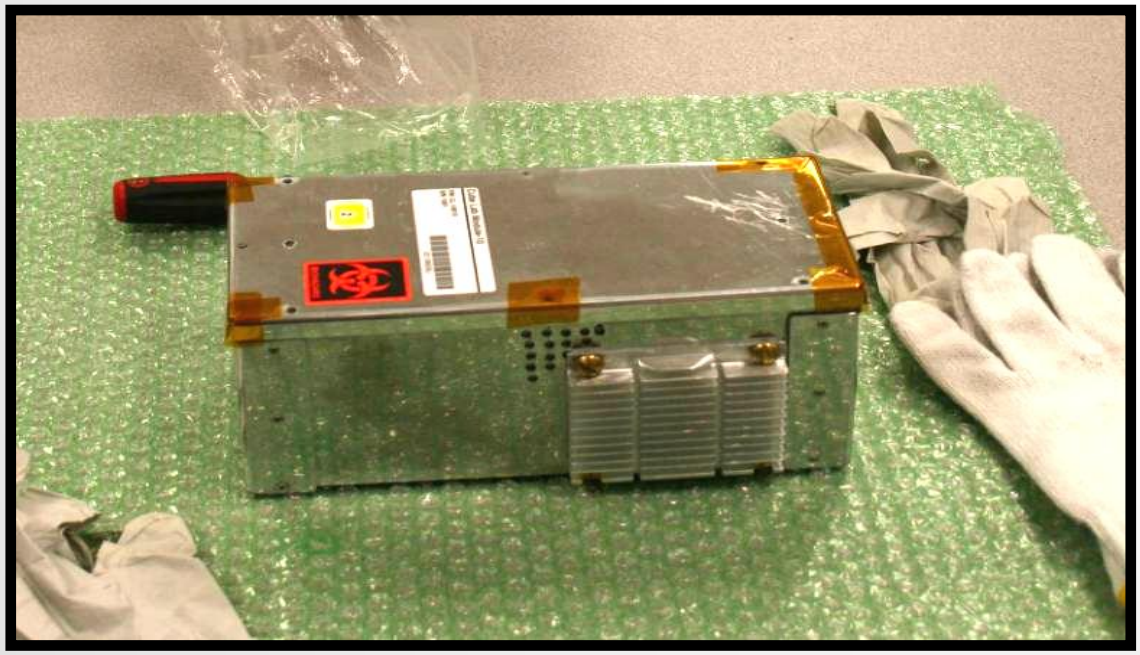
VALLEY CHRISTIAN SCHOOLS
Quest for Excellence
"Do it heartily as unto the Lord." Col. 3:23

"The Sky is No Longer the Limit"



A Presentation on our 2U CubeLab™ by Valley Christian High School Students

AMSE Institute

April 20, 2011

Student Presenters

Veronica Lane

• **12th Grade-Project Leader**
• Robotics Team Leader
• Cross Country & Track
• Pursuing Career in Engineering
• Accepted at MIT, CIT, Cal & Stanford

Ross Martinez

• **12th Grade-Payload Design**
• Cross Country & Track
• Accepted at University of Santa Clara

William Kohlmoos

• **12th Grade-Design Engineering**
• Involved in leadership, community outreach, marching band, and swimming and diving
• Pursuing a career in business

Mason Ivy

• **10th Grade-Engineering Mgmt & Design**
• Competes in wrestling
• Silicon Valley Science and Technology Championship Winner
• Awarded for his efforts which resulted in February 28 being designated as "Rare Disease Day" in California
• Pursuing Career in Engineering
• Plans to attend Cal Poly

Michael Lee

• **10th Grade-Mechanical Design**
•Fixes computers for fun and profit
•Pursuing a career in Computer Hardware Engineering
•Wants to attend CIT or MIT

Tanya D'Silva

• **10th Grade Mechanical Design**
• Won numerous piano competitions
•Pursuing a career in Astrophysics
•Wants to attend Cornel or Princeton

AMSE Institute

Mission Objective

- Provide an exciting Space Project where students can apply their ***Math, Science, and Engineering Skills***.
- Develop and document a process to launch a ***low cost*** student payloads into space ***within the school year***.
- Research, design and fabricate experiments conducted in a microgravity environment
- ***Learn*** new technical and management skills.
- ***Help*** other high schools get into space.

What is a CubeLab™ ?

- Dimensions of 1U unit
  - *10cm x 10cm x 10cm*
  - (expanded dimensions possible next year)
- Weight of *1kg* maximum
- Power provided via a USB connector
  - *5 Volts @ 400ma*
- Astronaut uplinks commands and downloads data via the *USB interface*
- CubeLabs™ can be installed in every *ISS resupply* mission
- Cubelab™ locker provides *air cooling*
- NanoRacks has space for *32 Cubelabs™* at one time onboard the ISS

Why CubeLab™?

- *Firm launch* dates from scheduled ISS Resupply Vehicles
- Low Launch cost of *$25k* for *10cm x 11.7cm x 15cm*, CubeLab™ (For All Future Launches)
- *Benign Environment* inside Launch Vehicle & ISS
  - Low level launch vibrations
    - Packaged in Bubble Wrap
  - Shirt sleeve temperature
  - Earth like atmosphere
- NanoRacks provides electrical power and near real time commanding and data via astronaut laptop
- Optional *Return* via Soyuz or SpaceEx

Project Start July 12, 2010

Valley Christian High School ISS Project Team

ISS Project Students

Cost, Schedule, & Control
Scott Main

•Monitor & Control Costs
•Maintain Program Schedules
•Logistics Parts & Storage

CubeLab Program Manager
Veronica Lane

•Program Management
•Leadership
•Oral Presentations

Quality Assurance
Carly Prichett

•Establish & Maintain Quality Standards
•Validate Test Procedures
•Inspect Manufactured Components

CubeLab Systems Engineering Management
Drew Gallatin/Mason Ivy

•Management/Leadership
•System Requirements
•System Test Requirements
•Oral Presentations

Public Relations
Eyobed Mesfun

•Publicity
•TV/Radio Interface
•News Releases
•Oral Presentations

CubeLab Design Engineering Manager
William Kohlmoos

•Management/Leadership
•Maintain Design Schedules
•Oral Presentations

Systems Requirements Engineer
Steven Pham

•**Jay Salandan**
•Interface Requirements
•Test Requirements
•Env.Test Rqmts
•On Orbit Payload Seqs
•UK & NanoRacks Interface

Systems & Environmental Tests Engineer
Jay Salandan
•**Gabe Davis**

Materials & Processes Engineer
Jay Salandann
Gabe Davis

•On Orbit Simulation Tests
•Vibration Tests
•Thermal Tests
•Out Gassing Tests
•Plastic Materials
•Glue Processes

Mechanical Design Engineer
Taehyun Park

•**Tanya D'Silva**
•**Michael Lee**

•SolidWorks
•Parts & PCB Mounting
•Sealed Payload Enclosure Design
•Thermal Design
•Mfg Enclosures

Design Integration Engineer
Mason Ivy

•Conduct Design Trade Studies
•Interface Integration
•Hardware/Software Integration

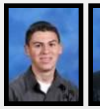
Electrical & Electronic Design Engineers

•**James Fairweather**
•**Andrew Lee**

•Analog Design
•Electrical Power
•Camera Remote Control
•PC Express or Equivalent
•Digital Design
•Printed Circuit Board
• Connector Selection

