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Supervisory Control – Implications for Environmental Control Systems

Why Supervisory Control?

- Enable or automate features not available in the GCS
- Bypass multi-platform support
- Protect intellectual property
- Incorporate special sensors
- Complex mathematics
- Access external data
- Maintain Independence

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Why Has it Taken So Long?

- Artificial intelligence requires human intelligence
- Models are too specific
- Integration difficulties
- Lack of Demand
- User Comprehension
- Complexity and Robustness
- Safety
- Failure Contingencies

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Points of Interaction

External Supervisory Control Application

Target Modifiers (Influences)

Targets (Climate, Moisture, Nutrients)

Equipment Control Loop

Control System

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The Dream

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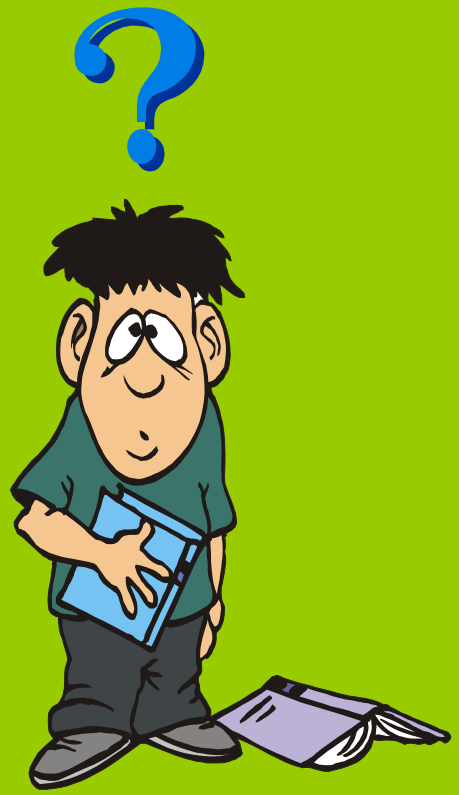
The Reality



Greenhouse Equipment

Equipment Control

Independent Controls

Greenhouse Equipment

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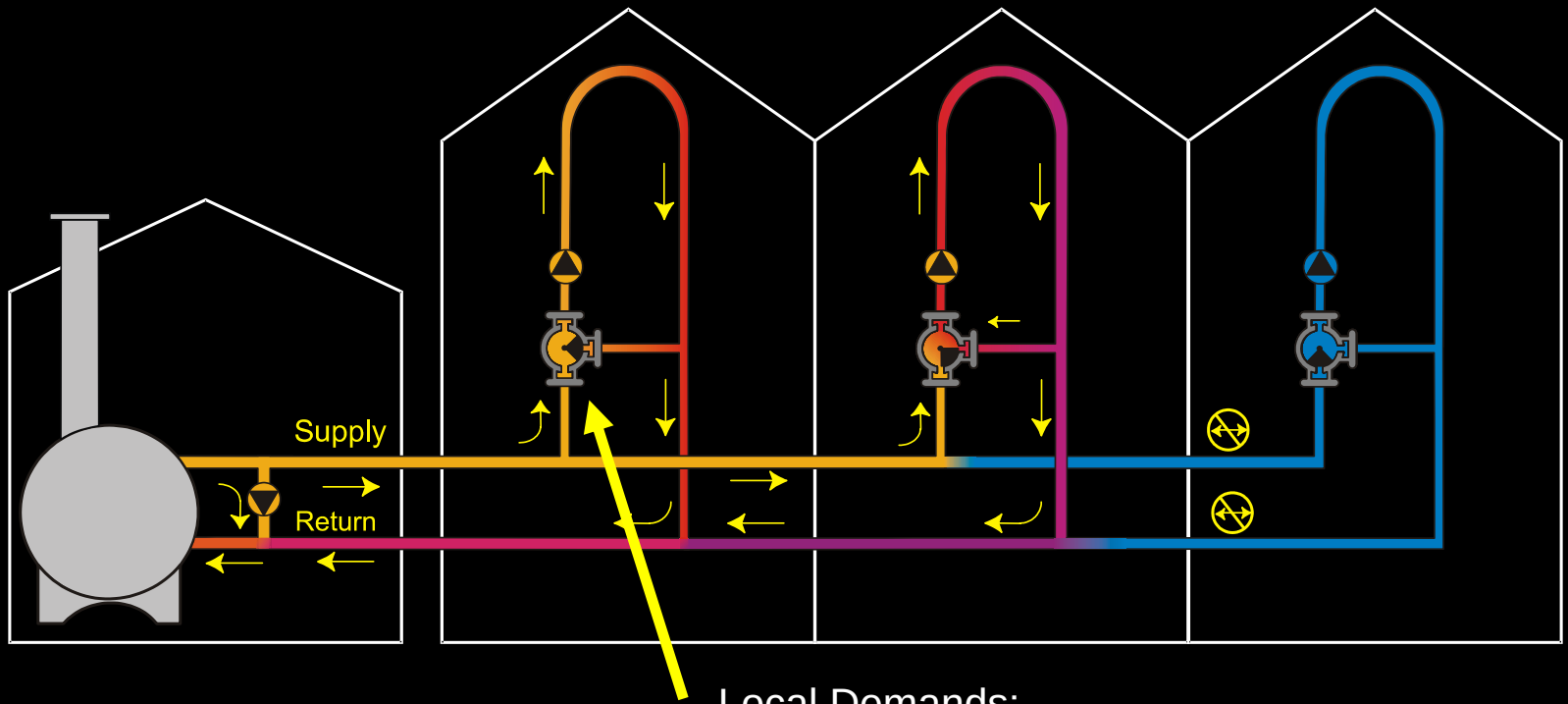
Equipment Constraints (direct)



