LED workshop

Eugenia Etkina and Gorazd Planinsic

Documents to use in the workshop

Workshop handout

https://docs.google.com/document/d/1BYgImWffXEJZmpKNwn4m5Z6UIoXtCeg6/edit

Workshop folder

https://drive.google.com/drive/folders/1GKzP4BfHrH-o6ABbCNTuDh-BwV0NJVla

Team 1 LED Handout for online learning.docx
Part 1 Activities 1-3

1. Observe and find patterns: https://youtu.be/y0Ghl3wCx4o
2. *Patterns and explanations* Describe the patterns that you found and present them in a table.

   The lightbulb was able to illuminate with 1 or 2 batteries and the orientation of the batteries did NOT affect whether or not the bulb was able to light up. The LED was only able to illuminate with 2 batteries AND the orientation of the 2 batteries DID affect whether or not the LED was able to light up.
1. Devise several *causal* explanations for the observed patterns in circuits with LEDs (here we would like you to devise the explanations that the students who know nothing about semiconductors would devise).

   Explanation 1: The LED only allows current to flow in one direction.

   Explanation 2: The LED allows current in both directions, but the LED only lights when the current goes in the correct direction.

Team 2 LED Handout for online learning.docx
Part 1 Activities 1-3

1. Observe and find patterns: https://youtu.be/y0Ghl3wCx4o

1. *Patterns and explanations* Describe the patterns that you found and present them in a table.
2. Devise several *causal* explanations for the observed patterns in circuits with LEDs (here we would like you to devise the explanations that the students who know nothing about semiconductors would devise).

https://youtu.be/y0Ghl3wCx4o

Lightbulb - The light bulb there was less brightness with one battery and more brightness with 2. It didn't matter which direction the current was flowing.
Led- there was no light with one battery in either direction. With batteries in only worked when the positive was attached to the long side leg of the LED

All together: Possible causal explanations and possible testing experiments

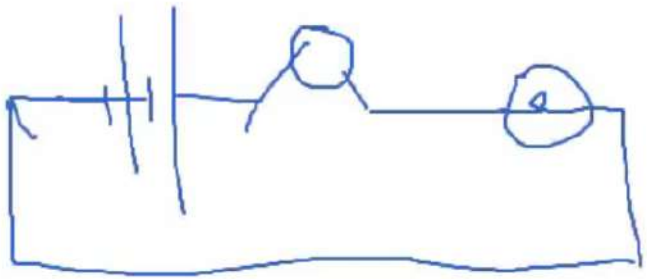
Explanation 1: The LED only allows current to flow in one direction.

Explanation 2: The LED allows current in both directions, but the LED only lights when the current goes in the correct direction.

All together

Imagine that you plan to use a lightbulb as an indication of current in a circuit: what circuit would you design for a testing experiment? What predictions will you make?

Paste circuit diagrams here



All together

Observe the experiment and explain whether it matched your prediction:

TE1 https://youtu.be/wj7omittGr0

After you watch the experiment you wonder about its outcome. What experiment can you perform to test the assumption you just uncovered? Observe the improved experiment and compare the outcome to the prediction. What did you learn from it?

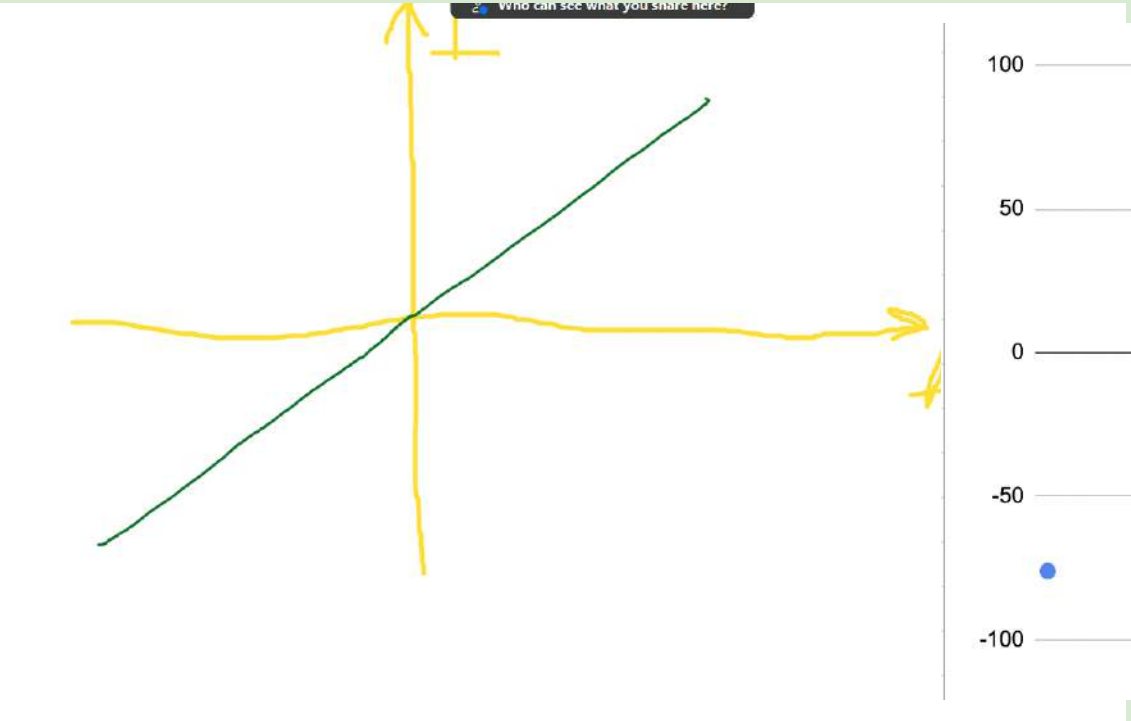
TE1 Improved https://youtu.be/0CZ9hODPJBE

