

A PhET-Based Laboratory Activity in Teaching Direct Current Circuits (Guided Inquiry with Formative Assessment)

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Education in the 21st century is integrated with the Information and Communications Technology (ICT). Moreover, it is continually being rationalized and updated with the constant development and new advancement in technology.

The researchers believe that educators of today should align themselves with the new breed of learners who are living in this generation. The use of ICT in education is vital in the students' development of 21st century skills, specifically Information and Communications Technology (ICT) Literacy. As educators, we should be capable of utilizing available resources that are valid and reliable in order to provide students the knowledge and skills they need and are appropriate for them[1].

The PhET project provides a stimulation software on electric circuit called Circuit Construction Kit (CCK). It exploits the idea of greater level of interactivity, illustration power and provides immediate feedback to those who are using it [2]. The simulations create animated games, like environments where the visual and conceptual models that physicists use, are made accessible to students. As consistent with constructivism, overwhelming data points out that virtual environment can be a best replacement for real objects laboratory activity [3],[4].

The researchers of this study aim to develop a PhET-based laboratory activity in teaching direct current circuits to enhance student's performance in their test scores with the core emphasis of guided inquiry mode [5], [1].

The strengthening of internet, the improvement of support technologies, and the global goal of student centered and constructivist stance simply made a radical move to rethink of what we long-termed as “time-tested modalities” to be in the way of retooling as these would not fit into the kind of cognitive frame of the 21st century learners. And simply put, there are concepts that cannot be fully grasped and elucidated without the more insightful and more magnifying power of simulations [6],[7].

References:

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2. Keller, C. J., N. D. Finkelstein, K. K. Perkins and S. J. Pollock. (2007). *Assessing the Effectiveness of a Computer Simulation in Introductory Undergraduate Environments*. AIP Conf. Proc. 883, 121; Syracuse, New York. Retrieved from <http://dx.doi.org/10.1063/1.2508707>.
3. Finkelstein, N. D., W. K. Adams, C. J. Keller, P. B. Kohl, K. K. Perkins, N. S. Podolefsky, S. Reid, and R. LeMaster. (2005). *When Learning About The Real World Is Better Done Virtually: A Study Of Substituting Computer Simulations For Laboratory Equipment*. Phys. Rev. ST Phys. Educ. Res. 1, 010103. Retrieved from <http://journals.aps.org/prstper/abstract/10.1103/PhysRevSTPER.1.010103>.
4. PhET Interactive Simulations. (2015). *About PhET*. Retrieved from <http://phet.colorado.edu/en/about>.
5. Moore, E. B., T. A. Herzog and K. K. Perkins. (2013). *Interactive Simulations As Implicit Support For Guided-Inquiry*. This article is part of themed collection: The Application of Technology to Enhance Chemistry Education. DOI: 10.1039/C3RP20157K <http://pubs.rsc.org/en/Content/ArticleLanding/2013/RP/C3RP20157K>
6. Rehn, D. A., Moore, E. B., Podolefsky, N. S., & Finkelstein, N., JoTLT. (2013). *Tools For High-Tech Tool Use: A Framework And Heuristics For Using Interactive Simulations*. 2(1), p. 31-55. Retrieved from <http://jotlt.indiana.edu/article/view/3507>.
7. Winsberg, Eric. (2015). "Computer Simulations in Science", *The Stanford Encyclopedia of Philosophy* (Summer 2015 Edition), Edward N. Zalta (ed.). Retrieved from <http://plato.stanford.edu/archives/sum2015/entries/simulations-science/>.

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Group No.: _____

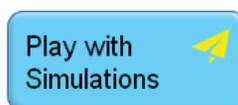
What happens in a Circuit?

Directions:

1. Log on to your computer
2. Go to the following website:

<http://phet.colorado.edu/en/simulation/circuit-construction-kit-dc>

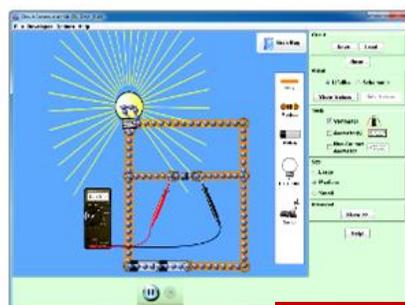
Click the button that says “Play with sims...”



3. On the side bar under Simulations, select By Grade Level and pick Elementary School. Then, scroll down and click on the application that says Circuit Construction Kit (DC Only).
4. Click “Run now.”



Circuit Construction Kit (DC Only)

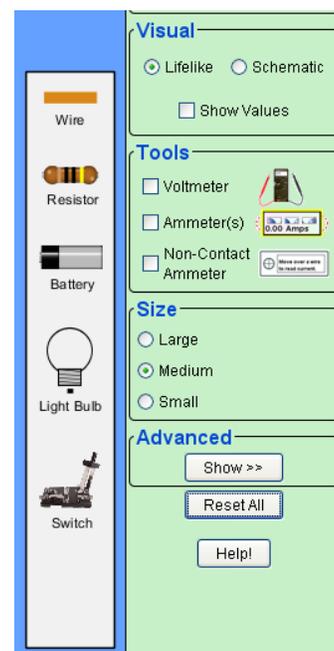


Download 2,207 kB

Run Now!