Local Demands:

Process Lags

Non Linear Output

Control Loop Tuning

Failure Modes

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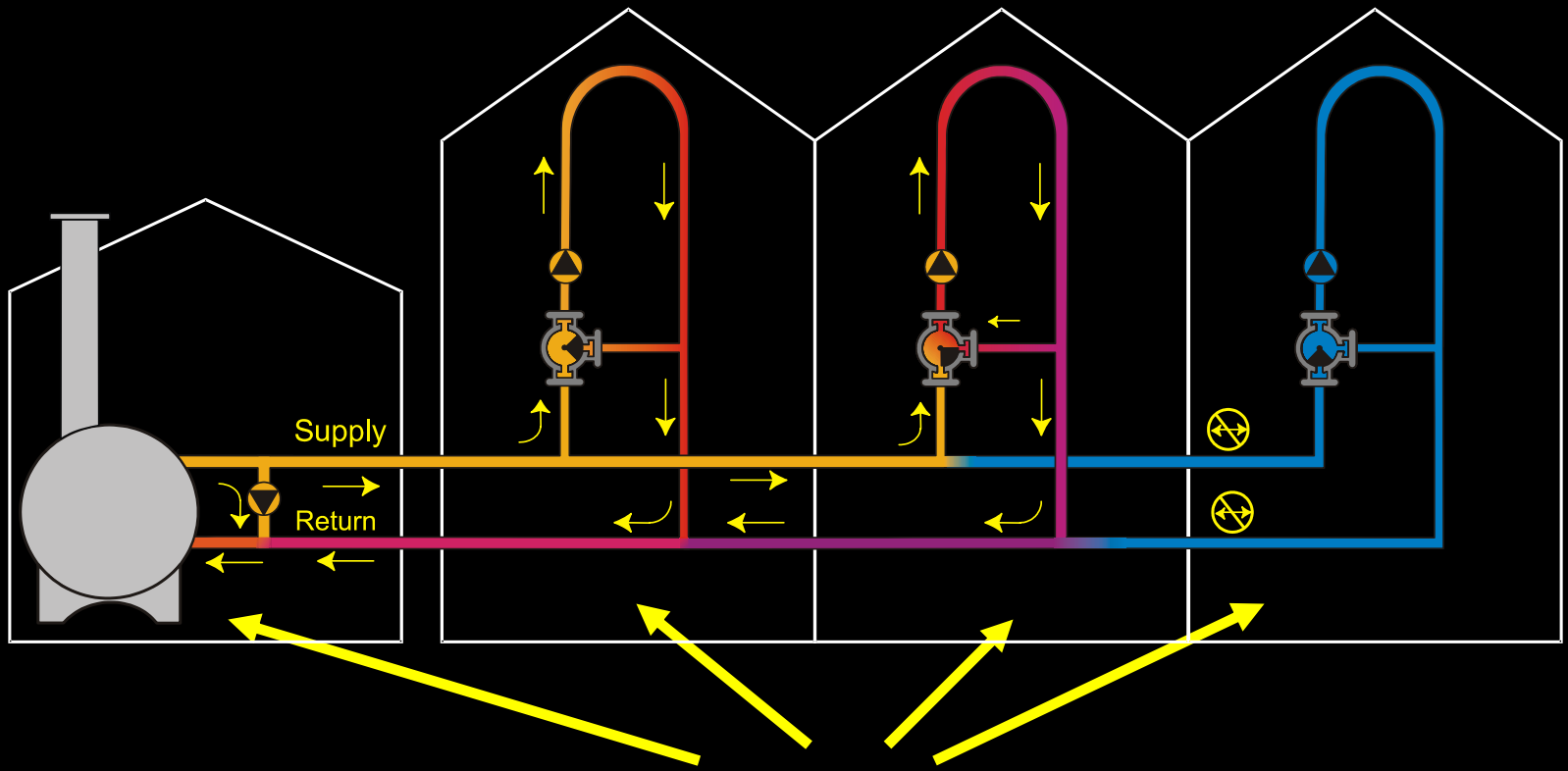
Equipment Constraints (global)