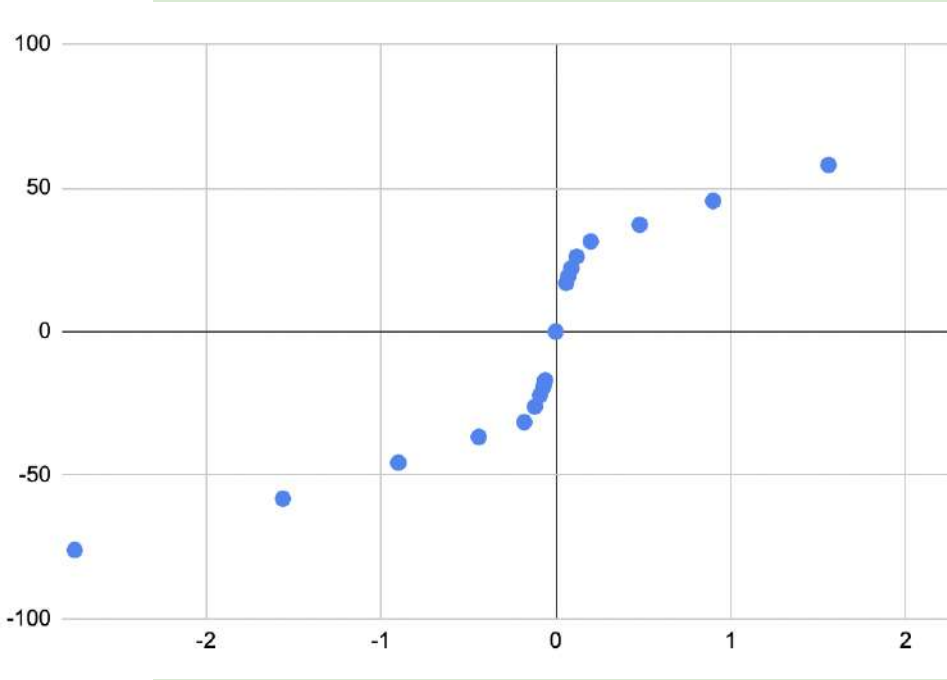
What if instead of a lightbulb for the current indicator you wanted to use an ammeter? Describe an experiment that you will do and predict the outcome, then watch the video and compare the outcome to the prediction

TE2 https://youtu.be/huGquFs3Aj4

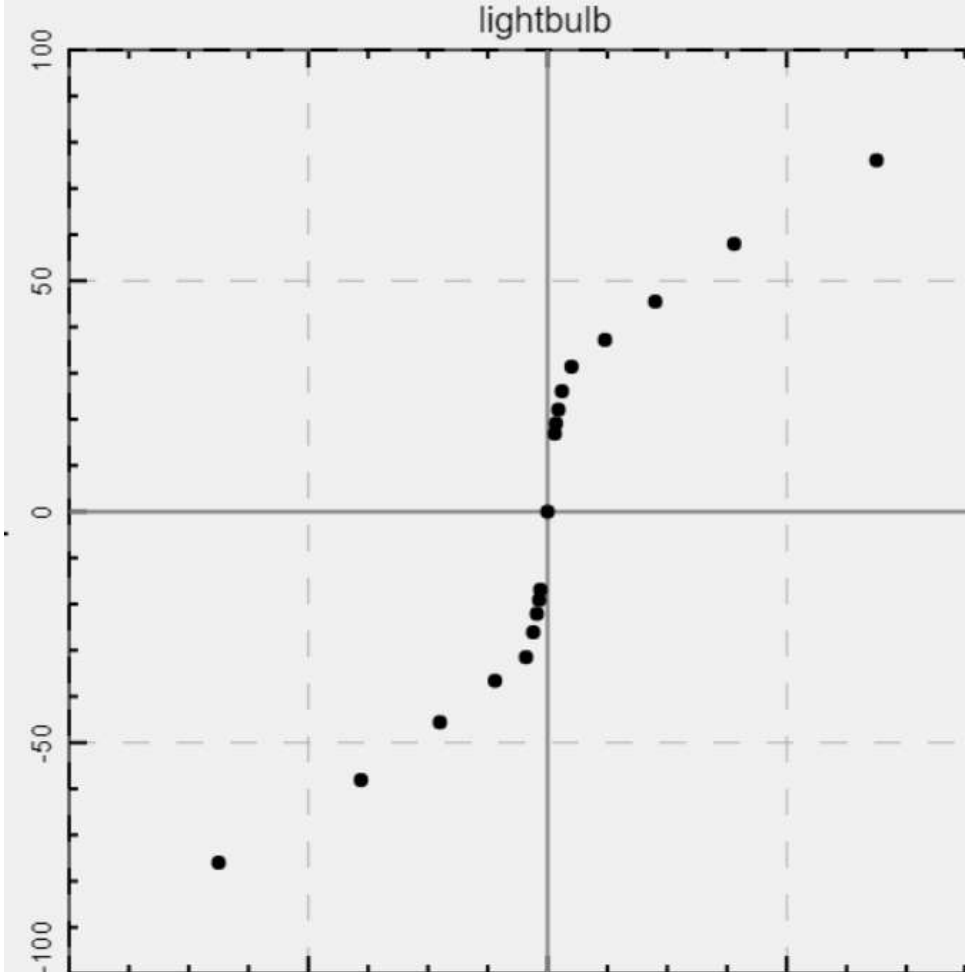
Equipment used in the activities that follow (Gorazd presents)

