SMART amp usage in Electricity & Magnetism

Greg Mulcair | John Abbott College

2016-06-02 | SALTISE pre-conference

JOHN ABBOTT CEGEP/COLLEGE

About me

- Greg Mulcair
  - Teaching at John Abbott since Feb 2009 (8.5 years)
    - Teacher in the Physics Department and Engineering Tech. program until 2015
    - Exclusively in the Physics department since 2015
  - Aerospace engineer before starting teaching
    - B.Eng. (Mechanical, McGill)
    - M.Eng. (Aero, Polytechnique)
    - 2 years at Pratt & Whitney Canada

My approach

- Active learning
  - Member of Active Learning Community of Practice
  - Peer instruction workshops given in India, China, various conferences
- Blended learning
  - Member of the Blended Learning Community of Practice
  - Pilot project leading to implementation of college guidelines in IPESA
- New technologies
  - Member of PUNT (Pedagogical Use of New Technologies) Committee (a sub-committee of Academic Council)
  - Promoter of efficient and effective uses of new technologies in the classroom, in the department and for remote learning.

My class

- I teach all three required Physics courses:
  - Physics NYA: Mechanics
  - Physics NYB: Electricity & Magnetism
  - Physics NYC: Waves, Optics and Modern Physics
- This semester:
  - Physics NYB: Electricity & Magnetism
  - Two sections (45 students each)
  - Two classes (1.5 hr) and one lab (2 hr) per week per section

Tools used

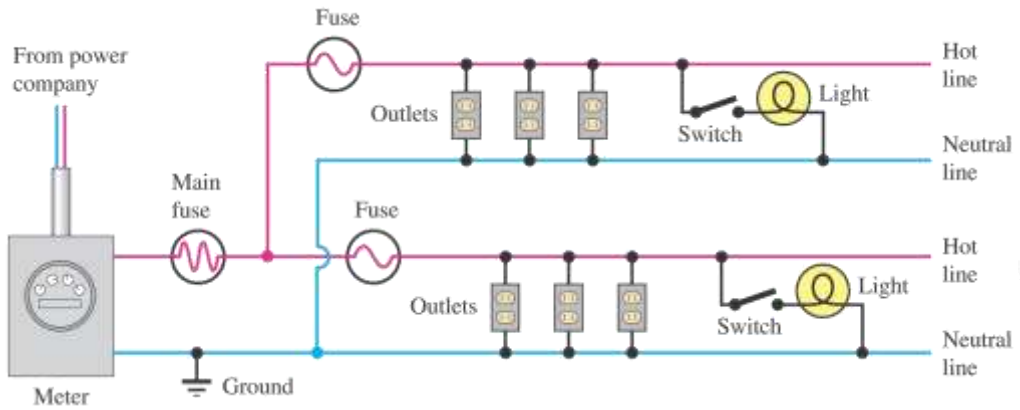
- Moodle used primarily:
  - Class forum
  - Lecture slides
  - Lab guidelines
  - Project instructions
  - Video solutions
- Lon-Capa used for online assignments
- Lea used for Gradebook

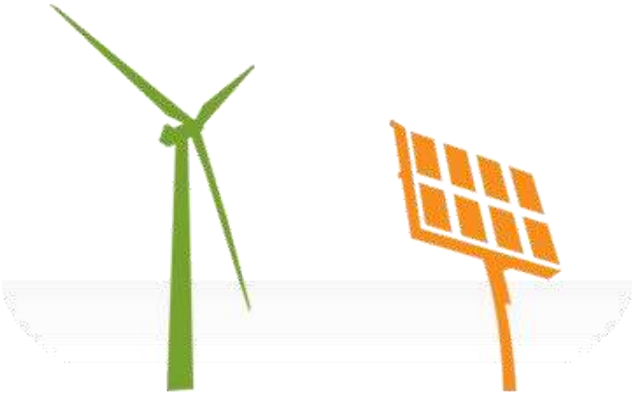
Classroom setup

- One section is in a standard Physics classroom
  - One SMART Board
  - Whiteboards on all walls
  - Fixed furniture
- One section is in the Active Learning classroom
  - Four SMART Boards
  - Whiteboards on most walls
  - Moveable furniture, rolling chairs