Software Programming & Test Engineers
Jonathan Allen

•**Mitchell Matos**
•**Erik Stansbury**



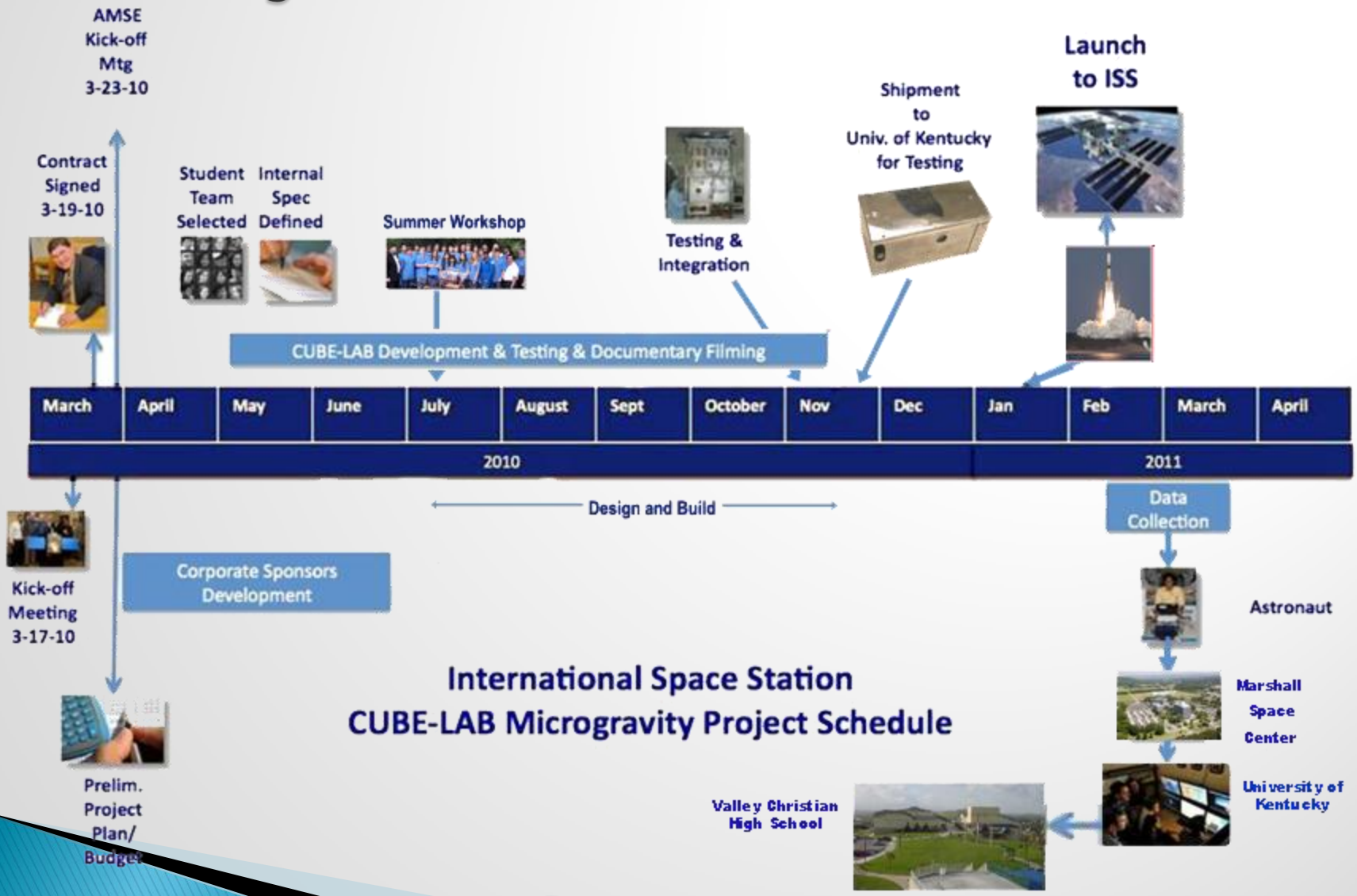
•Design Software Architecture
•PBasic Software Programming & Test

Payload Design Engineering
Ross Martinez

•**Dustin Laucella, Karen Lu**
•**Laraine Chan****

• Fluidics
* Plant Growth
• Camera Optics
• Component Selection
• Advanced Studies**

ISS Project Timeline



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Summer Workshop (July 12, 2010)

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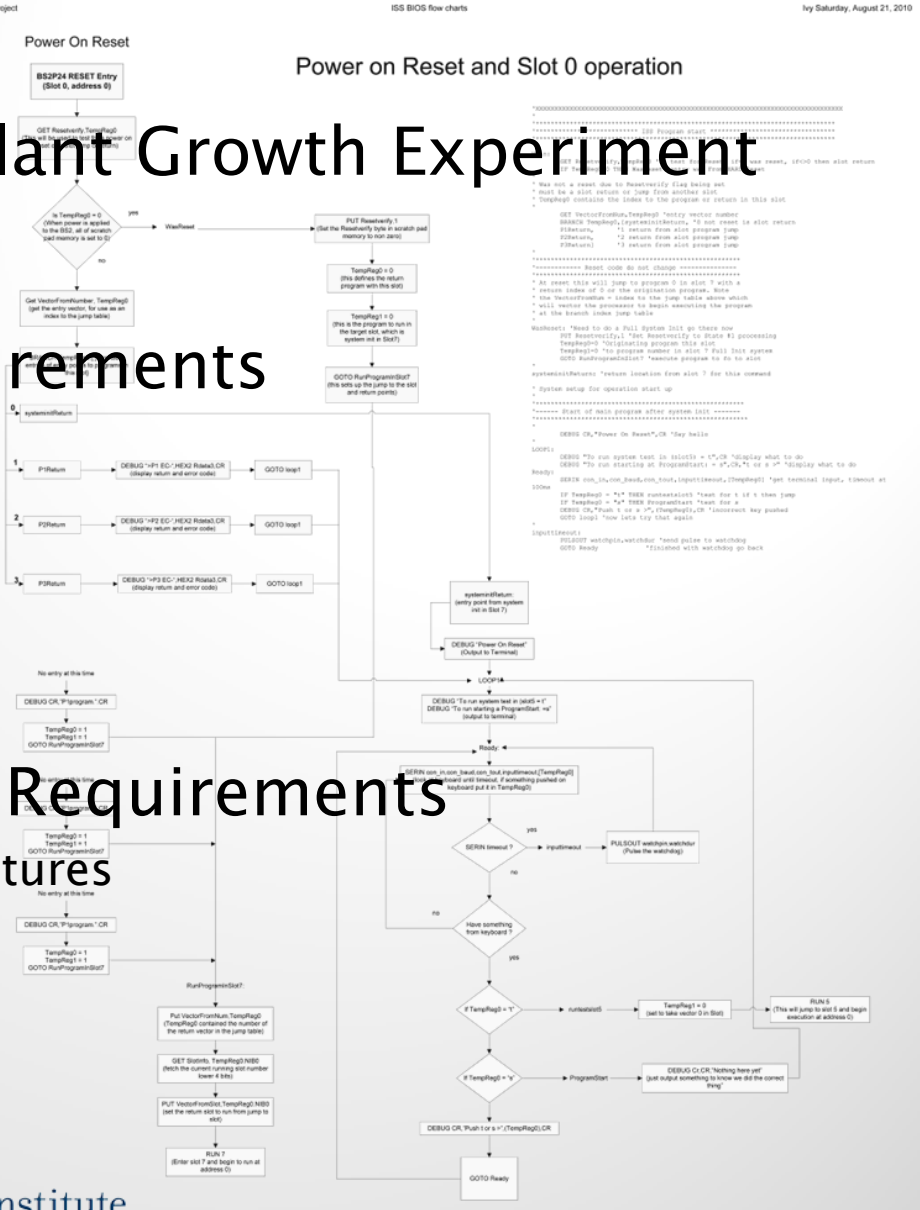
Design Plan at end of Workshop

