

Attracting Students to Science and Engineering with **Coffee**:

A New Freshman-Level Design Experience

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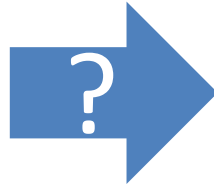


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What does Chemical Engineering have to do with Coffee???

Chemical engineers design ways to convert raw materials into valuable products



Cornerstones of Chemical Engineering

1. **Transport phenomena** – Transport of heat, fluids, and mass
2. **Thermodynamics** – Heat and its relation to energy and work
3. **Kinetics** – Chemical reactions

All crucial
for coffee!

New Course to Teach Engineering Design at the Freshmen Level

Open to **All** Majors

ECM 1 - The Design of Coffee

3 units: Lecture – 1 hour; Laboratory – 2 hours;
Project – 1 hour

Non-mathematical introduction to **how engineers think**, as elucidated by the process of roasting and brewing coffee. Qualitative overview of the **basic principles of engineering analysis and design**. Corresponding laboratory experiments testing the effect of design choices on the sensory qualities of coffee.



Lab 1 – Reverse Engineer a Mr. Coffee

Example key questions

- What makes the water move up?
- What is the complete process flow diagram?



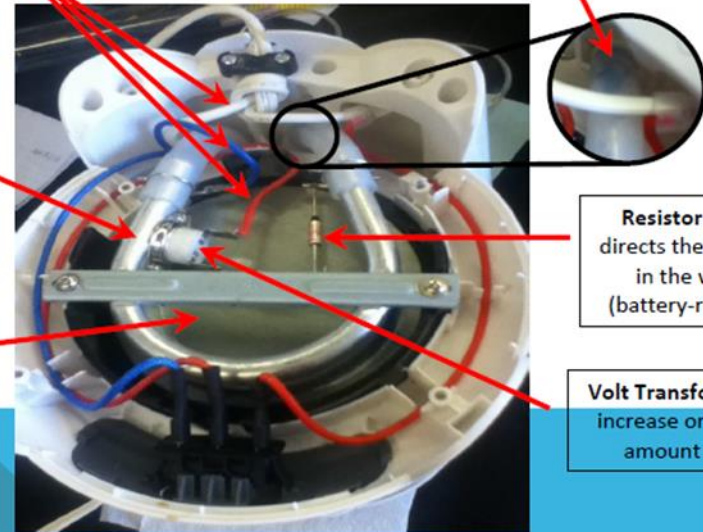
Power Cords: Supplies power to the Mr. Coffee.

Boiling Tube: Boils water supply from reservoir.

Heating Pad: Keeps the coffee pot warm and warms the boiling tube.

Bottom View

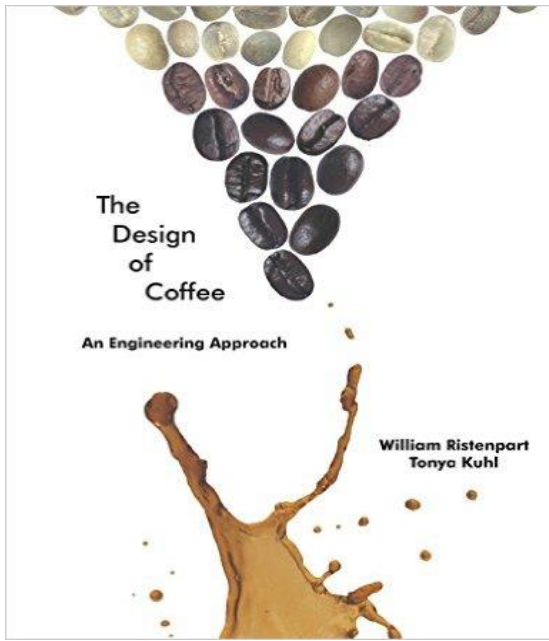
Check Valve: Permits water to flow in only one direction.



Resistor: Reduces and directs the current flowing in the whole circuit (battery-resistor-motor).

Volt Transformer: Used to increase or decrease the amount of voltage.

Lab Experiments in *The Design of Coffee*



Analysis

- Lab 1 – Reverse Engineering a Drip Coffee Brewer
- Lab 2 – Process Flow Diagram and Mass Balances for Coffee
- Lab 3 – The pH of Coffee and Chemical Reactions
- Lab 4 – Measuring the Energy Used to Make Coffee
- Lab 5 – Mass Transfer and Flux during Brewing
- Lab 6 – Coffee as a Colloidal Fluid and the Effect of Filtration

Design

- Lab 7 – Optimizing Strength & Extraction
- Lab 8 – Scaling Up to 1 Liter of Coffee
- Lab 9 – Design Competition and Blind Taste Panel

The goal of the coffee engineering design project is to make the **best tasting coffee**, using the **least amount of energy!**



Course Enrollment