Electrical consumption project

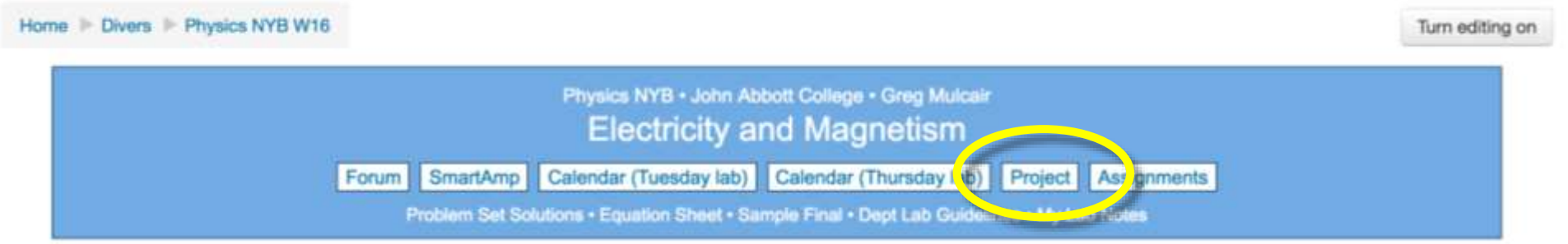
- A student project worth 5% of the final grade covering:
  - Home electrical wiring
  - Power consumption
  - Alternative sources of renewable energy (wind and solar)





Electrical consumption project

- Moodle forum to organize all project aspects:
  - Posting of initial instructions
  - Groups
  - Pre- and post-class work
  - SMART amp instructions
  - All instructions revealed as project progresses



Electrical consumption project

- Four distinct parts to the project:
  - Part 1: Home circuit investigation
  - Part 2: Check your group members' circuits
  - Part 3: In-class work with SMART amp
  - Part 4: Investigation into possibility of living off-grid

Part 1: Individual pre-class work

Project

Objective

This project counts for 5% of your grade in this course. The objective is to help you gain familiarity with everyday electronic circuits like the ones throughout your home, to understand their limitations and to see why we have breaker boxes which can stop those circuits if needed.

Part 1: Home circuit investigation

Due date: Sunday, March 13th, before midnight
Done by: Each student individually (no groups)
Submit your work: Through the Moodle forum (details below)

Step 1:

Take a photo of the breaker box in your home/condo (if this is not possible, take one from the home of a friend or family member). Here is how it should look (source: Wikipedia article on Distribution Boards)

Part 1: Individual pre-class work (cont'd)

Step 2:

Each circuit breaker (black switch) controls one circuit in your home, and the name of the area/room for that circuit is usually clearly identified (e.g. kitchen, bedroom 1, bedroom 2, etc...). Take note of all the different rooms/areas that are listed (you will use these later).

Step 3:

Choose one area/room from your home (for example: Kitchen), and choose one electrical device that would typically be plugged there (for example: Toaster).

Log into Moodle and visit the Project forum. Look at the posts that your classmates have posted. If someone has already posted the same device that you want to post, you need to find a different one.

Take a photo of that electrical device, and take a photo of the "power rating" that should be inscribed on it. For example:

Part 1: Individual pre-class work (cont'd)

Step 4:

Draw a simple circuit diagram for when that one device is plugged in. There should only be two elements to your circuit (the 120 V power supply and the device you selected). Calculate the current passing through the circuit when the device is being used. Remember that since you know the power the device will demand (P) and you know the voltage it will be provided (V) you can easily use the power equation to find the current that will be drawn.

Step 5:

Refresh this page and look at the posts that your classmates have posted at the bottom of this page. If someone has already posted the same device that you want to post, you need to start over and find an original one.

Once you have an original device, create a new post by clicking the **Add a new discussion topic** button at the bottom of this page. (Note: When you click the button, the whole page reloads so you will need to scroll back to the bottom of the page).

The **Subject** of your post should be "*Room Name - Device Name*" where you replace *Room Name* with whatever room/area you have chosen, and you replace *Device Name* with whatever device you have chosen.

In the actual **Message** part of your post, start by typing out all the rooms/areas that have breakers as a bulleted list. For example:

- Kitchen
- Bedroom 1
- Etc...

Upload the photo of your breaker box.

Upload the photo of your device and it's power rating.

Upload the photo of your circuit diagram including the calculation of the current through the circuit.

Publish your forum post.