Team 1 Same document LED handout Part 2 Activities 1-3

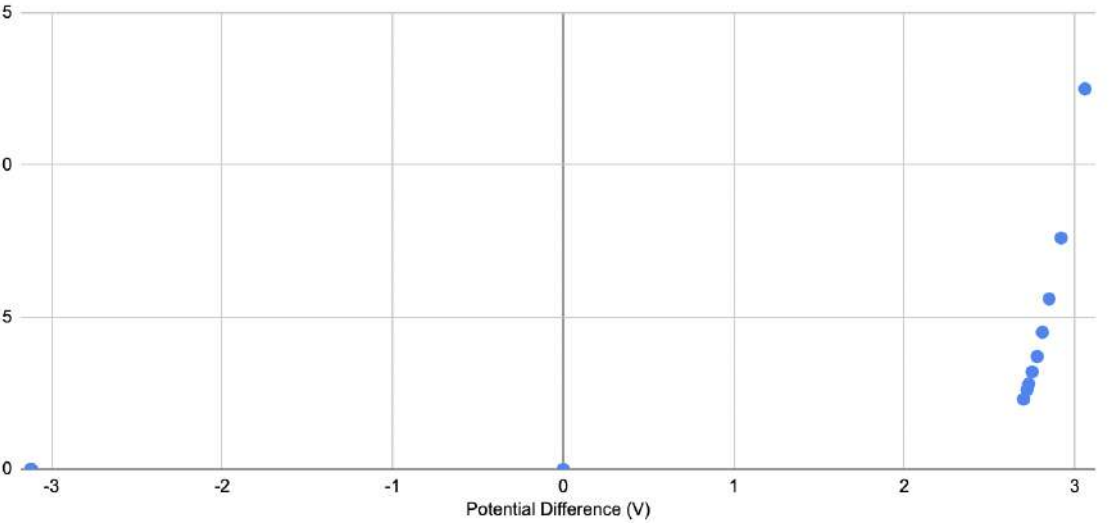


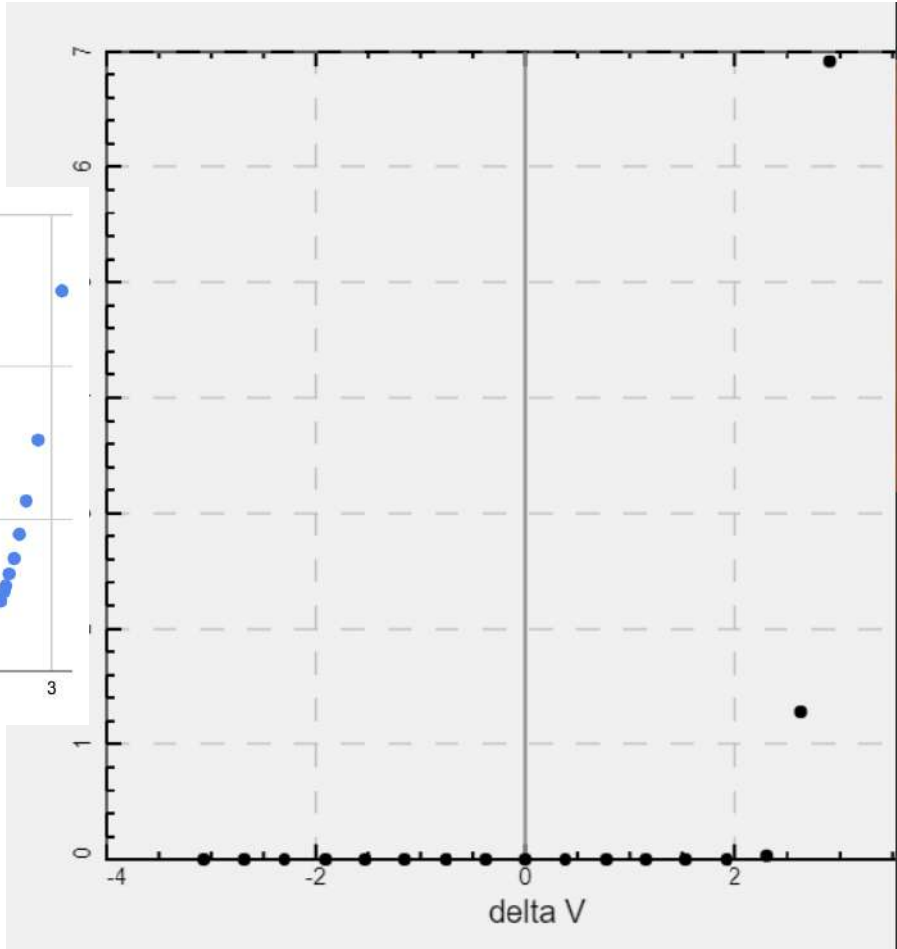


Team 1

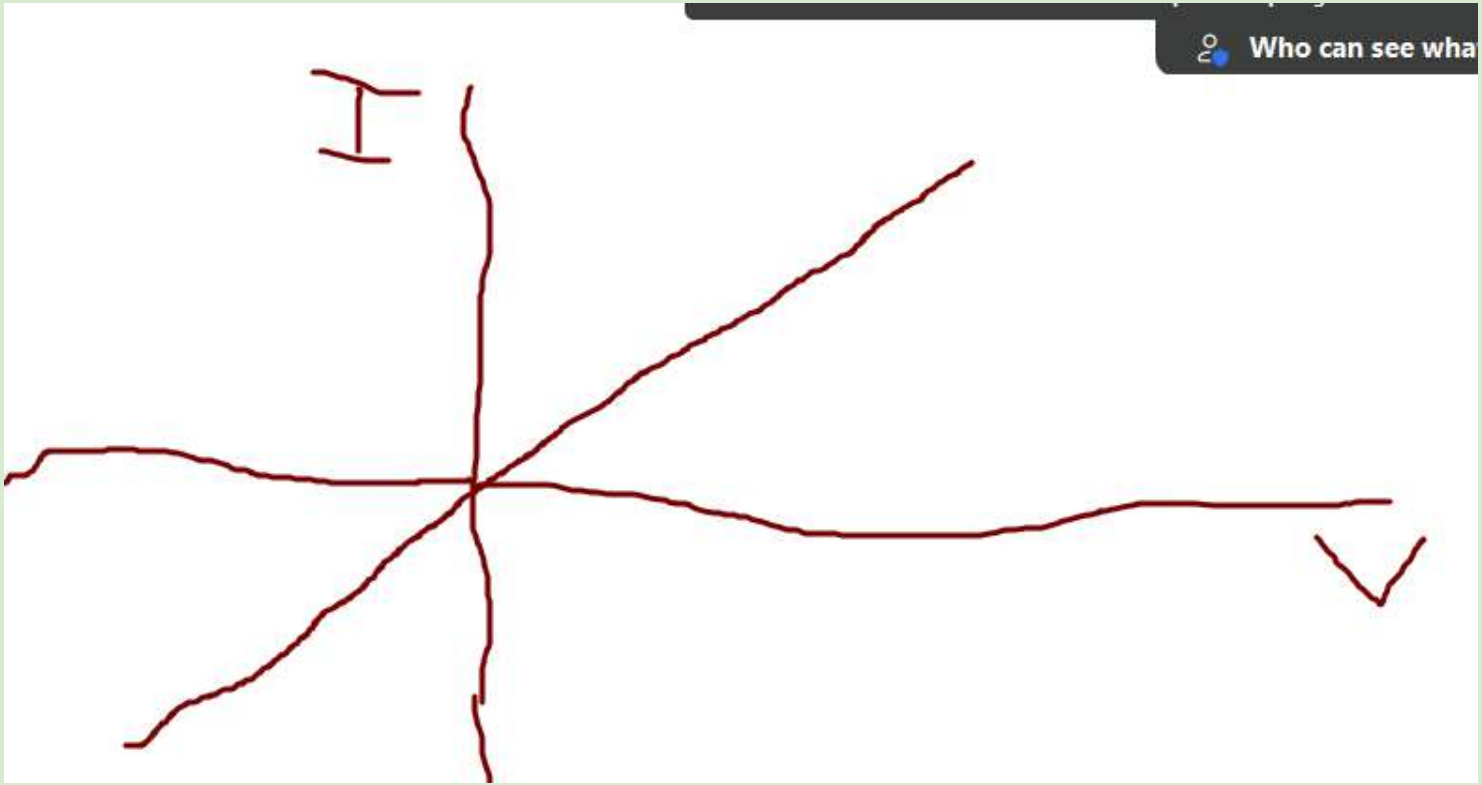


Team 1: with voltage divider g) and i)

