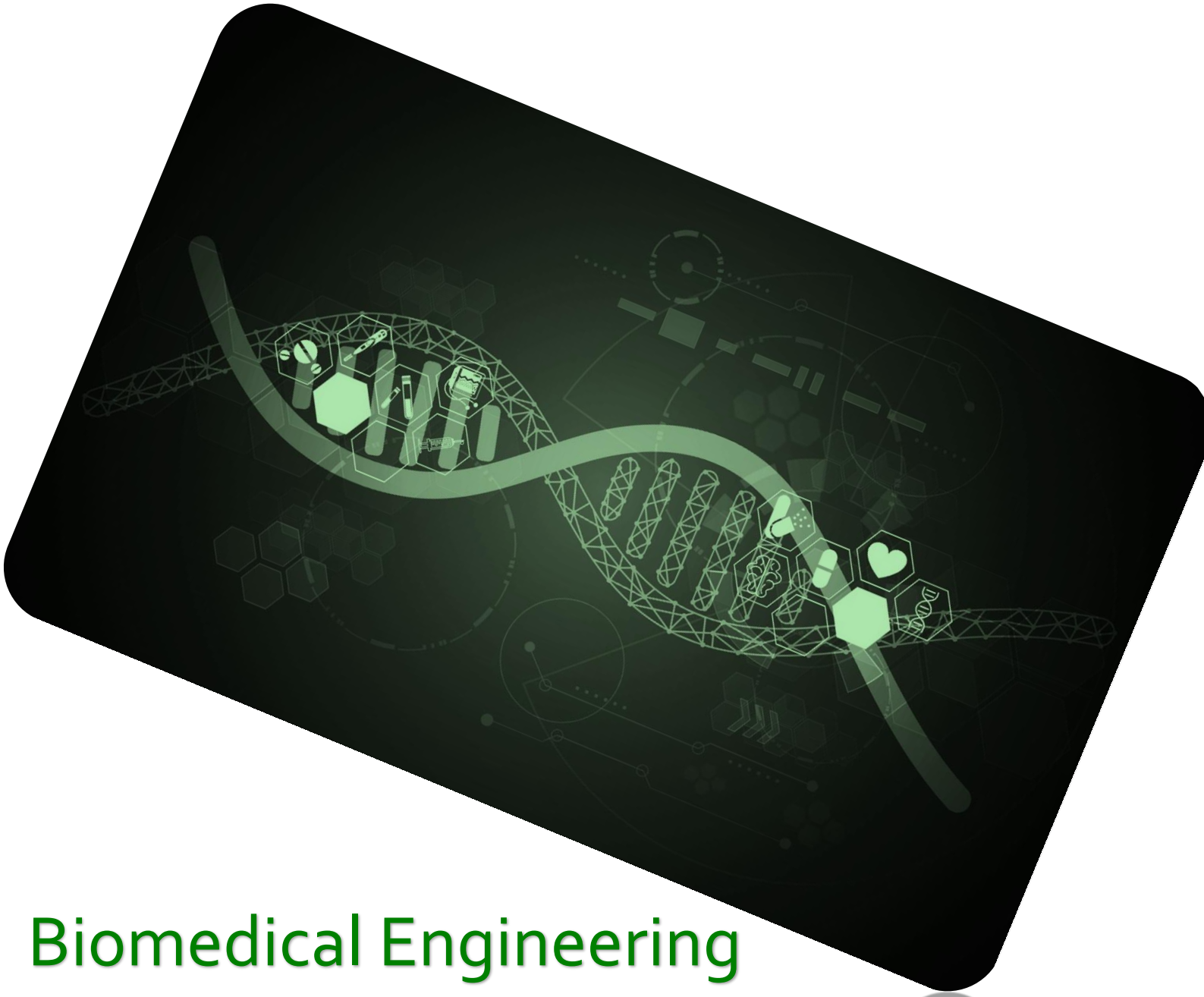


Biomedical Engineering Unpacked

Volunteer Pack

Before the Event

Think about the following:

- Why did you choose to study engineering?
- How did you become interested in biomedical engineering?
- What do you hope to get out of volunteering and encouraging female students to choose a STEM career?
- What do you wish you would have known about the biomedical engineering field/ engineering field before going in?