Part 2: Group work, peer help

- Based on their chosen device in Part 1, students are put into groups which represent one room with those devices (e.g. Kitchen, Bedroom, etc…)
- Students verify the work done by the members of their team in Part 1 and provide a reply with their comments

Part 2: Check your group members' circuits

Due date: Wednesday, March 16th, before class
Done by: Each student individually (no groups)
Submit your work: Through the Moodle forum (details below)

Step 1:

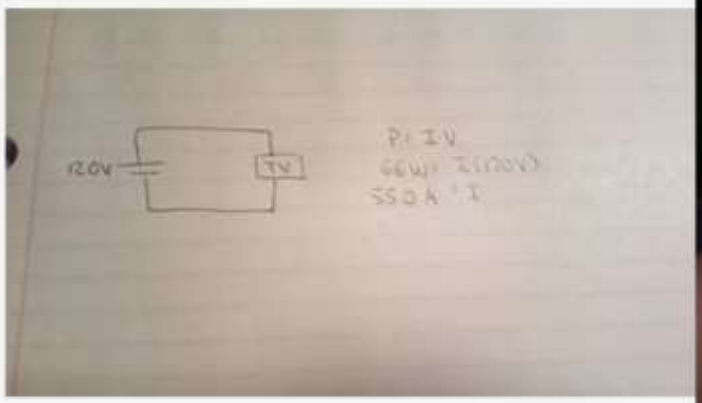
Click the following link to find what "Group room name" you have been assigned and who is in your room (these are your teammates for the rest of this project):

- Morning class, click here
- Afternoon class, click here

Step 2:

Open each of your teammates' forum posts in the Moodle Project forum. Read their post, analyse their circuit (compare with the power rating on the sticker of their device) and make any corrections by posting a "Reply" to their post. If there are no corrections to make and everything looks good, you can simply reply "Everything looks good!". But you must submit a reply to each of your teammates' posts.

Example: Student assistance



Edit | Delete | Reply

Re: Bedroom - TV
by [redacted] - Monday, 14 March 2016, 10:00 PM

It's hard to tell, but your current value should be 0.55A not 55A...66/120=0.55 :) I may just not be seeing it properly though!

Show parent | Edit | Split | Delete | Reply

Re: Bedroom - TV
by [redacted] - Monday, 14 March 2016, 10:51 PM

Oh wait you're right! It should be 0.55 A, thank you! :)

Show parent | Edit | Split | Delete | Reply

Part 3: In-class SMART amp group work

Part 3: In-class work with SMART amp

Due date: Wednesday, March 16th, end of class
Done by: Groups
Submit your work: Through SMART amp (details below)

The following steps will be explained in class before we do the activity, and you will be given an instruction handout with screenshots.

Step 1: Come to class with a tablet or laptop

Step 2: Sit in your groups. Move desks around to be comfortably sit to collaborate together.

Step 3: Log in to SMART amp by visiting www.smartamp.com.

Step 4: Open the "Home Circuit" worksheet for our class. From the left-hand menu, choose the "Bookmarks" icon and click the bookmark that has your room name. This will zoom you into one of the 11 spaces available to build the circuit for your room.

Step 5: Type your room name and student first names below the area for your circuit.

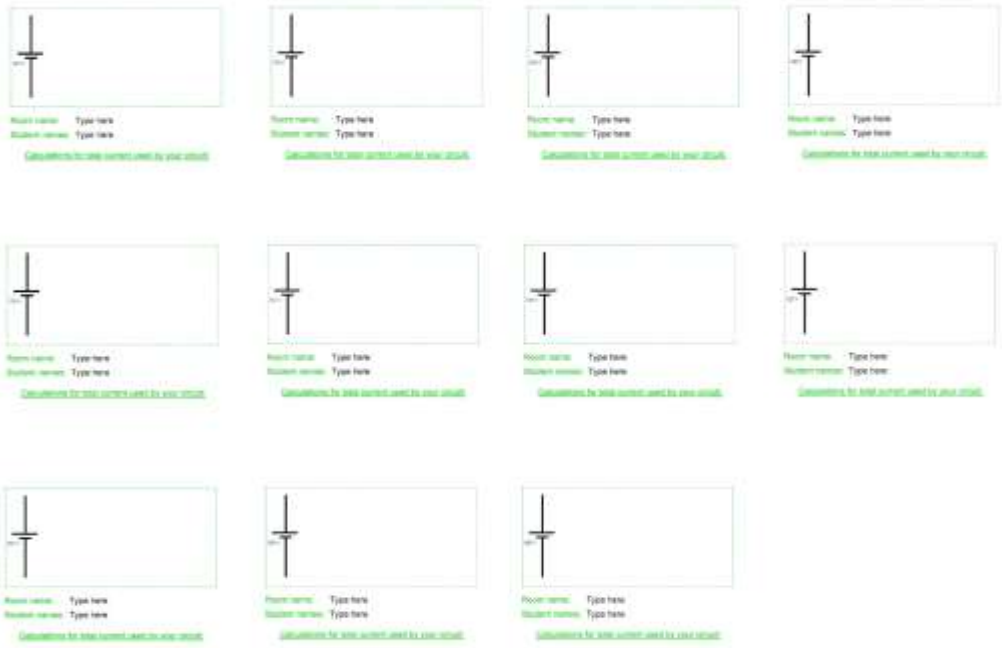
Step 6: Draw your home circuit and calculate the current it uses when all devices are turned on.