Global Demands:

Boiler Protection

Load Sharing

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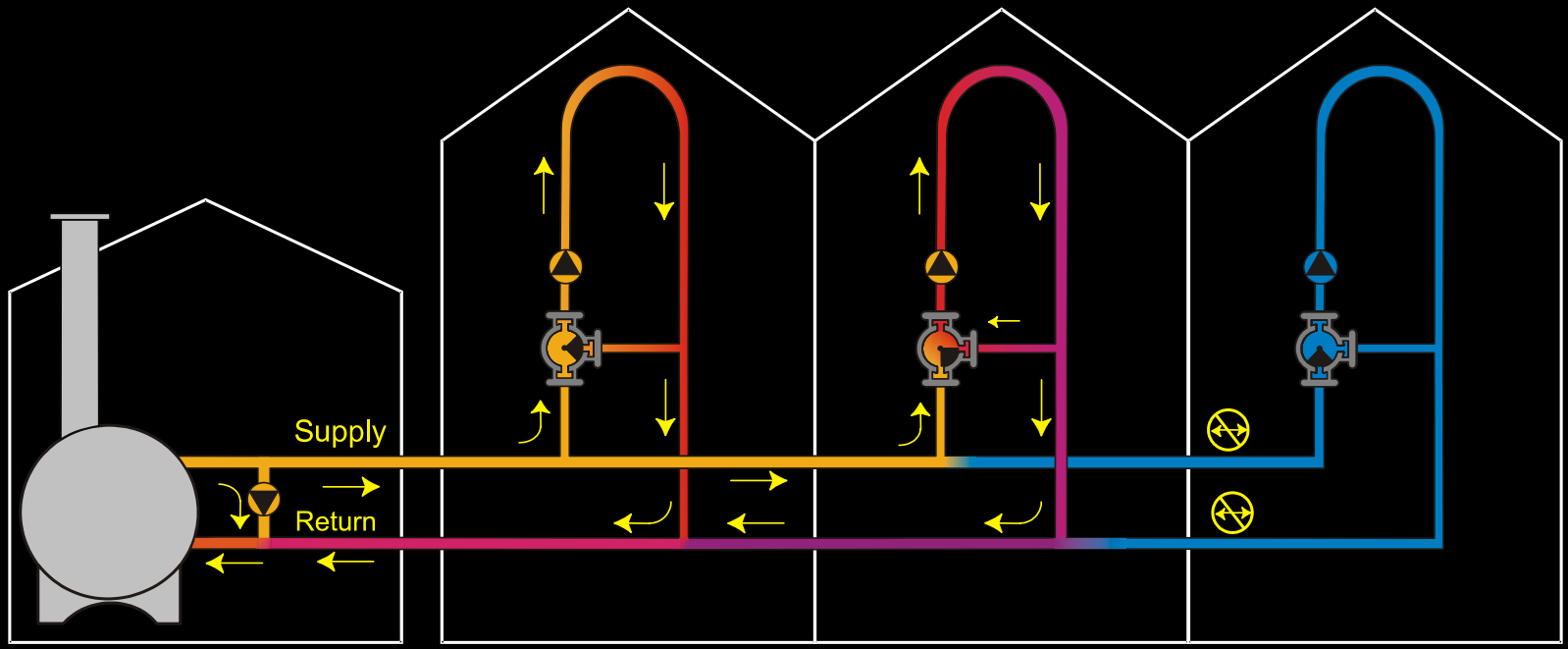
Control Objectives



