✦ SAFETY
✦ DEEP LEARNING
✦ R_{EQ} INSIGHTS

EGR 220 Lab 2

(1) SAFETY WITH LAB EQUIPMENT

SAFETY: VOLTAGE V. CURRENT

- Which is more dangerous – voltage or current?
- Why?
- What can you do to be safe?

EFFECTS OF ELECTRICAL CURRENT ON HEALTHY ADULTS

- Current Biological Effect

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- <u>Current Biological Effect</u>

  1 mA
  10-20 mA

  25 mA
  50-200 mA

- <u>Lightening?</u>
  - Several hundred million volts
  - Ten kiloamps
- <u>Household appliances ???</u>

EFFECTS OF ELECTRICAL CURRENT ON HEALTHY ADULTS

- Current / Biological Effect

Current	Biological Effect
1 mA	Threshold for feeling
10-20 mA	Voluntary let-go of circuit impossible
25 mA	Onset of muscular contractions
50-200 mA	Ventricular fibrillation or cardiac arrest

- Lightening?
  - Several hundred million volts
  - Ten kiloamps
- Household appliances ???

BODY RESISTANCE IN OHMS
REF: IEEE STANDARD 1048-1990

Resistance, Ω	Hand-to-hand		Hand-to-feet
	Dry condition	Wet condition	Wet condition
Maximum			
Minimum			
Average			

BODY RESISTANCE IN OHMS
REF: IEEE STANDARD 1048-1990

Resistance, Ω	Hand-to-hand		Hand-to-feet
	Dry condition	Wet condition	Wet condition
Maximum	13,500	1,260	1,950
Minimum	1,500	610	820
Average	4,838	865	1221

RESISTOR VALUES TO USE FOR SAFETY PURPOSES

- Current range that is safe?
- Voltage range suggested in labs?
- Therefore (applying Ohm's Law), what order of magnitude of resistor should you use, in general?
  - kilo-Ω or mega-Ω

LAB MEASUREMENT EXPECTATIONS

- Perform your calculations *before* coming to lab
  - Equivalent resistance
  - Voltage and/or current
- Why… You need to have an idea of what you expect to measure so that when you perform your experiments you know if you on track or doing something wrong

POWER SOURCES IN LAB

- Voltage source versus current source
- DC power supply
  - Constant voltage mode
  - Constant current mode
- The constant current mode is not too dependable so do not use it.

(2) DEEP LEARNING & THE ICAP FRAMEWORK

LABS AND LAB MEMOS

- Identify your learning objectives, from the list provided
- State your objectives for the week in your prelab
  - long-term *learning objectives*
- Determine what you need to do to make progress on your objectives.
  - Using this week's lab experiments to make progress
- Do the work and record progress
- Summarize your week's progress in your one-page memo.

ASSESSMENT

- Progress you make each week → a combination of course and personal objectives.
  - Make your objectives clear throughout the semester.
- Evidence of learning, which includes framing questions as well as making progress on them

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- Progress you make each week → a combination of course and personal objectives.
  - Make your objectives clear throughout the semester.
- Evidence of learning, which includes framing questions as well as making progress on them
- Evidence of performing your lab experiment.
  - Circuit, elements selected, expected behavior
  - Results – data, figures, graphs you make
- Evidence of learning about circuit theory
- Organization and neatness.
- Completeness (you did significant work each week)

WEEKLY PRE-LAB

- Identify your learning objective(s) and begin work/plan on how this lab will advance your learning objective(s)
  - At least one of the Questions of Understanding
- Design the circuits you will build and analyze
  - Draw circuit diagrams
  - Specify all element values
  - Identify the input and output(s) of the circuit
- Write your steps for taking measurements
  - Measuring which V and I values (and know why you want to do this)

ONE PAGE LAB MEMO SUMMARY

- Include **one statement** demonstrating your growing understanding, that **goes beyond** what is discussed in the lab handout.
- Focus on *your* **Q**uestion **O**f **U**nderstanding
- * Note that this statement *must* demonstrate some *independent thinking and learning*. *