Step 7: The current limit for a typical home wire is 20 A. If your circuit's total current exceeds that when all devices are on, choose the maximum number of devices that can be on at any moment, and now re-calculate the current your circuit uses.

Step 8: As a class, we will build the home circuit and discuss the total current and total power used, as well as how the metre measures this in kWh.

SMART amp home circuit

- Students start with empty SMART amp workspace.
- They follow the instructions to build the circuit for their group's room.
- On the front SMART Board, we can see the entire circuit being built

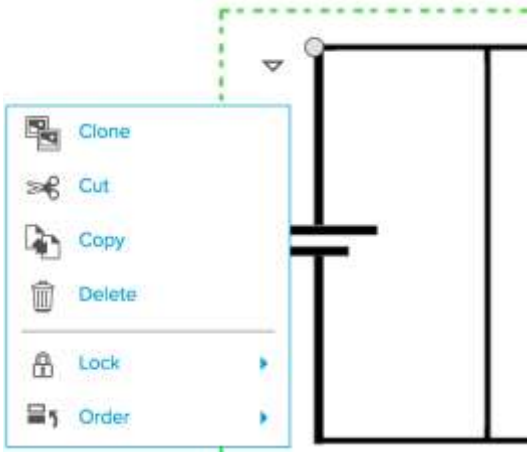


SMART amp interface

- In the menu bar at the top, you can use the:

  - Hand to move the page
  - Pencil to draw
  - Eraser to erase
  - Magnifying glass to zoom
  - Garbage to delete an item

- When you select an item, the dropdown menu allows you to easily clone or delete it.

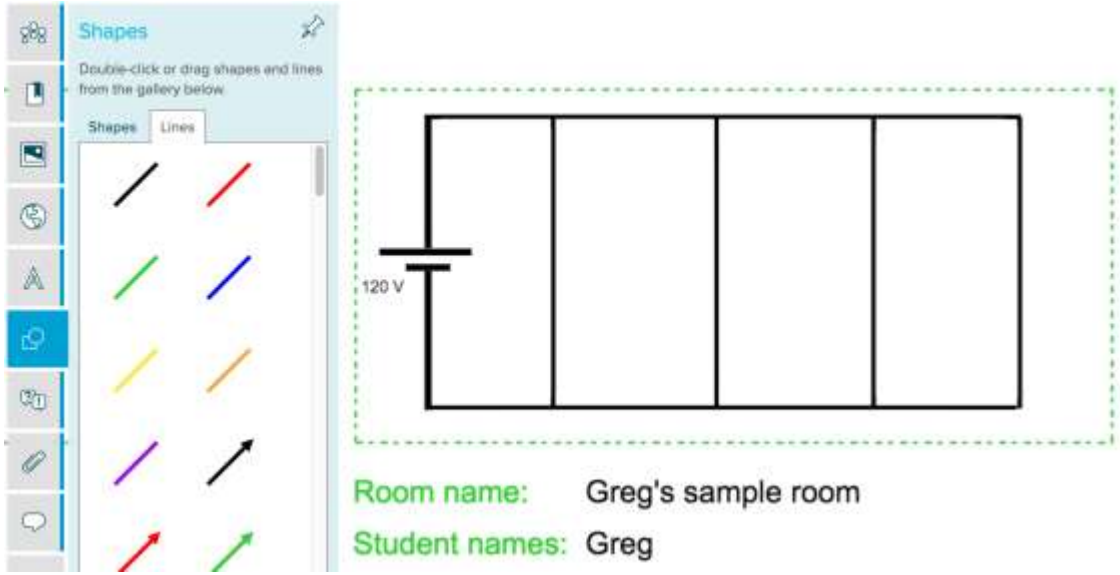


Activity

- Log into SMART amp (www.smartamp.com)
- Open the workspace for our class:
  - "Home circuit – Morning class" or
  - "Home circuit – Afternoon class"
- Click the Bookmark icon and click the bookmark with your room name:
- This will zoom you into your room's circuit. Type the room name and the first names of the students in your group