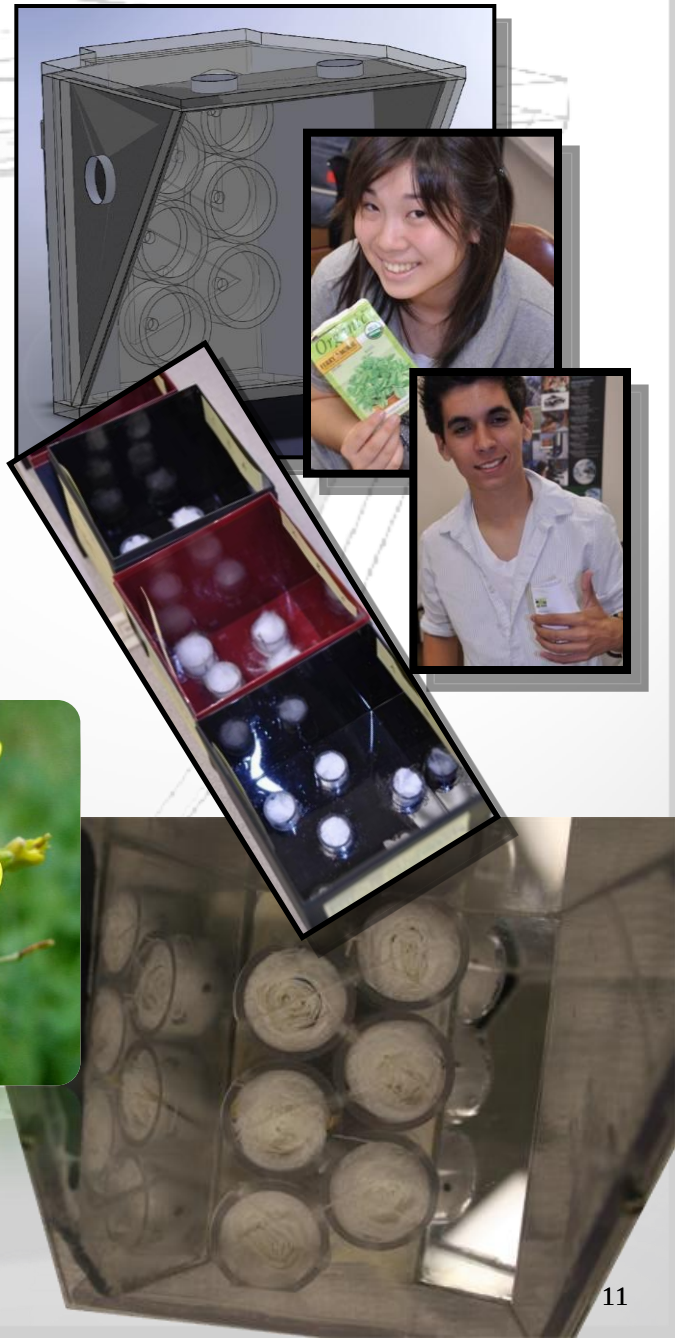
- ***Payload*** Determined – Plant Growth Experiment
  - Type of Plants
  - Plant Requirements
- ***Electrical Design*** Requirements
  - Microcontroller and I/O
  - Electrical controlled devices
  - Camera Selection
- ***Mechanical Design***
  - Size and material
- ***Data and Operational*** Requirements
  - Download steps and file structures



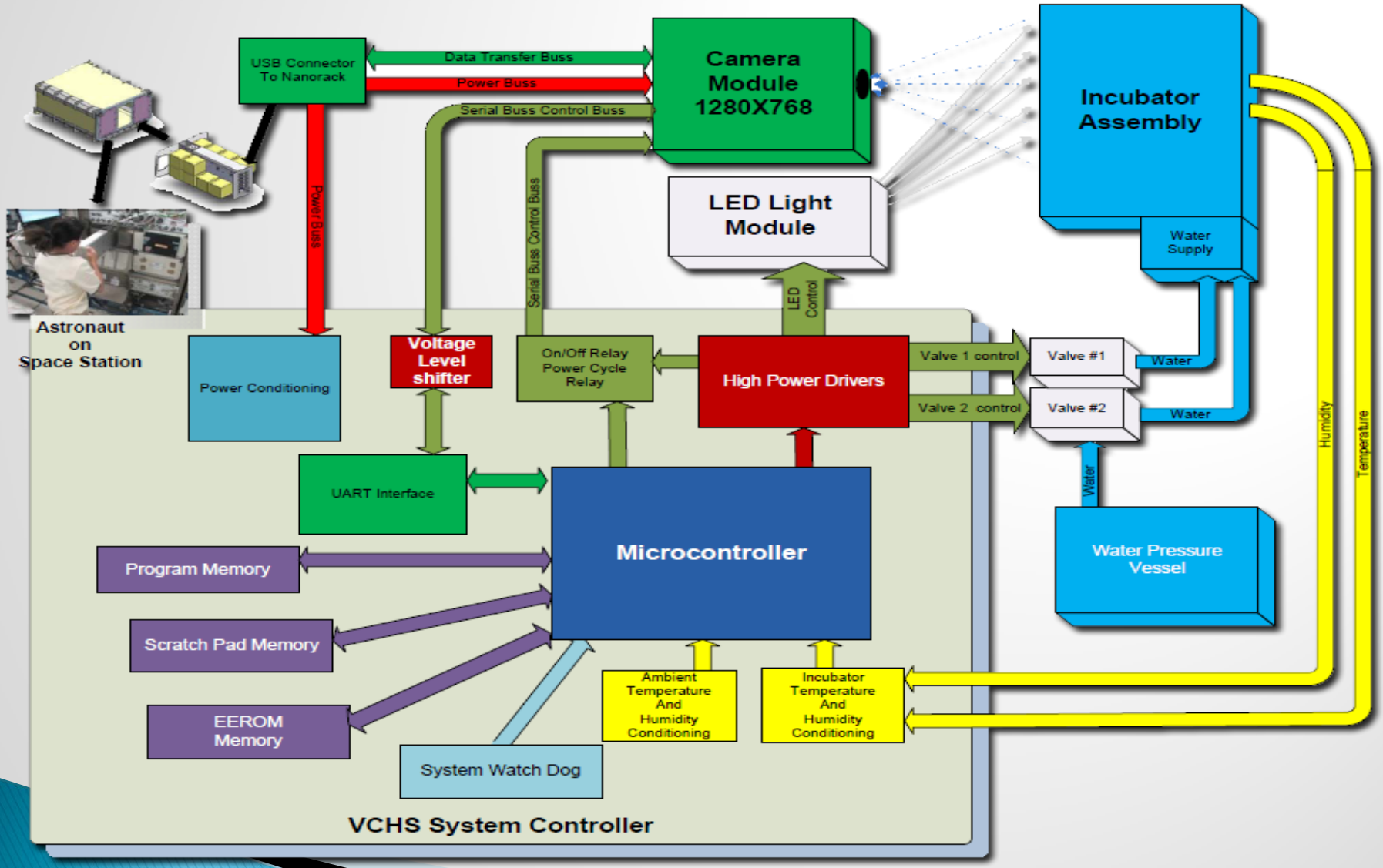
Design –*Payload*

- ***Growing Plants***
  - Research needed for future **long space travel**
  - Cannot bring enough **food**
  - Trip to Mars 3-years (roundtrip)