Control Objectives:

Air Temperature

Max Pipe Temperature

Snow Melting

Humidity

Crop Activation

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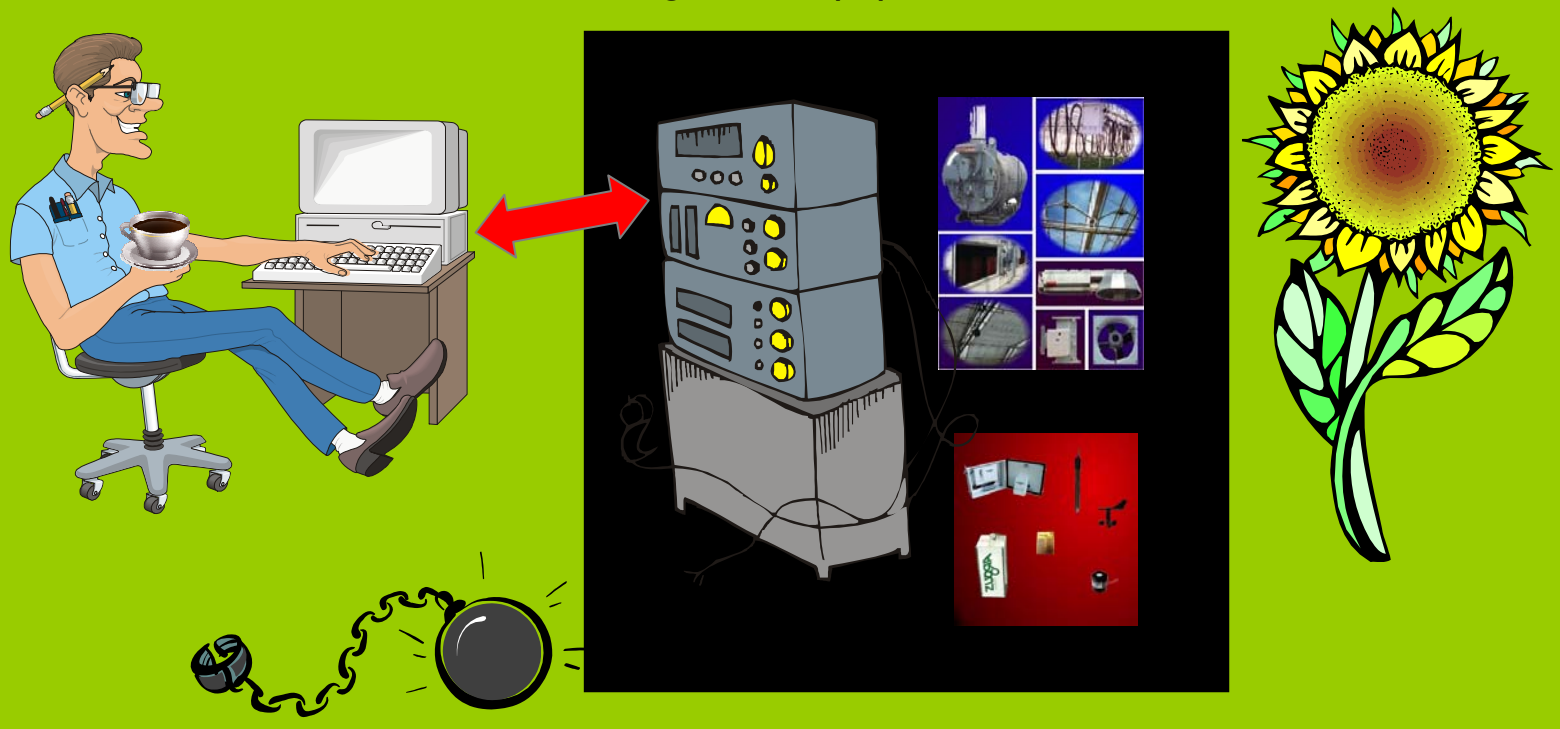
Breaking the Chains