Embed

Version: 3.20 (change log)



5. You now have the raw material to create a circuit. Take a moment to look over the site and find all the different materials. To build a circuit you will need several wires, a light bulb, a battery, a switch, and a resistor. Play with it to see how to grab and manipulate these tools.

6. Click the reset button.



Introduction



Image Source:

img08.deviantart.net/8397
f/2014/291/1/7/circuit_ma
n_powered_up_by_ultimat
emaverickx-d7zvcj3.png

Hello Kids! Did you know that electricity flows in a path called **circuit**? An electric circuit is composed of interconnected electrical components. These components form a complete path of an electric circuit.

By the way, I am Circuit Man, and I badly need your help! The people in Bright Town have been experiencing a *blackout* for three days now. This is because Scorch Man has stolen all the components of my circuit. He would only give each component back if I do the activity, and answer all his questions correctly.

Please help me bring light to Bright Town again!



Bright Town is wrapped in *darkness*!



WORD BANK:

Black out is a period of darkness caused by a failure of electrical power.



Learning Competency

I am Scorch Man!
If you can determine the effects of changing the number or type of component in a circuit, then you can help Circuit Man. If not, Bright Town will be in darkness forever!



Procedure

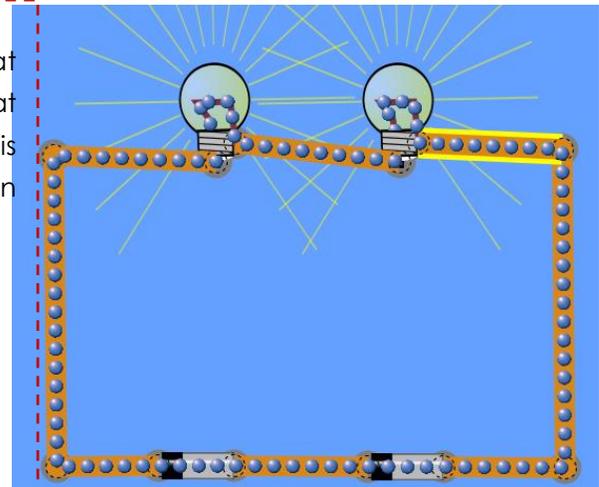
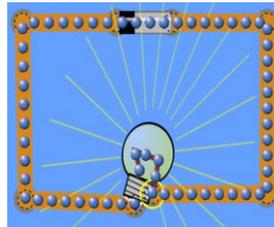


I. There are two types of circuits, the series circuit and parallel circuit. Using the Circuit Construction Kit, build a simple series circuit that consists of 10 pieces of wire, 2 light bulbs, and 2 batteries.

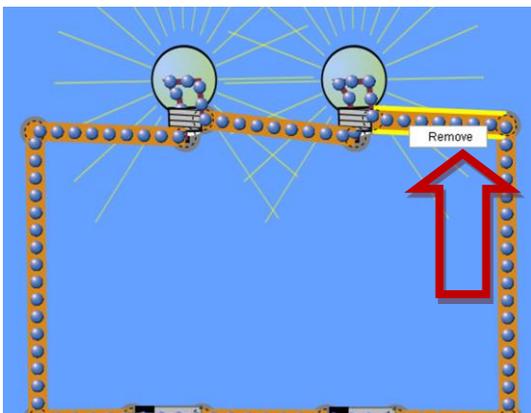
Your circuit may look like the image below.

NOTE:

In order to complete the circuit, the red circles at the end of each must overlap. Please note that the light bulb also has TWO circles. Your circuit is complete and working when the light comes on and the blue dots begin moving.



II. Now right click on one of the wires connected to a light bulb, and click remove.



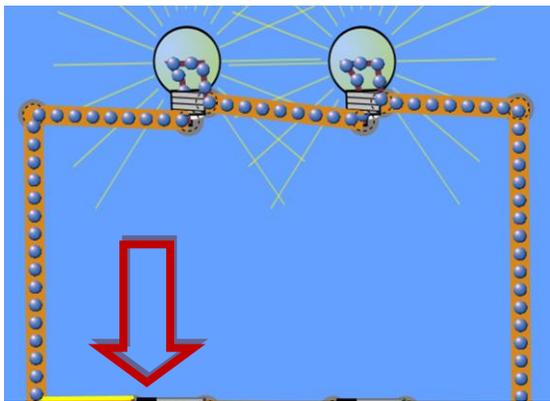
Question A:
What did you observe?





Answer to Question A:

III. Return the wire you removed in II. Then, remove one of the wires touching the battery.



Question B:
What happened to the light bulbs and the blue dots in the circuit?



Answer to Question B:

IV. Return the wire you removed in III. Now, add a light bulb to the circuit.



Question C:
What happened to the brightness of the light bulbs?
How about the flow of the blue dots in the circuit?