- ***Plants chosen:***
  - Basil
  - Marigold
  - Wisconsin Fast Plant

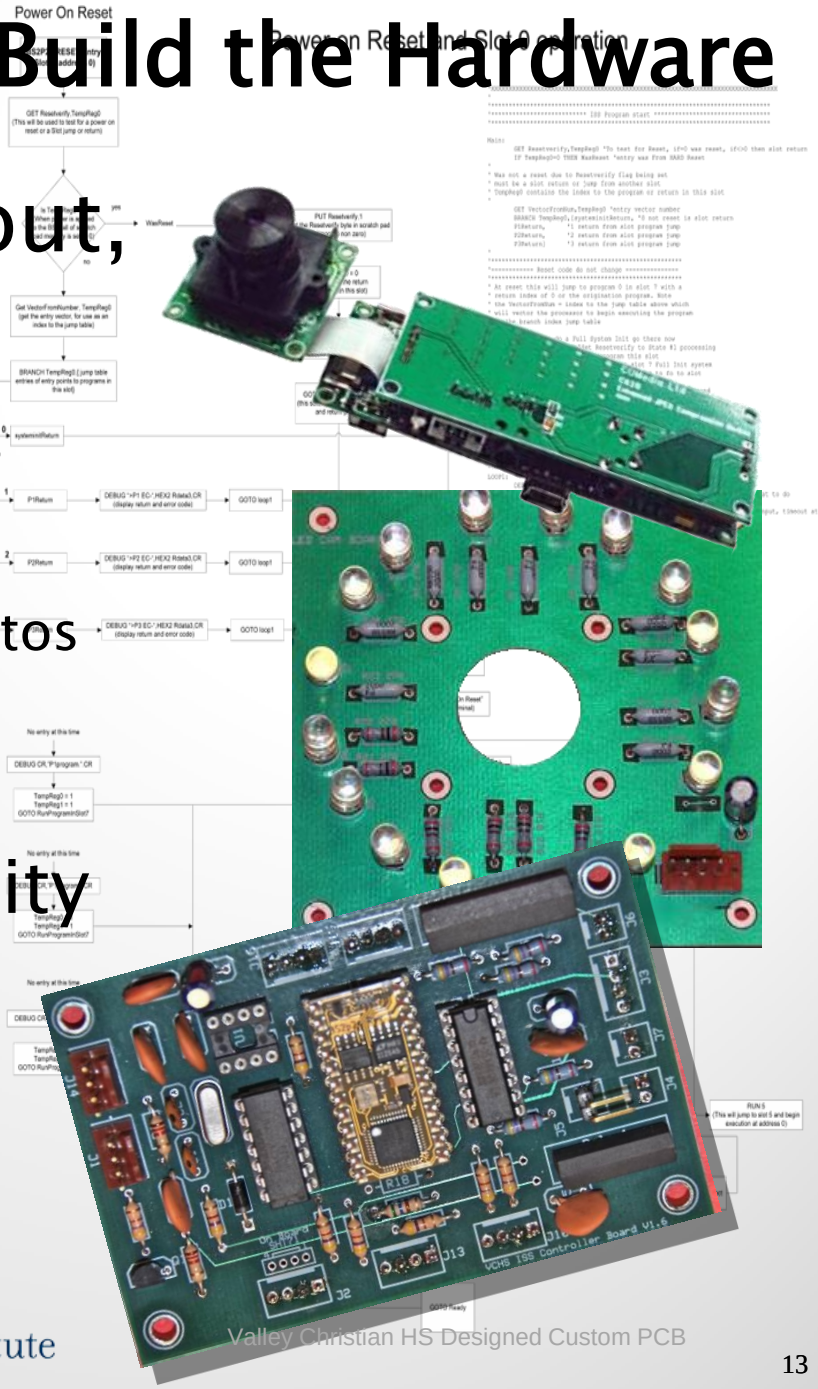


Design –*Block Diagram*



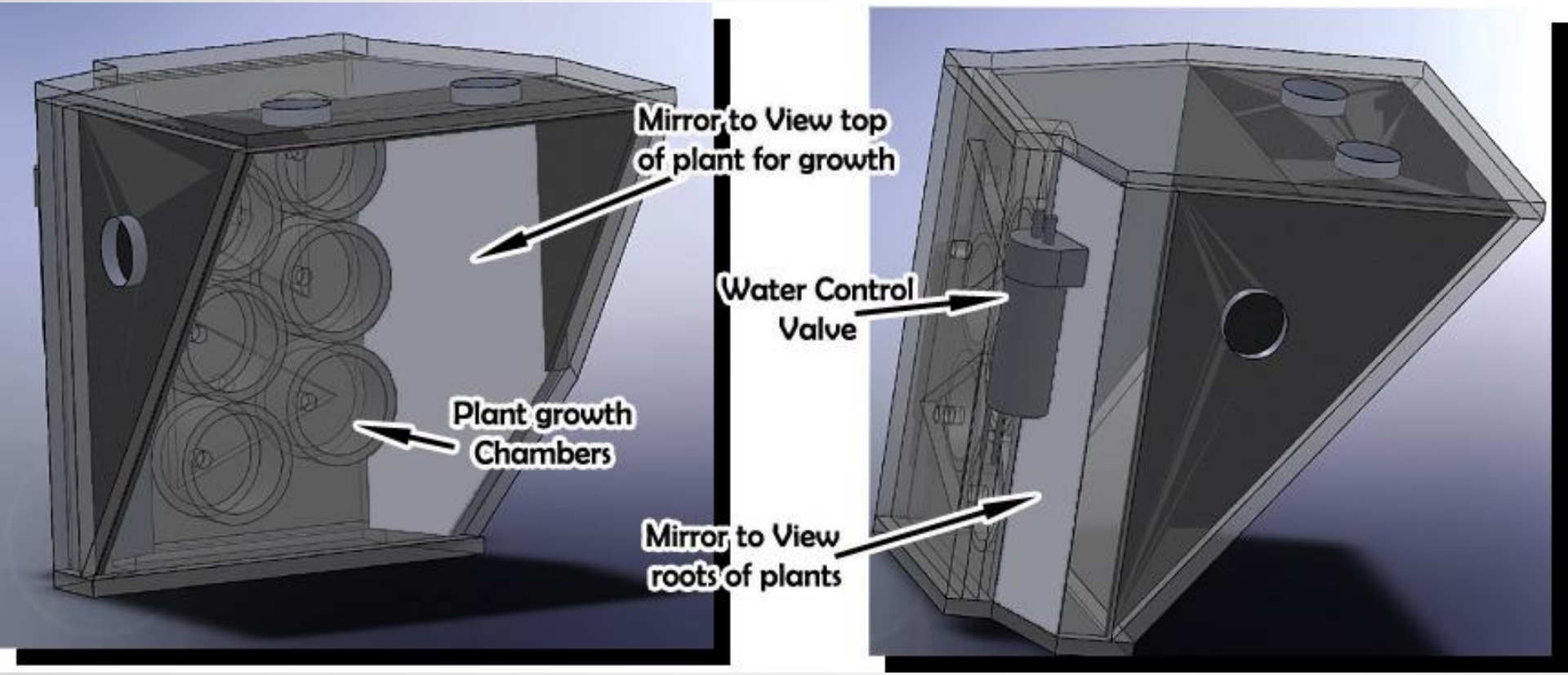
Design the Software and Build the Hardware

- Student designed, layout, and built hardware
- Project Software Tasks
  - Photos
    - High Resolution Plant Photos
    - Data Photos
  - Water Plants
  - Monitor Temp. & Humidity
  - Transmit Data
  - Error Recovery
    - Power Failure
    - Hardware Failure