A Greenhouse Control System
Integrates Equipment Control



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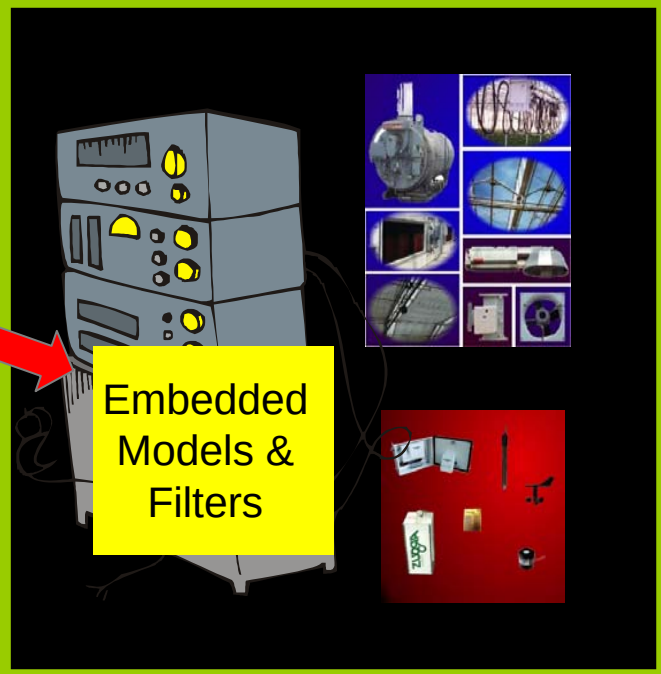
Embedded Models & Filters