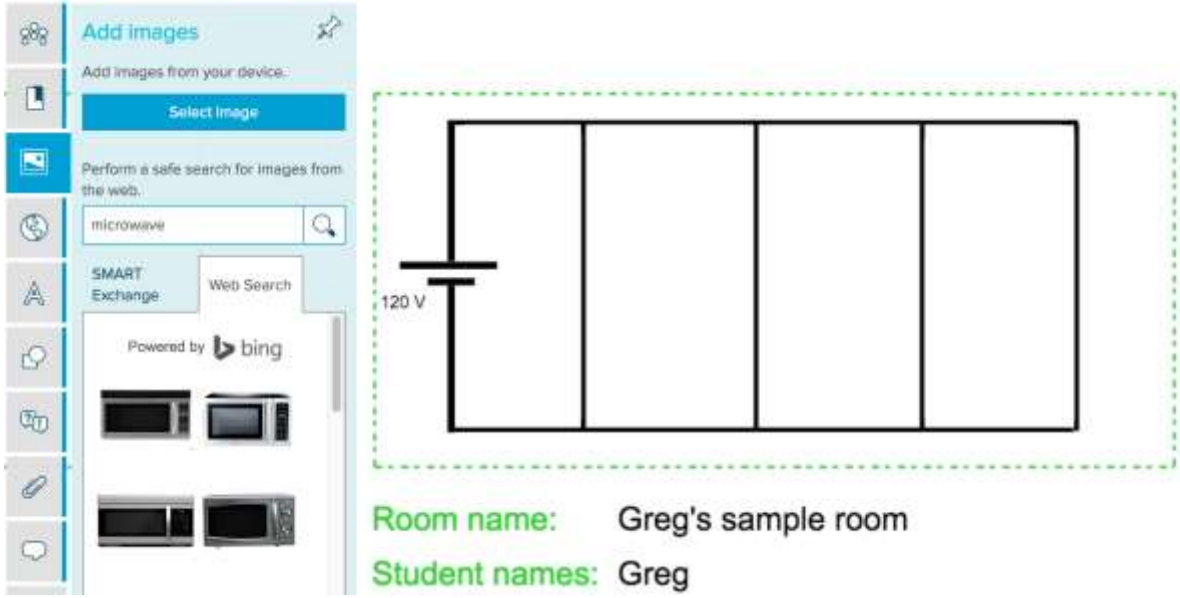
Draw lines of circuit

- Start your circuit using **Lines** in "Shapes"



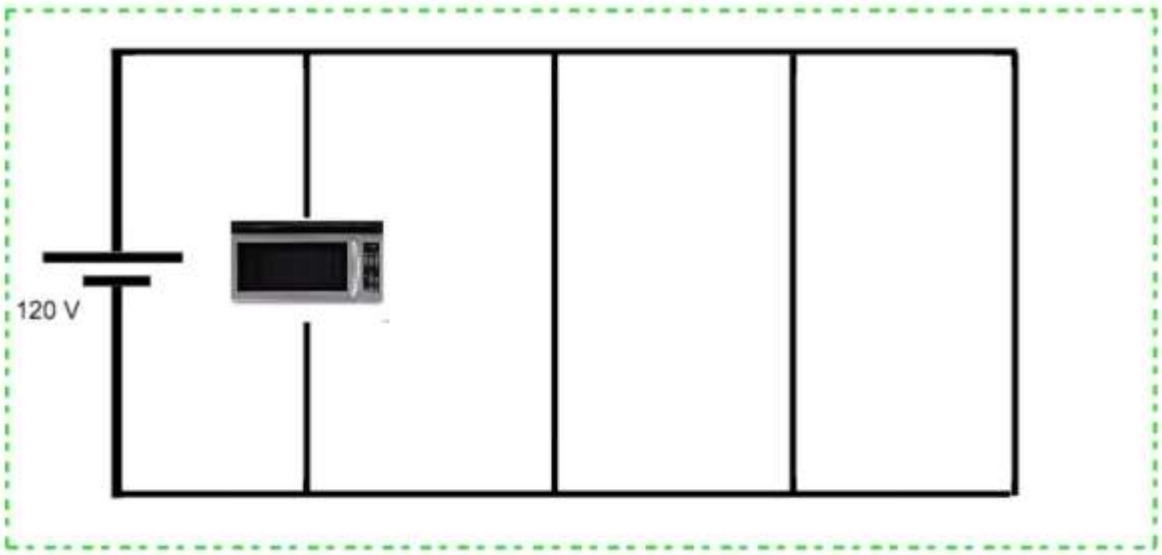
Add devices

- Find the device from a **Web Search** in "Images"