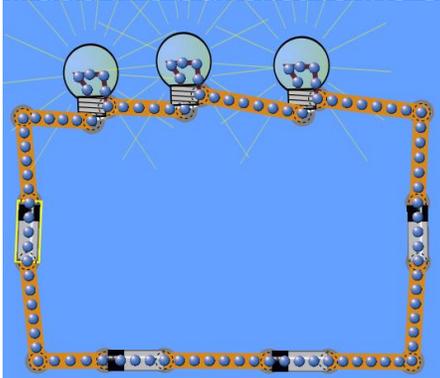
NOTE:

To add a light bulb, right click on one of the wires connected to the bulb, then press **Split Junction**. Then grab a light bulb and wire to complete the circuit.



Answers to Question C:

V. Then, add two batteries to the circuit.



Question D:
What happened to the light bulbs? How about the flow of the blue dots in the circuit?





Answers to Question D:

VI. Raise your hand and let your teacher check your working series circuit.

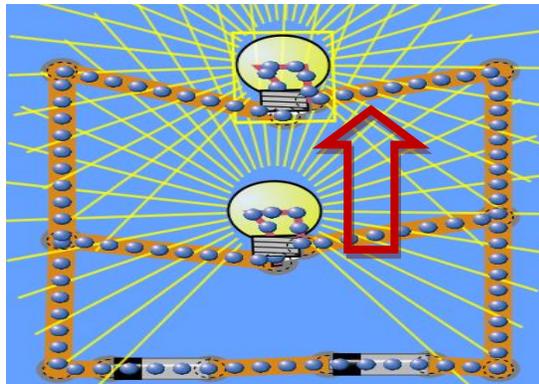
Click the **Reset All** button to begin working on the next circuit. Parallel circuits provide more than one path for electrons to move. Create a parallel circuit in the Circuit Construction Kit, using 10 wires, 2 batteries and 2 light bulbs.

Your circuit may look like the image below



NOTE:

Your circuit is complete and working when the light comes on and the blue dots begin moving.



VII. Now, right click on one of the wires connected to a light bulb. Remove the wire.

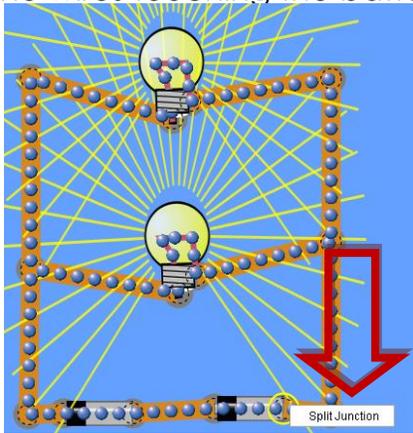
Question E:

What did you observe?



Answers to Question E:

VIII. Return the wire you removed in VII. Then, remove one of the wires touching the battery.



Question F:
What happened to the circuit?



Answers to Question F:

Question G:

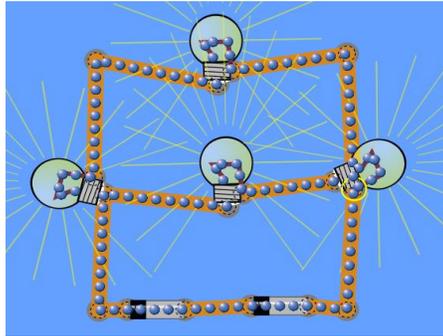
What is the difference between removing the first wire and the second? Why is this significant?

Answers to Question G:





IX. Add two light bulbs to the circuit.
Your circuit now looks like this.

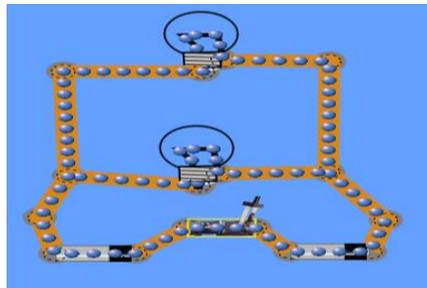


Question H:
What happened to the light bulbs? How about the flow of the blue dots in the circuit?

Answers to Question H:



X. Remove the two light bulbs and add a switch to the circuit.
Your circuit now looks like this.



Question I:
What happens when you turn on the switch? How about when you turn it off?

Answers to Question I:



XI. Raise your hand and let your teacher check off your working parallel circuit.

Question J:

What do you think do the moving blue dots represent?

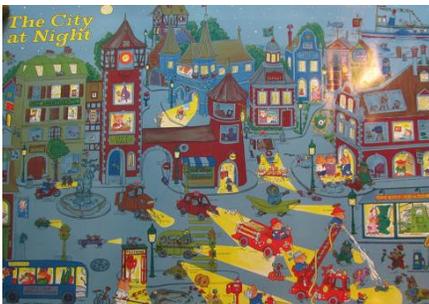


Answers to Question J:

What's Your
**BIG
IDEA?**

Conclusion

How does changing the number or type of component affect a circuit?



Thank you!
You have helped me bring light back
to Bright Town.
GREAT JOB!