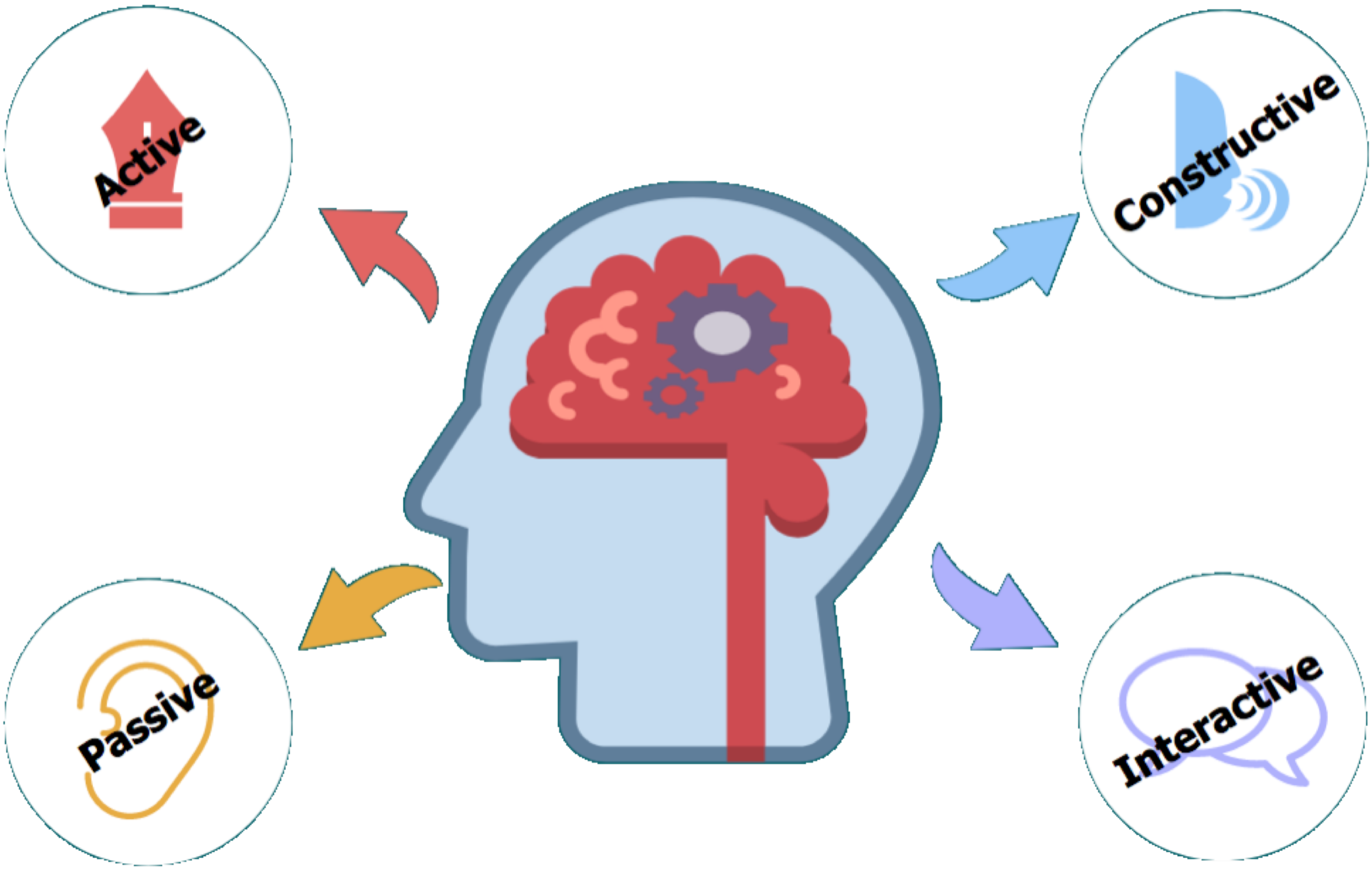
QUESTIONS OF UNDERSTANDING

1) How are voltage and current inter-related?
   - What do I understand about the theoretical and practical connections between voltage and current?
2) What is voltage?
   - What do I understand about the concept of voltage?
3) How do conservation laws apply to circuit theory?
   - What is my understanding of how conservation laws are used in circuit analysis and design?
4) What does "equivalent" mean for electrical circuits?
   - What is my understanding of how "equivalence" is used to design and analyze circuits?