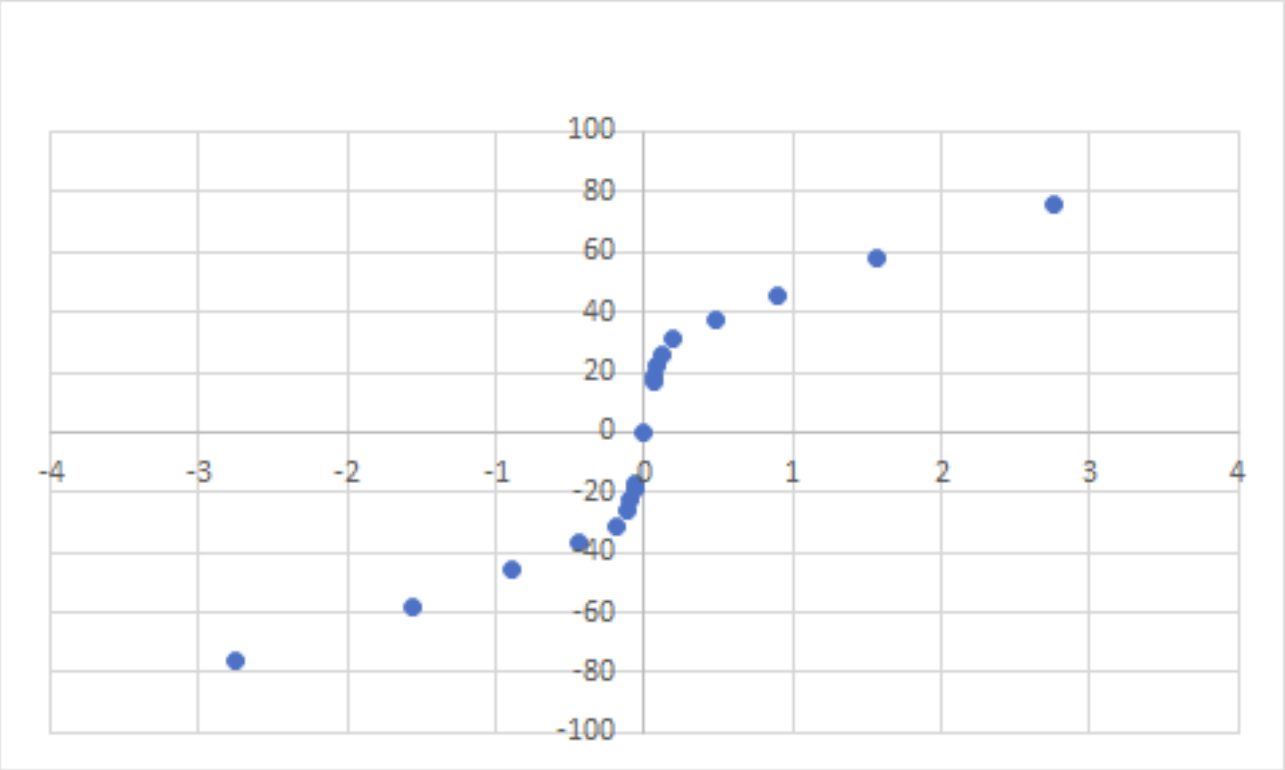


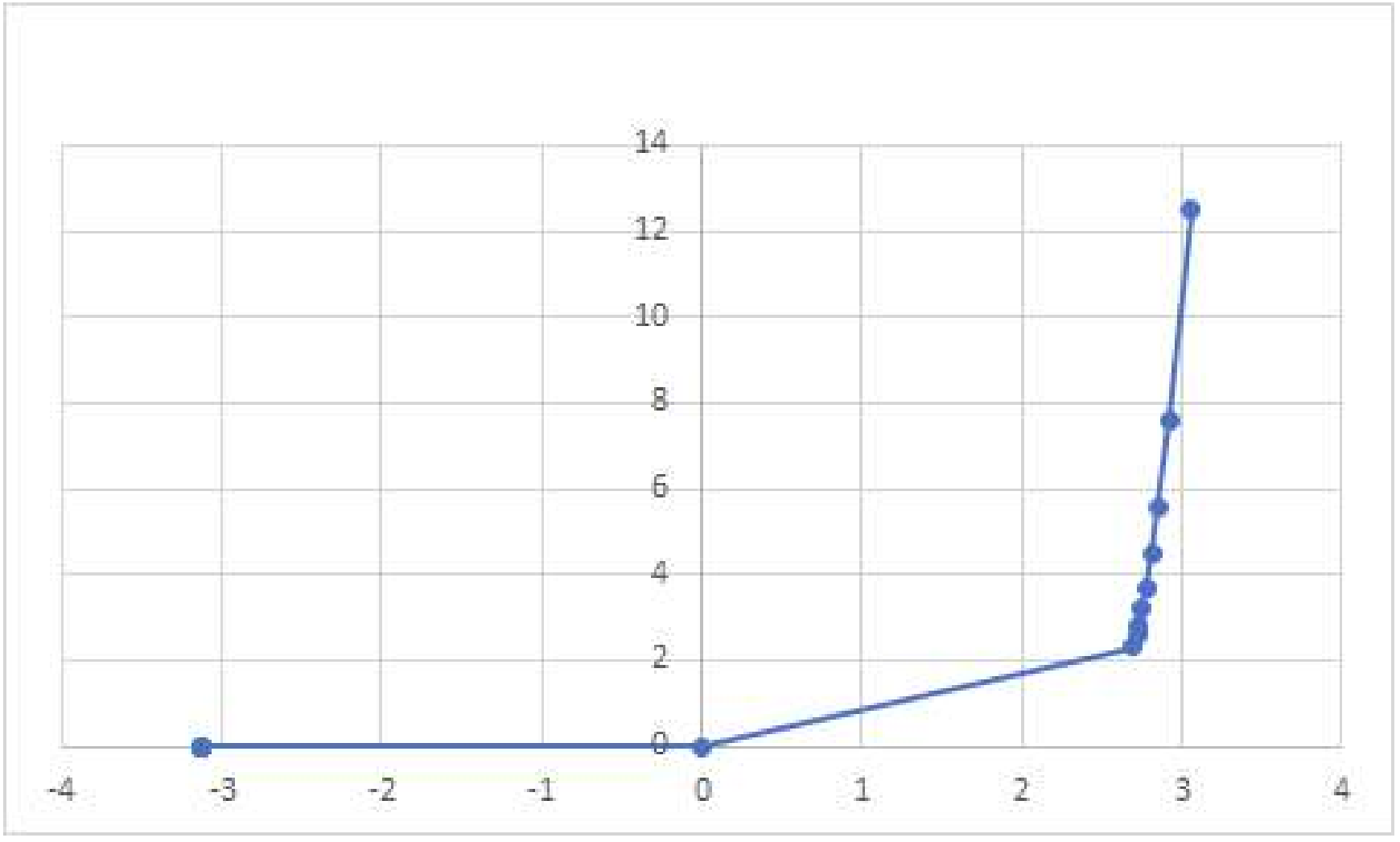


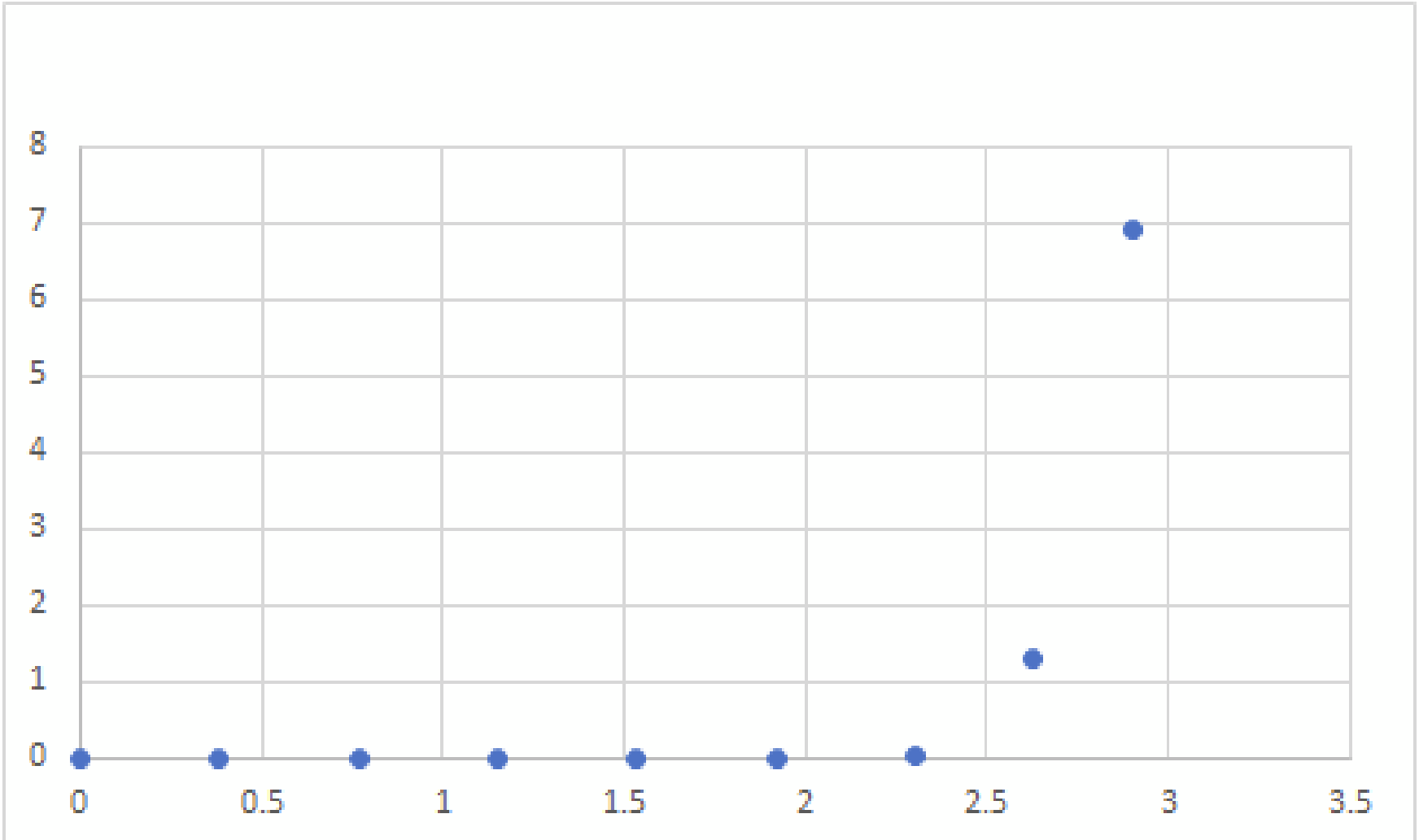