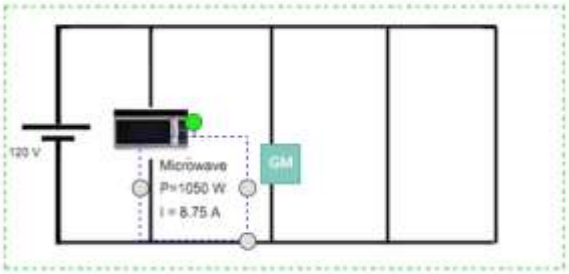
Add the image to the circuit

- Drag the found image into the circuit and resize



Add device name, power, current

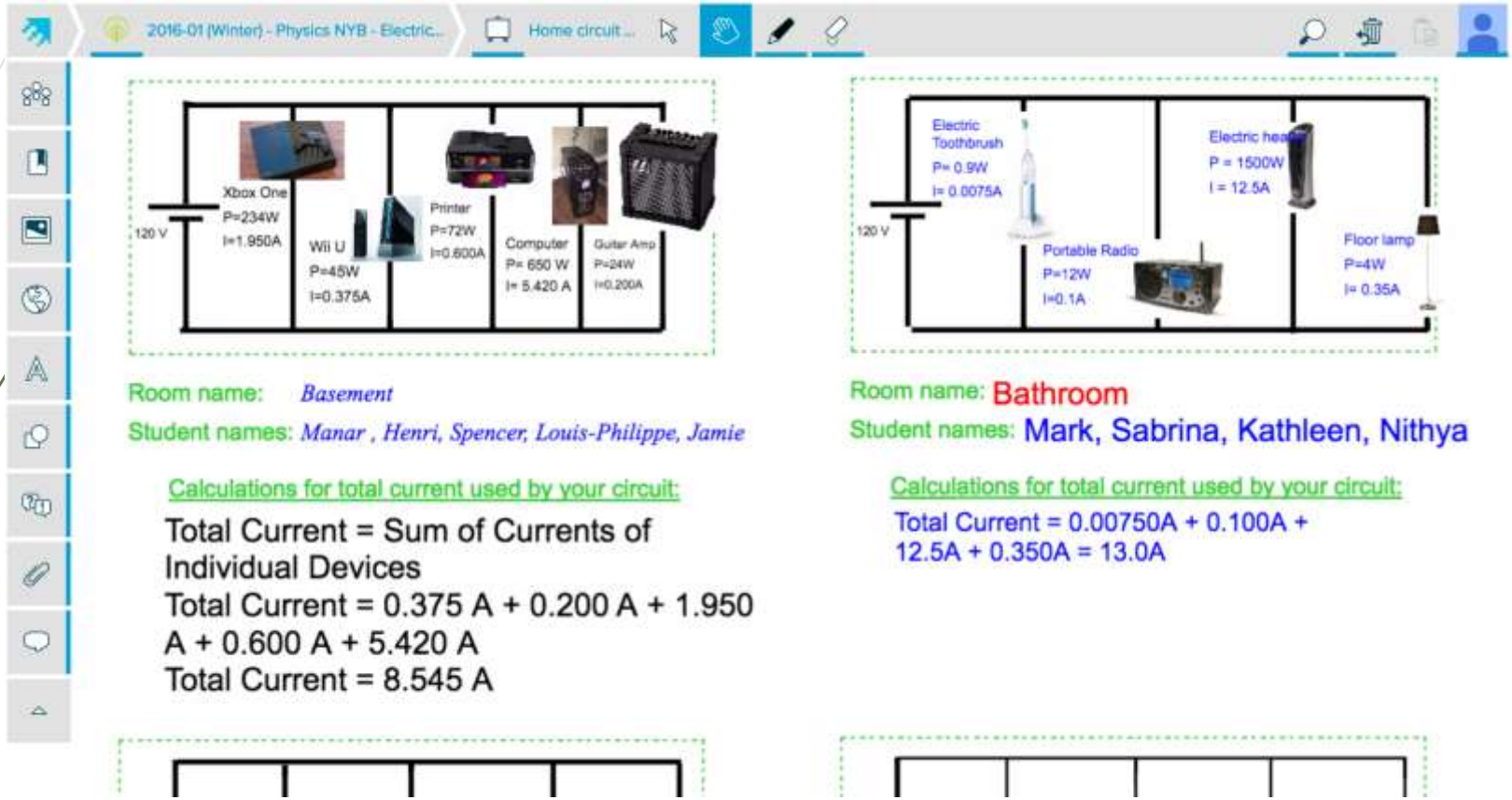
- Calculate the current used by the device.
- Drag a text block into the circuit from "Text" 
- Double-click it to enter the text edit mode.
- Change font size to 18pt.
- Type the name, power and current for the device.