Programmed Growth
Management



Greenhouse Control System

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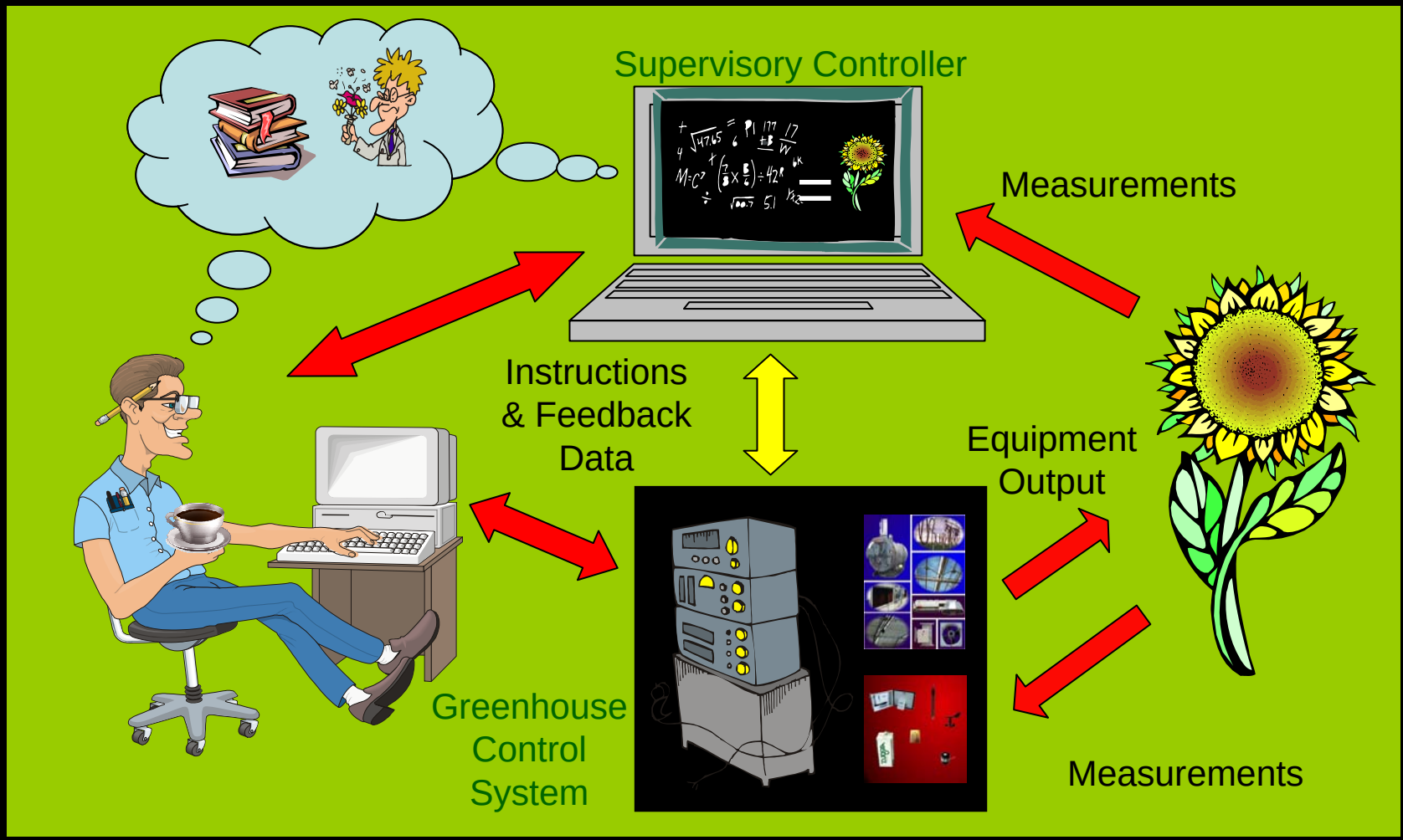
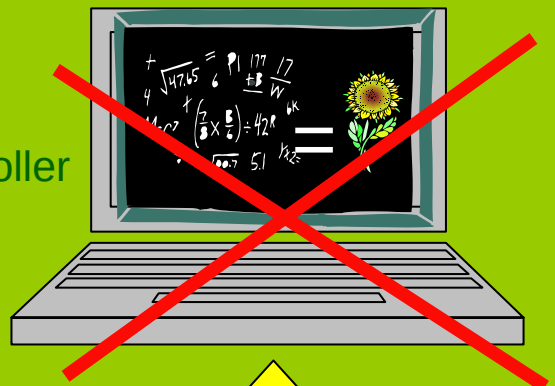
Supervisory Control



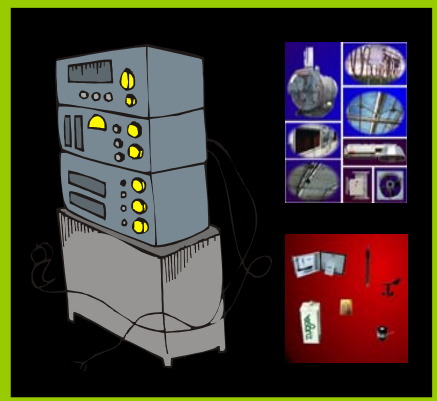
So What Could Possibly Go Wrong?