Team 2 Same document LED handout Part 2 Activities 1-3



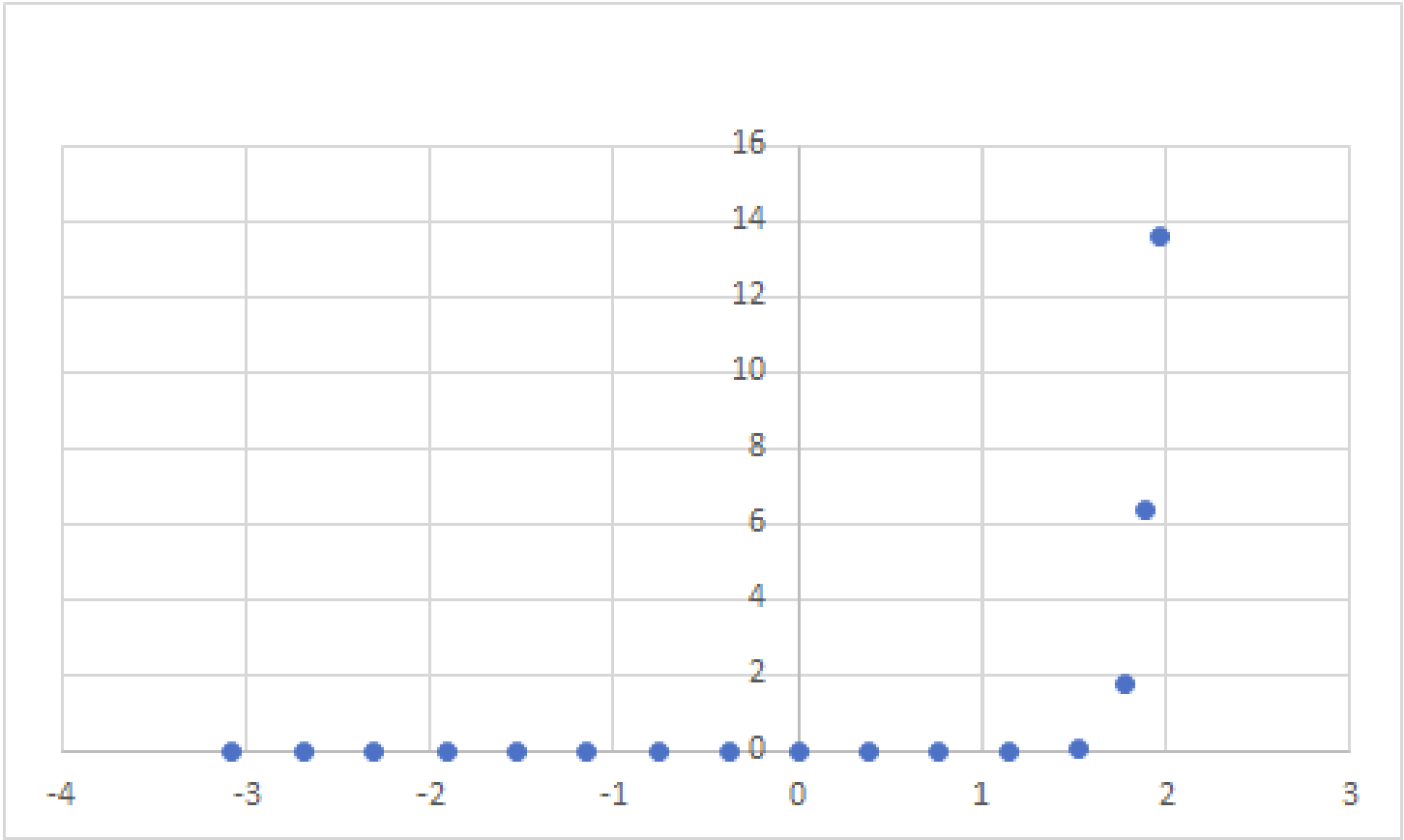
Team 2 Same document LED Handout Part 2 Activities 1-3