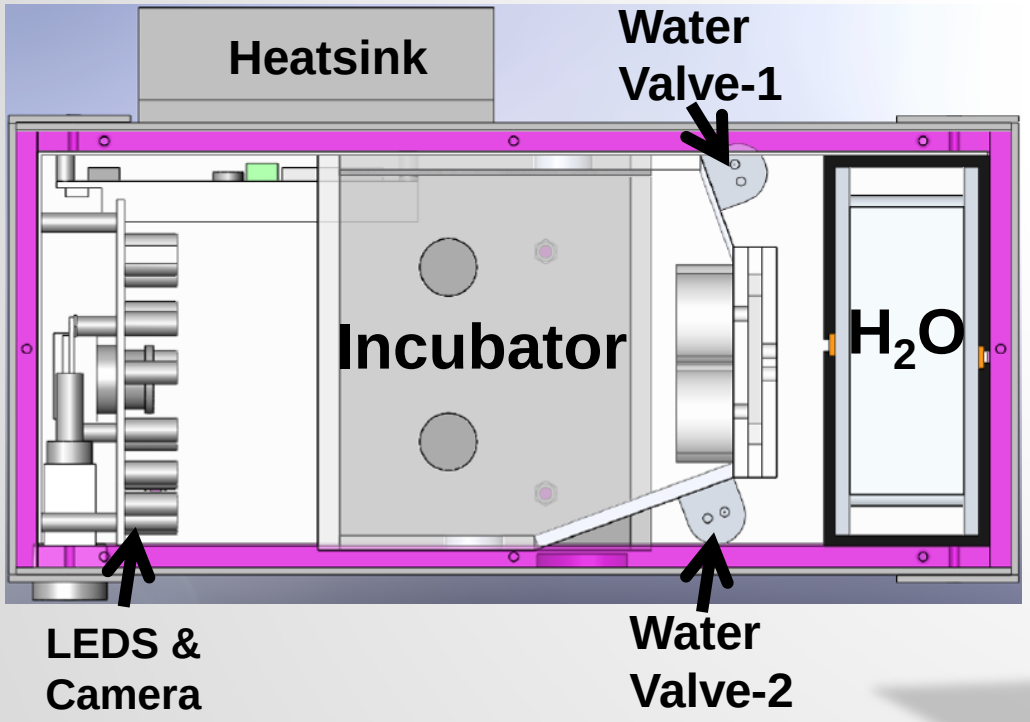
Valley Christian HS Designed Custom PCB

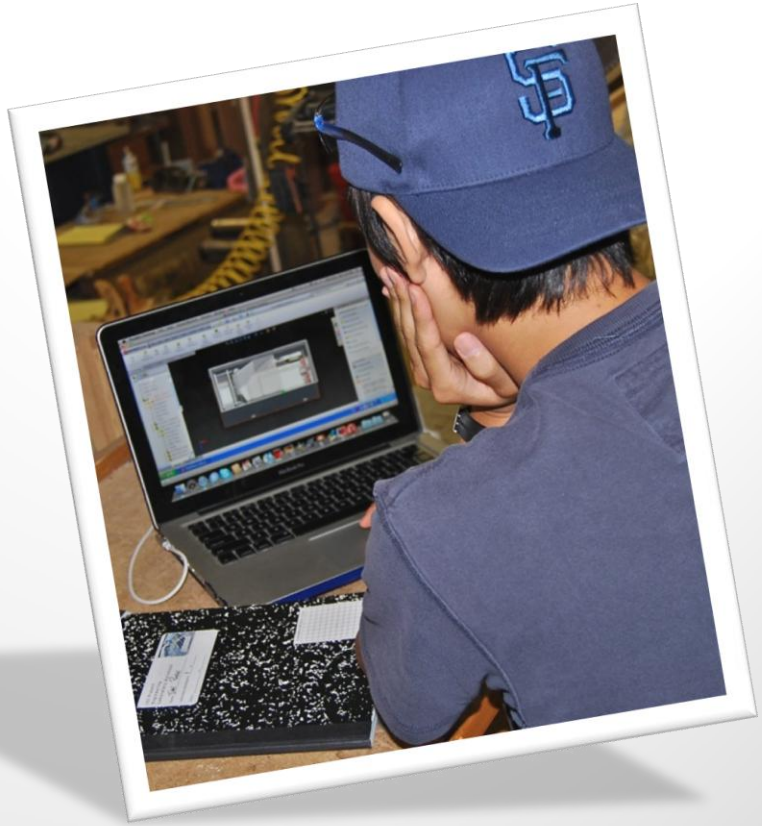
Design –*Mechanical*



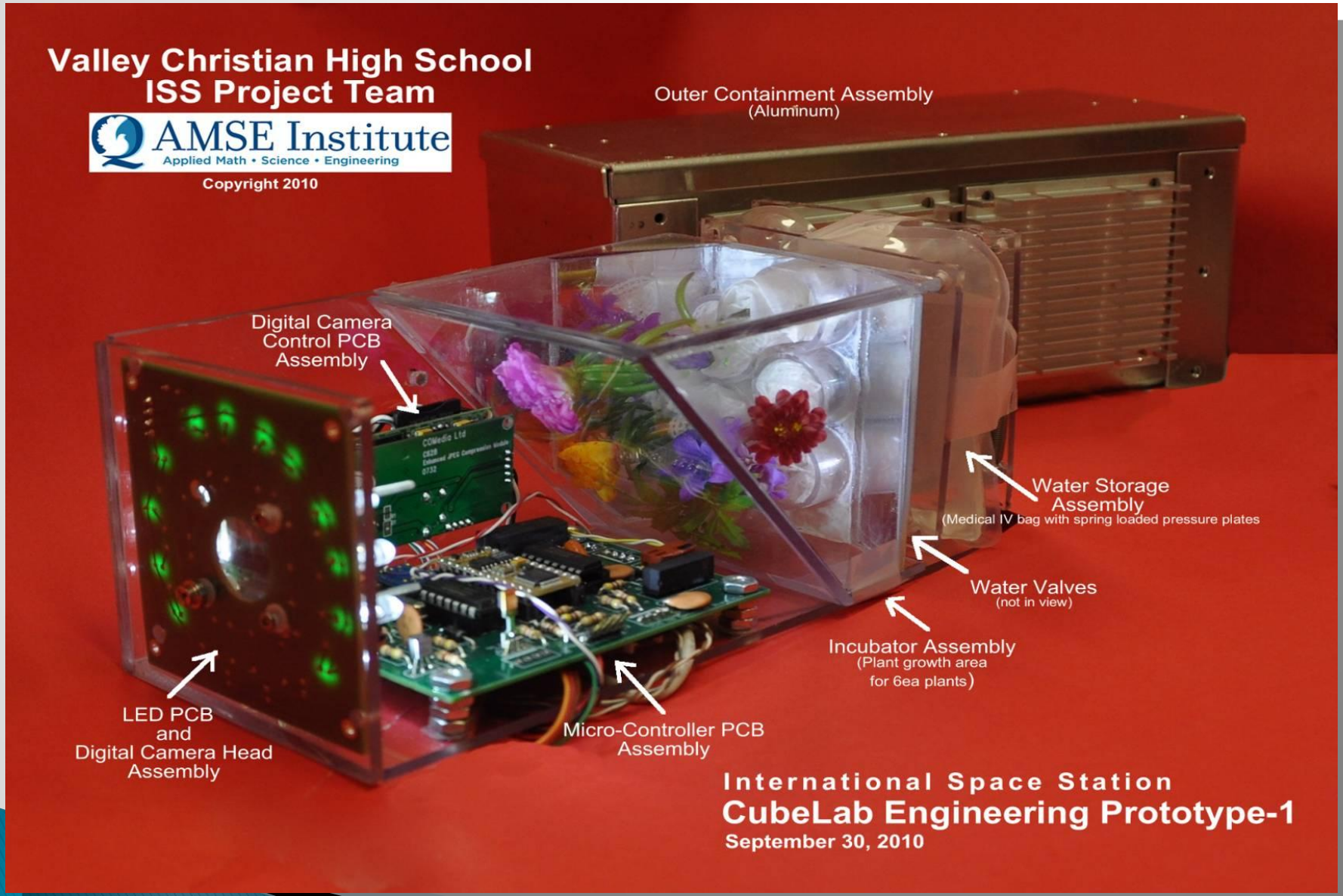
Incubator Assembly Design

Design –*Mechanical*





CubeLab™ Design



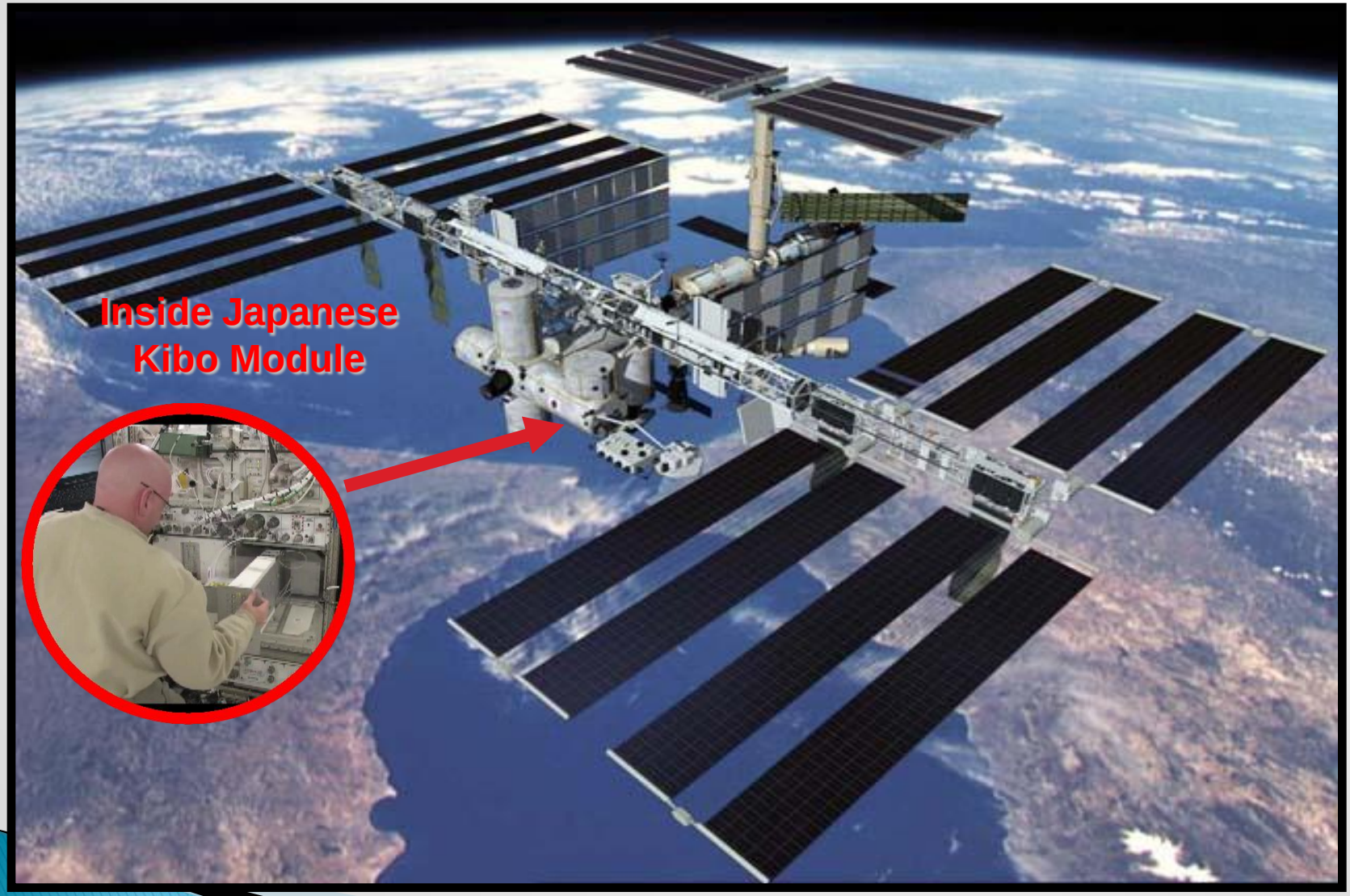