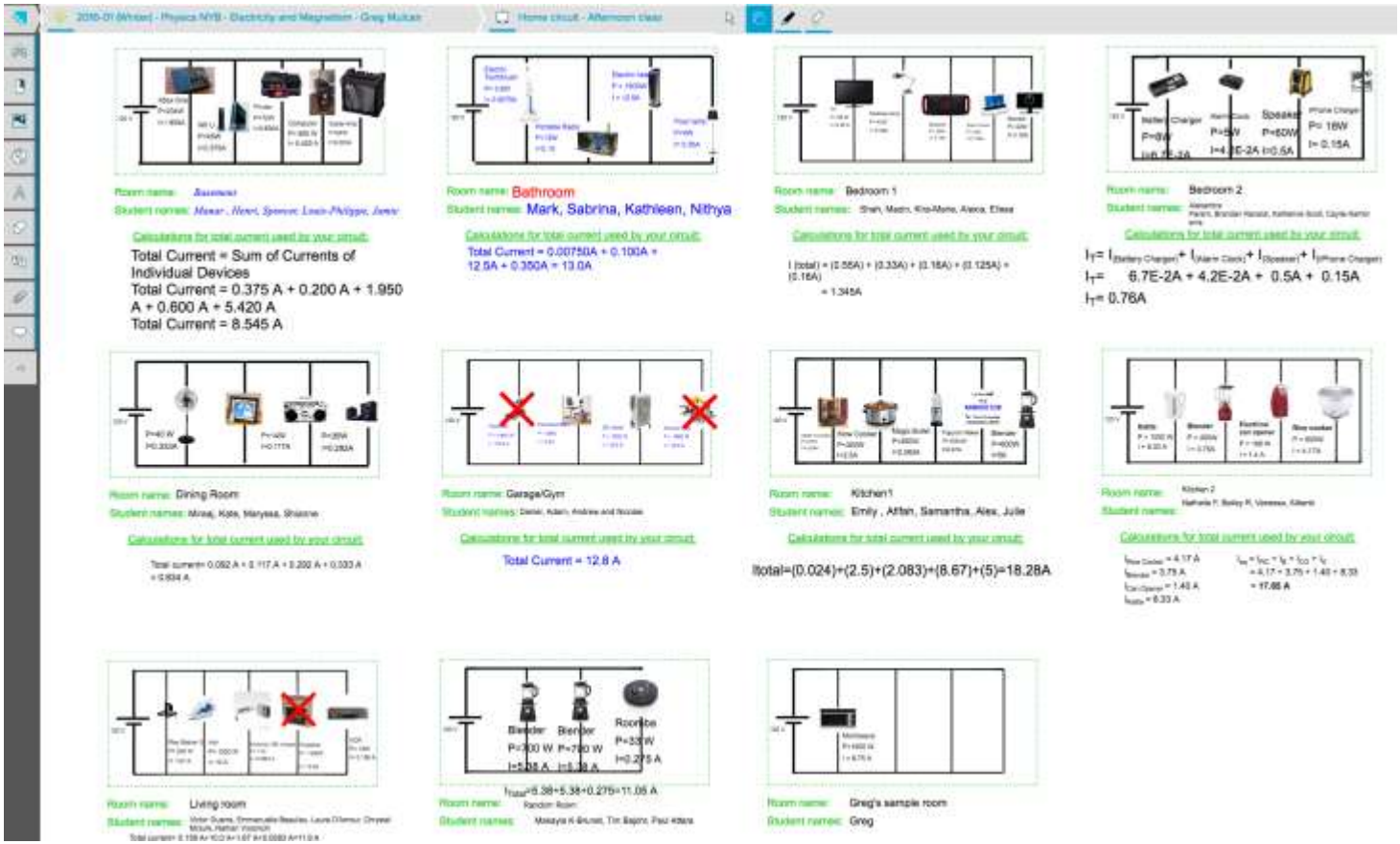
Find total current

- Repeat for all other devices (add image and type their respective names, powers and currents)
- Calculate the total current drawn by your circuit and type it in the space provided below your circuit
- If the total current is above 20 A, "turn off" enough devices (put red X through them) so that the current is below 20 A. Find the new total current.