14
12
10
8
6
4
2
0
-4
-3
-2
-1
0
1
2
3
4

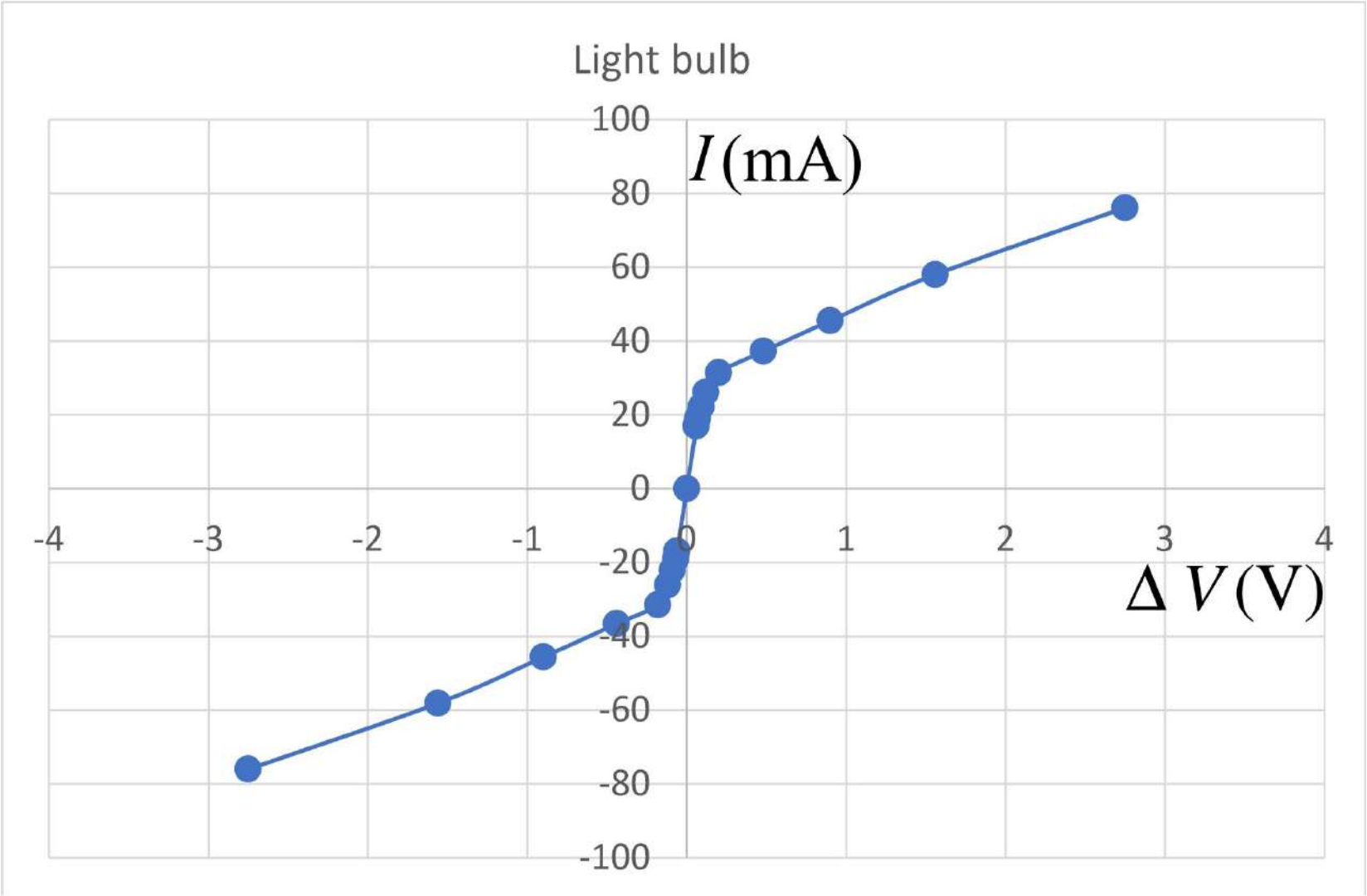

8
7
6
5
4
3
2
1
0
0
0.5
1
1.5
2
2.5
3
3.5

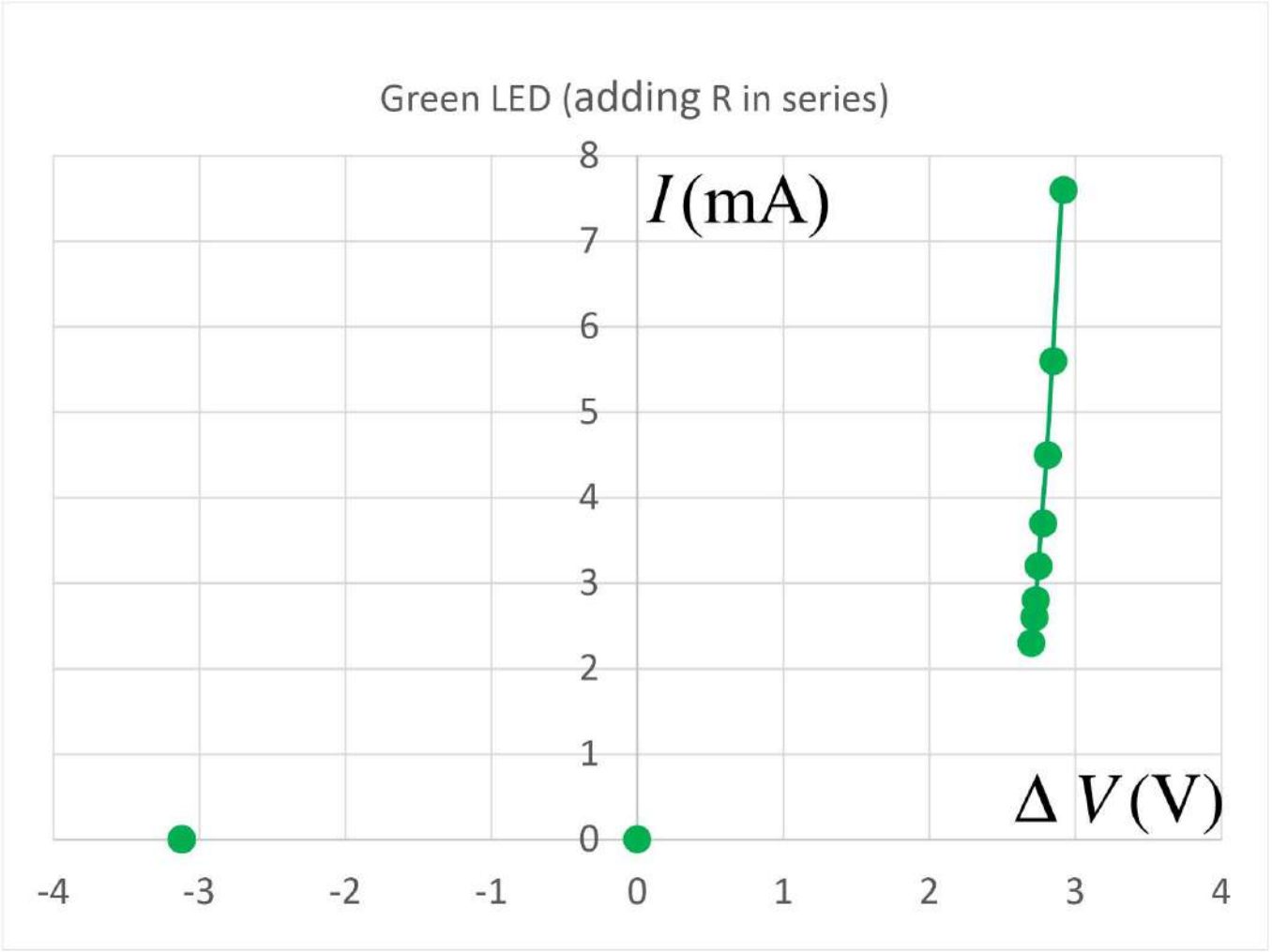
Red LED

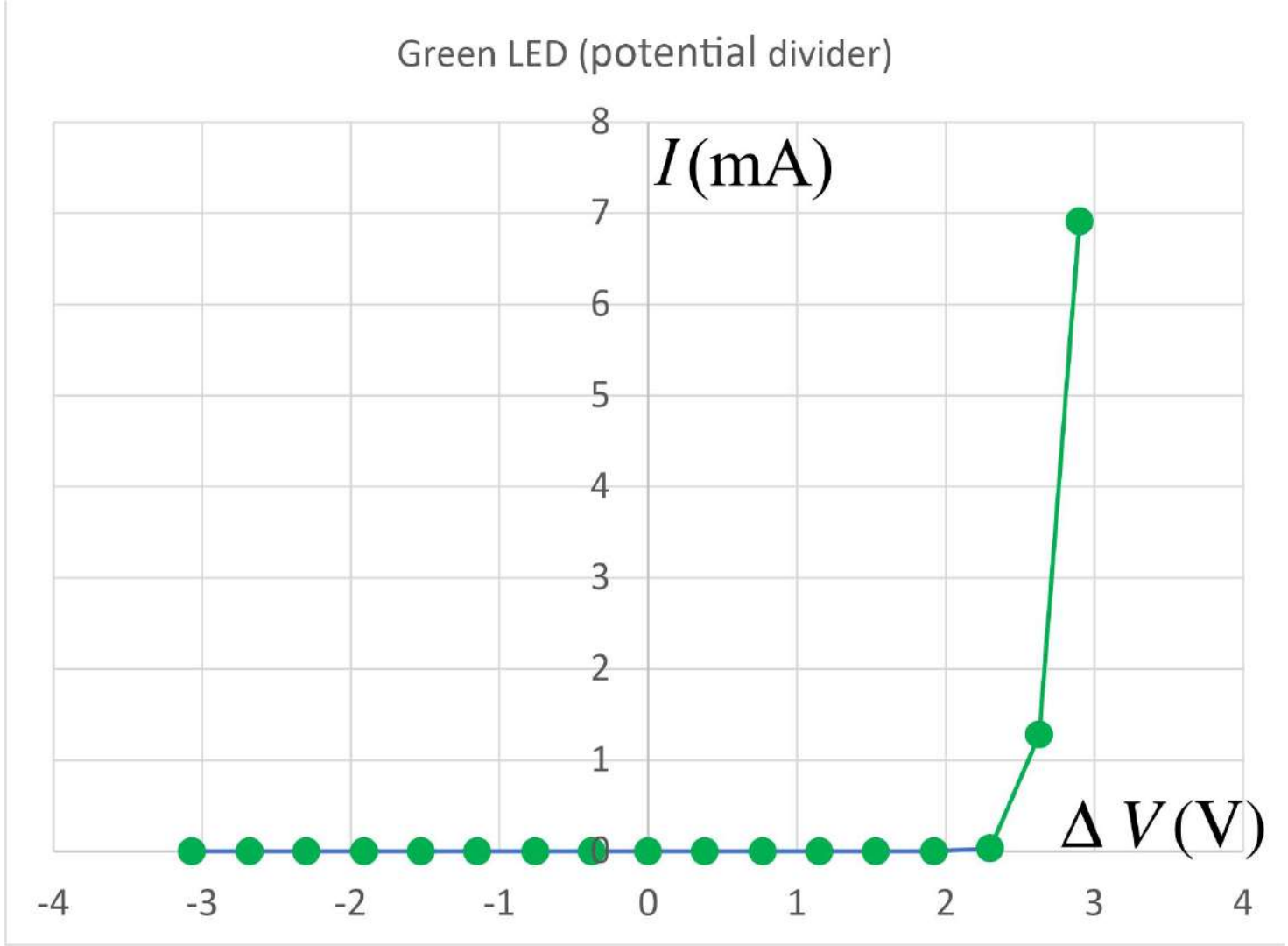


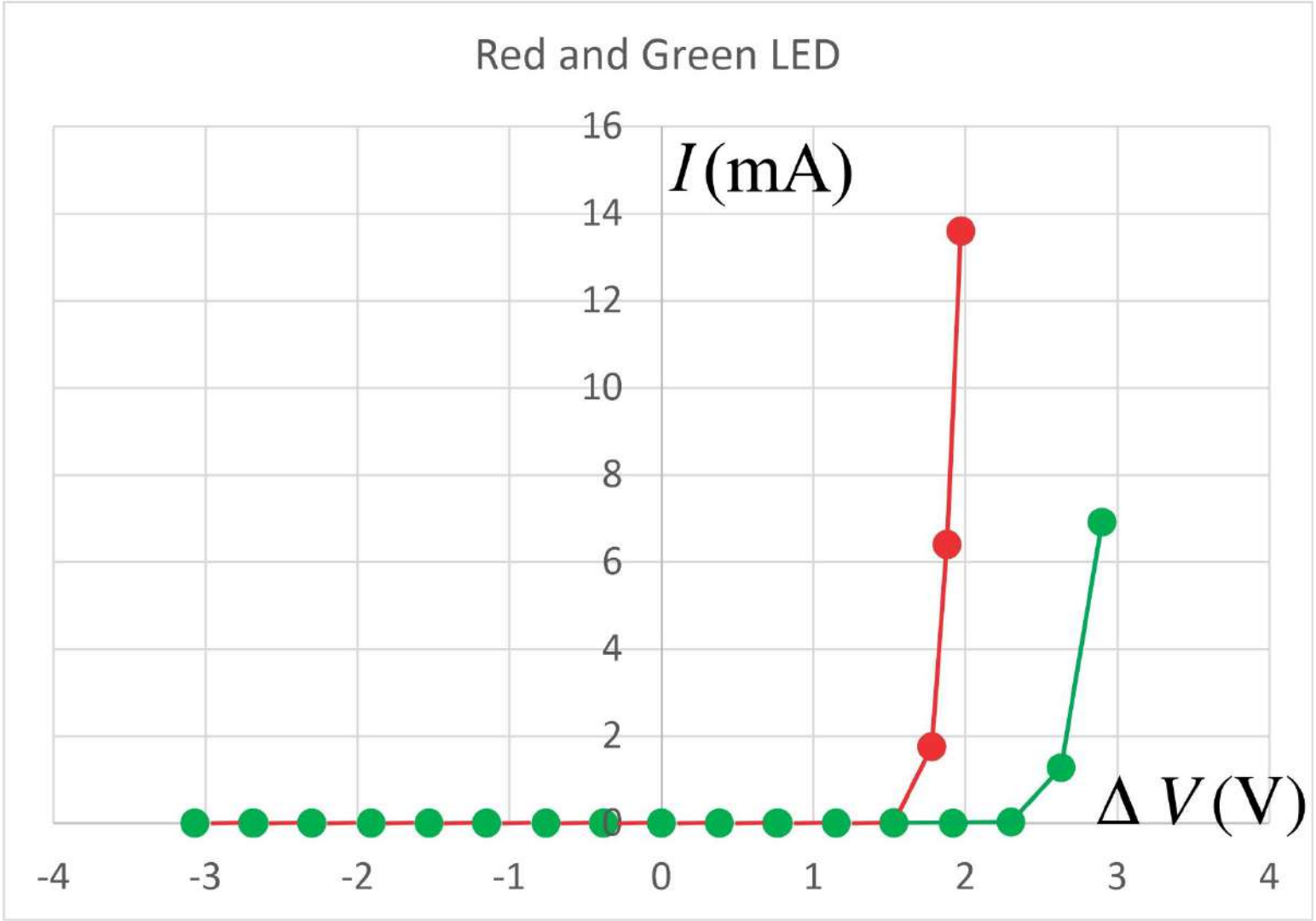
Summary

What did you learn about incandescent light bulbs and LEDs from these activities?


Light bulb
I (mA)
ΔV (V)
100
80
60
40
20
0
-20
-40
-60
-80
-100
-4
-3
-2
-1
0
1
2
3
4


Green LED (adding R in series)
I (mA)
ΔV (V)
8
7
6
5
4
3
2
1
0
-4
-3
-2
-1
0
1
2
3
4


Green LED (potential divider)
I (mA)
8
7
6
5
4
3
2
1
0
Δ V (V)
-4
-3
-2
-1
0
1
2
3
4


Red and Green LED
I (mA)
16
14
12
10
8
6
4
2
0
Δ V (V)
-4
-3
-2
-1
0
1
2
3
4

All together Activity 4

Application experiment 2 Use what you have learned about LEDs and what you know about AC circuits to predict the outcome of the following experiment: You connect an LED and a 300-ohm resistor to a 9-V AC transformer in series. Represent your prediction graphically. After you make the prediction, observe the instructor conduct the experiment. Suggest improvements to the experiment to make the behavior of the LED in AC circuits visible.

Observe the video of the experiment and compare the outcome to the prediction:

https://youtu.be/vhsopxZQuiE

All together. Part 3 Activities 1-3