EXAMPLES FOR PUSHING YOUR UNDERSTANDING

1) How are voltage and current inter-related?
   - What is my theory to explain these connections?
2) What is voltage?
   - What am I unsure about, for the concept of voltage?
3) How do conservation laws apply to circuit theory?
   - How can I experiment with conservation laws?
4) What does "equivalent" mean for electrical circuits?
   - Can I design and test two circuits to explore my theory of equivalence?

CONNECTING LEARNING PROCESS TO LEARNING OUTCOMES



https://create.piktochart.com/output/20281985-icap-framework-final

THE ICAP FRAMEWORK

Category	INTERACTIVE	CONSTRUCTIVE	ACTIVE	PASSIVE
Characteristic				Receiving
Definition				Merely paying attention to receive the learning material
Knowledge-change processes				Storing isolated, encapsulated info
Expected cognitive outcomes				Recalling verbatim in the identical context
Learning outcome				Minimal understanding
Examples of learning activities				• Listen to a lecture • Read an article • Watch a video
Hypothesis				**P**

Source: Chi, M. T., & Wylie, R. (2014). The ICAP framework: Linking cognitive engagement to active learning outcomes.*Educational Psychologist*,*49*(4), 219-243.

THE ICAP FRAMEWORK

Category	INTERACTIVE	CONSTRUCTIVE	ACTIVE	PASSIVE
Characteristic			Manipulating	Receiving
Definition			Manipulating learning materials to focus attention	Merely paying attention to receive the learning material
Knowledge-change processes				Storing isolated, encapsulated info
Expected cognitive outcomes			Applying in similar contexts	Recalling verbatim in the identical context
Learning outcome			Shallow understanding	Minimal understanding
Examples of learning activities			• Take verbatim notes • Highlight key information • Pause or replay	• Listen to a lecture • Read an article • Watch a video
Hypothesis			**A >**	**P**

Source: Chi, M. T., & Wylie, R. (2014). The ICAP framework: Linking cognitive engagement to active learning outcomes. *Educational Psychologist*, *49*(4), 219-243.

THE ICAP FRAMEWORK

Category	INTERACTIVE	CONSTRUCTIVE	ACTIVE	PASSIVE
Characteristic		Generating	Manipulating	Receiving
Definition		Generating new inferences or information beyond what is presented	Manipulating learning materials to focus attention	Merely paying attention to receive the learning material
Knowledge-change processes		Inferring, connecting,comparing, reflecting		Storing isolated, encapsulated info
Expected cognitive outcomes		Transferring to new contexts, interpret	Applying in similar contexts	Recalling verbatim in the identical context
Learning outcome		Deep understanding	Shallow understanding	Minimal understanding
Examples of learning activities		• Reflect out loud • Summarize in new words • Compare to another video	• Take verbatim notes • Highlight key information • Pause or replay	• Listen to a lecture • Read an article • Watch a video
Hypothesis		**C >**	**A >**	**P**

Source: Chi, M. T., & Wylie, R. (2014). The ICAP framework: Linking cognitive engagement to active learning outcomes.*Educational Psychologist*,*49*(4), 219-243.

THE ICAP FRAMEWORK

Category	INTERACTIVE	CONSTRUCTIVE	ACTIVE	PASSIVE
Characteristic	Dialoguing	Generating	Manipulating	Receiving
Definition	Generating additional inferences and information via dialoguing with a peer	Generating new inferences or information beyond what is presented	Manipulating learning materials to focus attention	Merely paying attention to receive the learning material
Knowledge-change processes	Co-Inferring (taking turns, mutual benefit)	Inferring, connecting,comparing, reflecting		Storing isolated, encapsulated info
Expected cognitive outcomes	Co-Creating, inventing new products	Transferring to new contexts, interpret	Applying in similar contexts	Recalling verbatim in the identical context
Learning outcome	Deepest understanding	Deep understanding	Shallow understanding	Minimal understanding
Examples of learning activities	• Defend a position in a group • Ask and answer in pairs • Debate justification with a peer	• Reflect out loud • Summarize in new words • Compare to another video	• Take verbatim notes • Highlight key information • Pause or replay	• Listen to a lecture • Read an article • Watch a video
Hypothesis	**I >**	**C >**	**A >**	**P**

Source: Chi, M. T., & Wylie, R. (2014). The ICAP framework: Linking cognitive engagement to active learning outcomes.*Educational Psychologist*,*49*(4), 219-243.