Testing and Qualification

- Performed at University of Kentucky
- Form, Fit, and Function
- Power Consumption
- System Error Recovery
- System Operation and Procedures
- Weight and Fluid Containment
- Depressurization test to 4psi

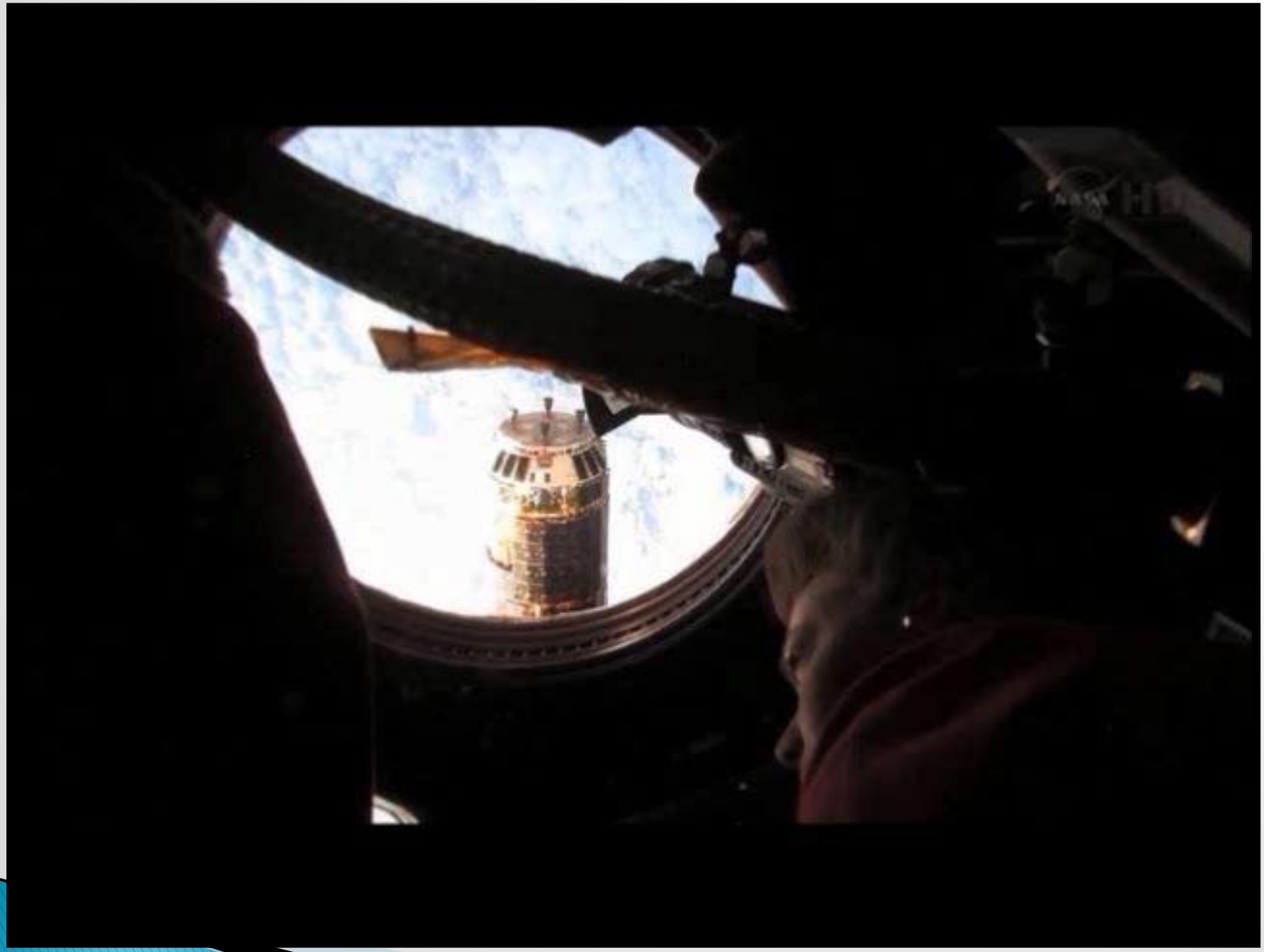
CubeLab™ Final Ready to Ship (11/26/2010)