1. *Observational experiment* In a bright room, connect a red or green LED to a voltmeter (no battery) and observe the reading on the voltmeter. Observe the outcome: https://youtu.be/I1399aZ2CLw
2. *Explanation* Devise an explanation/s for a non-zero reading of the voltmeter although it is not connected to a battery.

Explanations and testing experiments

Team 3. Part 3 Activities 1-3

Observe the outcome of our experiment: https://youtu.be/XPBrU4HP7NE

What does it tell you about your explanations?

All together - Part 4 all activities

Team 1 Part 5

The goal of this experiment is to design a procedure for a quantitative comparison of performance of an LED and an incandescent light bulb as light sources from the energy perspective.

Application experiment: Design a procedure that will allow you to compare the efficiency of conversion of electric energy to light energy of an incandescent light bulb and a white LED.
Observe the video of the experiment, collect the data and answer Question 5: Why do we use LEDs to light up our houses? https://youtu.be/0LaclpwZuK4

	Lightbulb	LED
Voltage (V)	2.88	3.08
Current (A)	0.77	0.19
Power (W)	2.2176	0.5852

77.9 mA 2.89 V P =

19,5 mA 3.06 V P= VI= (LED)

Team 2 Part 5

The goal of this experiment is to design a procedure for a quantitative comparison of performance of an LED and an incandescent light bulb as light sources from the energy perspective.

Application experiment: Design a procedure that will allow you to compare the efficiency of conversion of electric energy to light energy of an incandescent light bulb and a white LED.

Observe the video of the experiment, collect the data and answer Question 5: Why do we use LEDs to light up our houses? https://youtu.be/0LaclpwZuK4

The lightbulb uses 4 times more current than the the LED with about the same voltage. The lightbulb uses more power probably because there is energy transferred into heat energy. You could test that by touching the bulbs.

Click this link to follow the story

LED_theory 2.pptx

What did you learn today?

LED is quite complex device, a lot of physics inside it

Voltage divider is so simple but so cool thing

LED can change electric energy to light energy but vice versa also!

See inside LED without breaking it, using glycerin

The versatility of using LEDs to learn about so many different topics.

LEDs are connected to so many topics in Physics, and simple demos showing voltage with no batteries from light alone will generate lots of questions for students to wonder.

I loved learning that the led has voltage when exposed to light.

Power of simple observational experiments