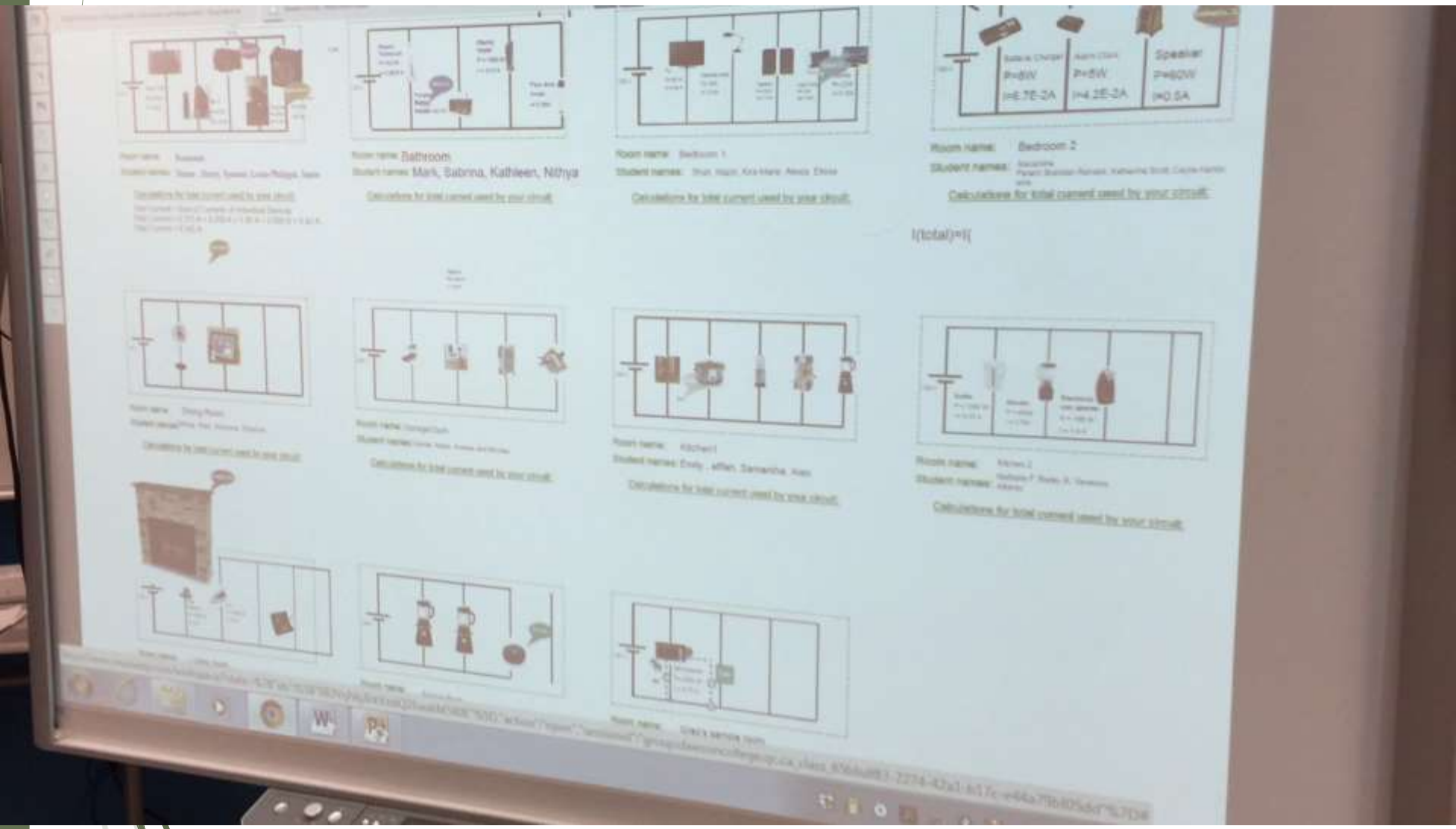
Example: Room circuits built by groups



End result: Entire home circuit



Video: Circuit built by everyone



Part 4: Report about entire home and off-grid alternatives

Part 4: Investigation into possibility of living off-grid

Due date: Monday, April 25th, start of class
Done by: Groups (same groups as part 3)
Submit your work: In class as one printed report per group (≈3-4 pages single spaced)

For this final part of the project, your group will submit a printed report consisting of the following:

Section 1: Home energy analysis (≈1.5-2 pages single-spaced)

For this part of the report, I want you to complete the table below. To do this, each student will need to write a few sentences of explanation and calculations, which must be included so that I understand how you got the numbers in your table. Hint: Consider using Google Docs or something similar to collaborate on the same document.

1. Each student in the group will estimate how many kWh of energy their actual home (or apartment or condo) uses in a typical summer month. This can be found using your home's HydroQuebec invoices, or if you live in an apartment, by asking the landlord for an estimate. The purpose of this is just to give you an idea of your home's usage, but is not required for the next parts of this project. If neither of these are possible, use a friend or family member's home as an estimate. Add this to a table (see example below) and also calculate the typical monthly cost, basing yourself on HydroQuebec's rates:

- 5.68¢/kWh for the first 30 kWh/day
- 8.60¢/kWh for the remaining energy consumption

	Home's kWh/month	Home's cost/month
Student 1 name		
Student 2 name		
Student 3 name		