JAXA HTV2 Launch (01/21/11)

CubeLab™ Location and Installation

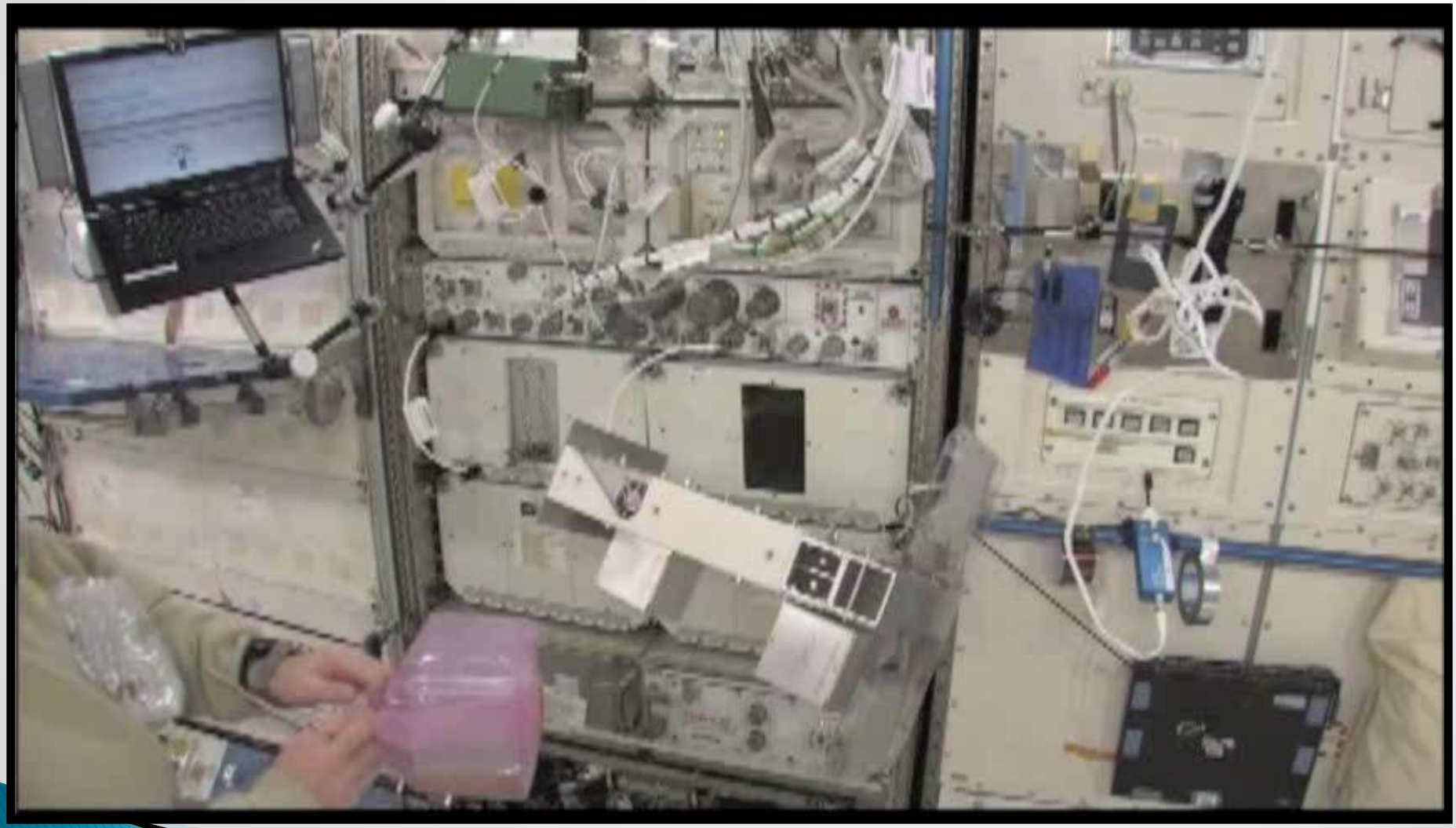


HTV2 Rendezvous with ISS (1/27/2011)



Moving Cubelab™ from HTV2 to ISS

Installation of CubeLab™ (2/3/2011)



First Photo of 3,005 photos taken and downloaded from the ISS

1st Data Set from ISS (02/03/2011)