Supervisory Controller



Instructions
& Feedback
Data

Greenhouse
Control
System



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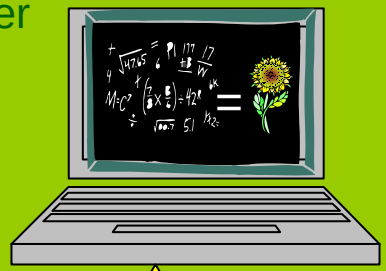
The Guardian

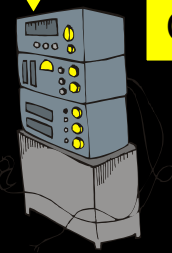
Supervisory Controller

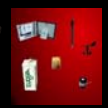


Data Verification

Limit Filtering

Fail-Safe Contingencies





Greenhouse Control System

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Guardian Features:

- Accepts external control instructions
- Trap and limit errors
- Fail-safe/fail-soft defaults
- Test platform
- ‘Black box’ equipment control
- Error protection
- Focus on outcomes rather than control processes
- Leverage existing sensing and data recording

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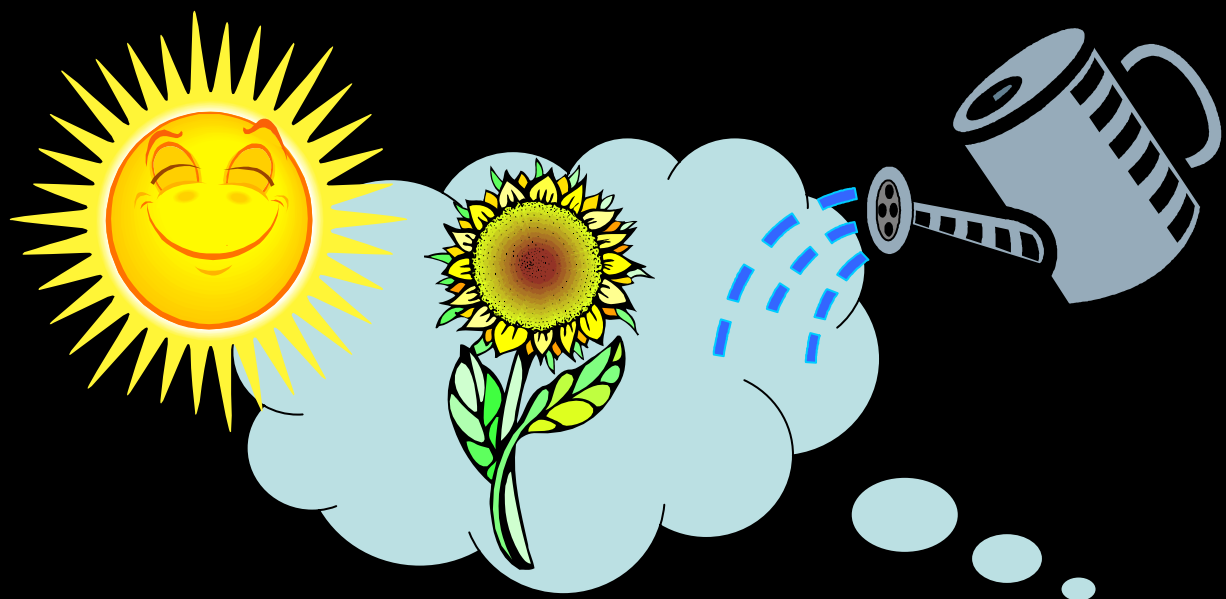

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