Description

Score 1 There is little substantive discussion or only one student's statements are substantive.

- Students *do not* clarify or add to their partners' statements, instead voicing generic responses of agreement.
- One student decides what to do (measure, write, plot...) while the other agrees but contributes very little or nothing.

Score 2 One student's statements are mostly substantive and the other varies between substantive and shallow statements and responses.

- Statements and responses are discontinuous as each student makes assertions independent from those of the other.
- One student contributes most to what will be done while the other takes a smaller, though substantive, role.

Score 3 Substantive statements and responses of each student build upon those of the other, indicating a shared line of reasoning.

- Students clarify or complete their partners' statements through expanding, elaborating, restatement or rebuttal.
- Conclusions are co-constructed with both students involved fairly equally in determining what to do.

SAMPLE DIALOG 1

1) Student A1: Have you seen this first graph before?
2) Student A2: No.
3) Student A1: I learned this in my material class before; strain and stress. It shows the relationship between these two.
4) Student A2: So, E is the energy?
5) Student A1: E is the elastic modulus.
6) Student A2: Oh elastic modulus.
7) Student A1: It is elastic modulus and it was elastic modulus in the pre-test.
8) Student A2: Yeah.
9) Student A1: But that number is just the relationship. It shows the relationship between these two. And so it is the slope. A has the higher elastic modulus because it has a greater slope.
10) Student A2: Yeah, relationship.
11) Student A1: Does that make sense?
12) Student A2: Yeah.

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SAMPLE DIALOG 2

1) Student B2: How do modulus, bond energy, coefficient of thermal expansion …I do not know. Ohh…uhmmm…A greater modulus probably means the greater bond strength, right?
2) Student B1: Yeah
3) Student B2: Okay so, bonding energy lower that's so except for coefficient of thermal expansion. The greater modulus, greater bonding energy and a greater melting point all relate to higher bond strength.
4) Student B1: Okay so, a greater modulus has greater bond energy and…
5) Student B2: uhhmmm will result in a higher melting point.
6) Student B1: Yeah…well yeah…will result in a higher melting point
7) Student B2: And this all relates to a higher bond strength, greater bond strength
8) Student B1: What? Okay…All characteristics…
9) Student B2: All relates to…
10) Student B1: Relates to…
11) Student B2: Higher bond energy bond strength
12) Student B1: All relates to higher bond energy, uhmmm…

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SAMPLE DIALOG 3

1) Student C2: how do modulus, bonding energy, coefficient of thermal expansion and melting point affect bond strength? Can you explain your reasoning?
2) Student C2: It is just intuitively, metal A is the strongest because it does not deform as much when you apply the same strain to it and it takes a lot more ripped part of a bond, I guess.
3) Student C1: And its melting point, more energy is required to melt.
4) Student C2: Make it destabilize, yeah.
5) Student C1: So,
6) Student C2: And when you heat it, it does not change its shape as easily as metal C.
7) Student C1: So, how do we handle bond…metal A would be strongest per se. All four contributing the bond strength…
8) Student C2: How about elastic modulus, bond energy and melting point all increase bond strength while high coefficient of thermal expansion decreases bond strength?
9) Student C1: How this decreases bond strength? [Showing figure 3]
10) Student C2: I am not sure it decreases it directly; I just notice it is the opposite of these three.
11) Student C1: So, I guess thermal expansion does not contribute to the other three.
12) Student C2: Possibly, I am remembering that the thing we read mentions that thermal expansion means the molecules are getting further apart,…

(3) LAB 2: R_{EQ}

LAB 2 – LAB EQUIPMENT AS PART OF YOUR CIRCUIT

- Think about why…
  - Ideal voltmeter $R_m = \infty\ \Omega$
  - Idea ammeter $R_m = 0\ \Omega$

- When you connect equipment to your circuit
  - It is part of your circuit
  - The effective, equivalent resistance of the equipment is resistance added into your circuit
- How does the Req you just connected affect the
  - Voltage drops?
  - Current flow?