Ambient Temperature/Humidity

Mission Time Clock

Incubator Temperature/Humidity

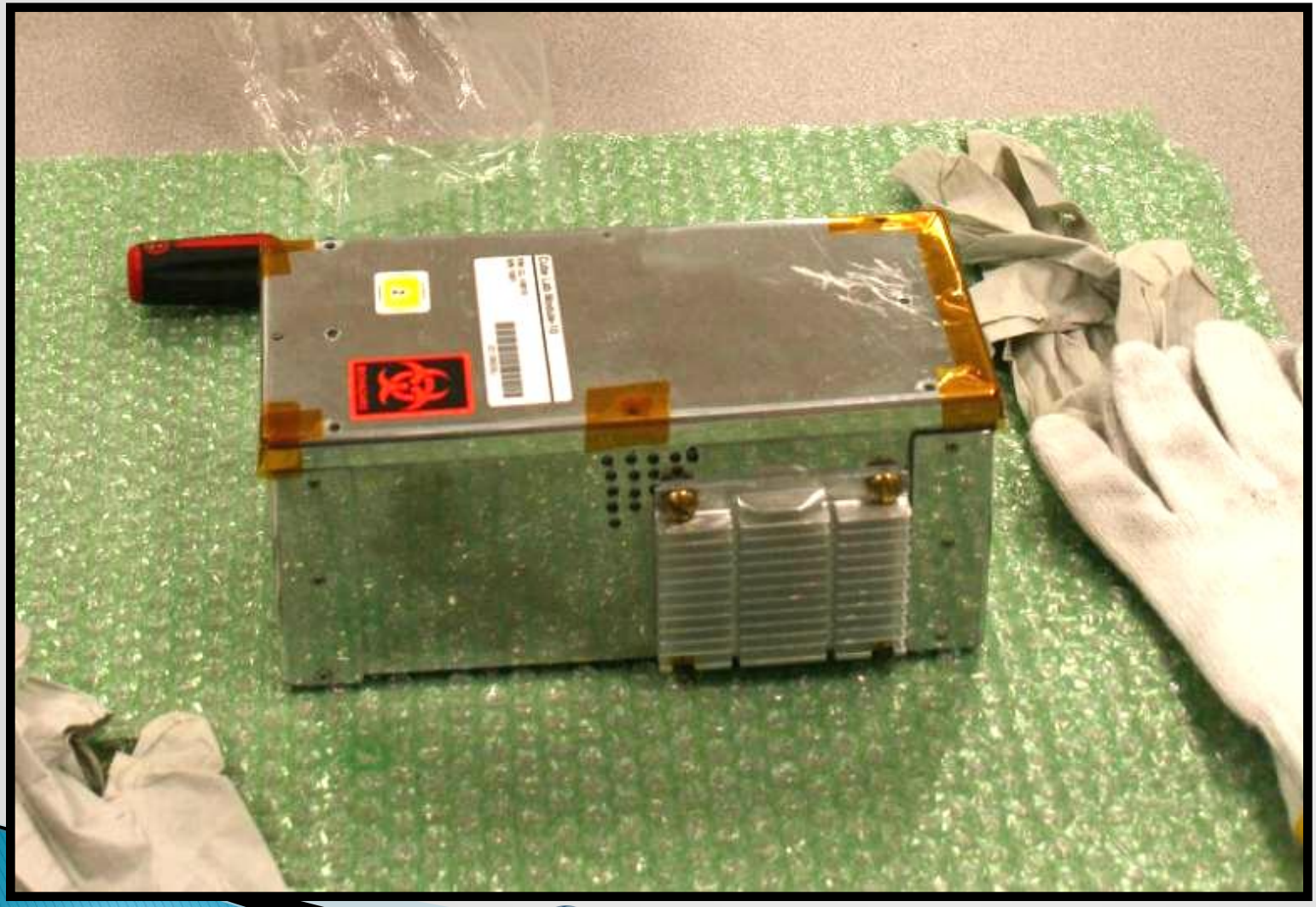
Status and Error Conditions

Orbital Operations

- In orbit *53 days* Power applied *28 days*
- Downloaded *3005 JPG photos*
- CubeLab™ *error recovered* after Astronaut laptop malfunction
- Data *download* every *3 days from ISS* to Marshall Space Center, to University of Kentucky, then to Valley Christian High School

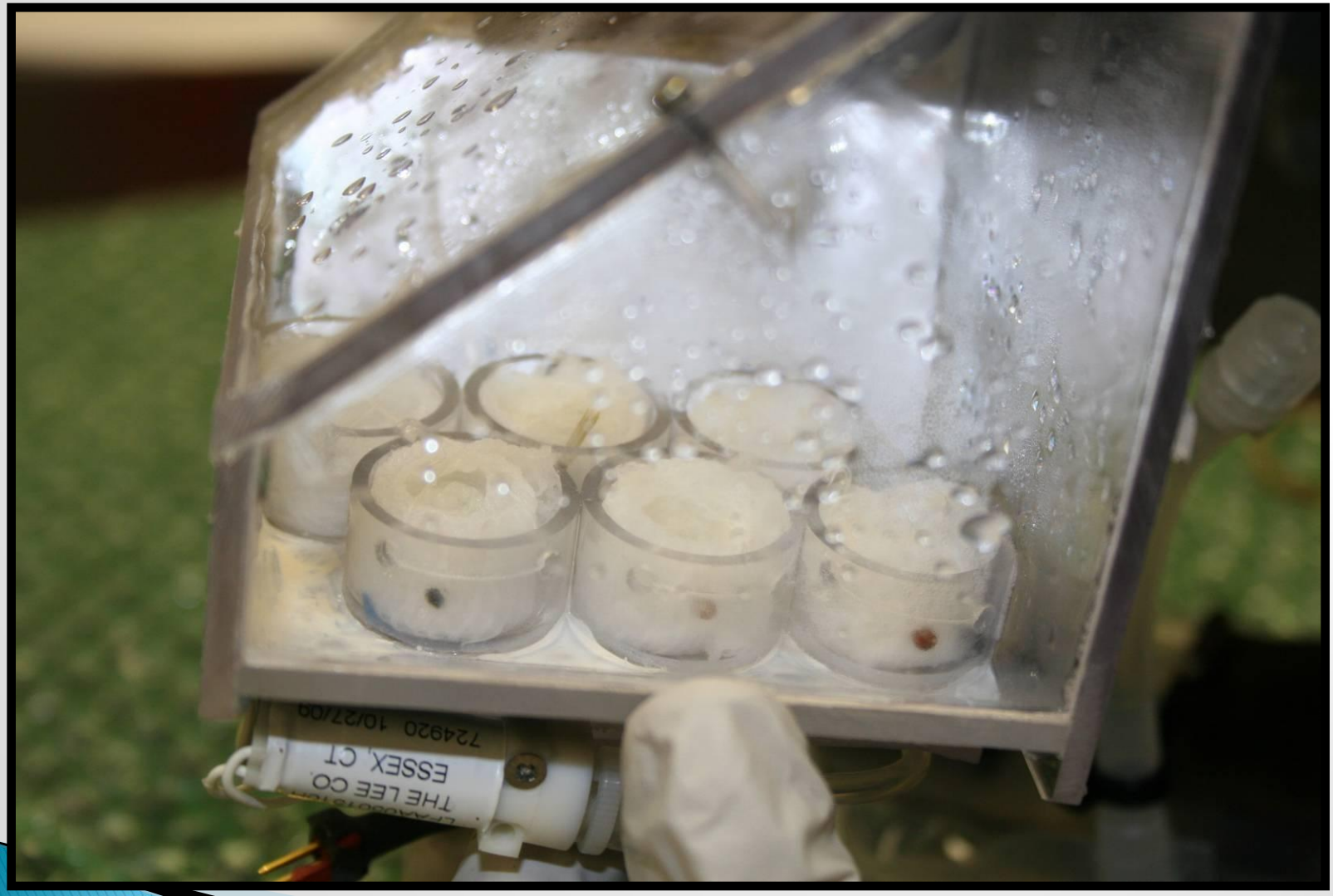
Soyuz Undocked and Landing (3/16/2011)

CubeLab™ returned from the ISS after 23,000,000 miles traveled



Removing Incubator after Flight

Examination of the Incubator after flight



Flight Results

- All Systems ***performed as designed***
  - Plant Lighting System Simulated sunrise to sunset
  - Automatic Plant Watering System provided amount of water programmed
  - Digital Camera System Stored and Downloaded 3005 plant growth photos
  - Watertight three level containment System remained in tack
- CubeLab™ ***automatically recovered*** after Astronaut laptop malfunction.
- ***Extensive ground testing revealed that Silicone sealant stopped the plants from growing after initial seed germination (acetic acid, low ph)***

Conclusions

- A Low cost CubeLab™ can be designed, built, qualified, and launched in *6.5 months*.
- *Commercial off self components* can be used successfully in *low vibration* launch and transportation load applications.
- CubeLabs™ are a Viable Low Cost method to get *student payloads* into space in a *Timely Manner*.
- *"The Sky is No Longer the Limit"*

Future Plans

- Contracting with NanoRacks to Launch **Two 1U CubeLabs™ on the Ariane ATV-3** Resupply Mission scheduled for February 29, 2012.
  - Each Cubelab™ to house up to four independent payloads each with its own digital camera and microcontroller.
  - **Three other high schools will be providing their own payloads**
- Build a Satellite Tracking and Control Ground Station – 2011
- Planning to launch a CubeSat from the ISS in 2013

The Valley Christian High School
ISS Project Team

Thank You for attending our presentation.

Questions Please!

Plant Growth Experiment Results and Conclusions

- Note: after 28 days in orbit there was no plant growth.
- Silicone sealant containing methyltriacetoxysilane, polydimethyliloxane, and Silicone dioxide was used to seal the incubator.
- Last 1280x768 photo taken aboard the ISS
- The ***Methyltriacetoxysilane*** and ***Polydimethyliloxane*** will generate acetic acid when they contact water vapor.
- The acid lowered the ph of the water, seeds, and growth material to a point that prevented the plants to germinate and grow.