Using the essence of these answers, please put together a 1-minute introduction into who you are, what you studied, and why you are excited about biomedical engineering.

There will be a section of the event where you are going to introduce yourself.

Structure of the Day

The bold indicates where the volunteers are expressly needed, however, volunteers can also answer questions from girls and can interact with the girls during the breaks / can stay on after with the girls.

Time and Duration	Activity	Description
10 – 10:05 (5 minutes)	Arrival	- **Get seated** - **Notes will be on the table** - **Write name on a name tag and stick to shirt**
10:05 – 10:15 (10 minutes)	Introduction and Welcome	- Introduce the day - Describe what is to be achieved during the day - Introduce myself (1 minute) - **Volunteers introduce themselves (1 minute * 5= 5 minutes)** -
10:25 – 10:40 (15 minutes)	What is Engineering Presentation	- Unpack what is engineering with video and description - Cover skills of engineers - Take Questions
10:40 – 10:52 (12 minutes)	What is Biomedical Engineering	- Unpack what biomedical engineering is - Unpack the different subdisciplines - Understand the different careers - Take Questions
10:52 – 11:00	Break	- Toilet/food
11:00- 11:15 (15 minutes)	Brainstorming of Problems in Biomedical Engineering	- **Split into the number of groups as there are volunteers and go round to each girl to brainstorm all the biomedical problems they want to solve. In addition, discuss the**

		biomedical problems the girls prepared. Volunteers must engage with the girls and prompt them to think more deeply about the problems
11:15 – 11:25 (10 minutes)	Discussion with Group	- Go round to each group and unpack what each of the group came up with
11:05 – 11:15 (5-10 minute break)	Break	- Snack break - Toilet Break
11:15 – 11:30 (15 minutes)	Design Process Understanding and Introduce Activity	- Go through Engineering Design Process - Take Questions - Introduce the rest of the activity.
11:30 – 11:45 (15 minutes)	Research and Imagine stage	- Go through the relevent research - Go through some ideas for imaging new solutions
11:45 – 12:15 (30 minutes)	Group Creation and Start Activity	- **Hand out equipment** - Ensure that the girls have connected the device correctly to the laptops provided. - Take questions on the activity.
12:15 – 13:00 (45 minutes)	Lunch Break	
13:00 – 14:15 (75 minutes)	Activity	- **Volunteers on standby to assist girls as they move through the activity.**
14:15 -15:00 (45 minutes)	Activity Wrap up and questions	- Go through the last solution - Take Questions - Explain the routes into biomedical engineering

Discussion 1:

Thinking About Biomedical Problems

The students have been given the following questions in their student packs:

- What biomedical problems would you want to solve?
- How would you approach solving them?
- What possible limitations are there currently to solving this issue?
- Can you brainstorm some ways of tackling these limitations?

You will be responsible for facilitating these questions and providing some additional reflection points. Please try and think of some possible example answers for the above questions and any of the sample prompting questions beforehand. Additionally, feel free to prepare your own prompting questions. You will have 15 minutes to work through this activity with between 5-6 girls.

Activity structure:

Select one of the students to be the speaker to report back to the bigger group. Then go around and ask each of the students to introduce themselves by giving:

Their name, school and what they are hoping to get out of the course.

Thereafter, ask the group the first question.

Questions

- **What biomedical problems would you want to solve?**

Sample Prompting Questions:

1) Which biomedical subdiscipline do you think that problem falls into?
2) Why did you select that biomedical problem?
3) Do you know if anyone has solved similar problems in the past?

Thereafter – as a group decide on one problem to focus on for the rest of the session.

Next, go through the rest of the questions with the girls and prompt them on how best they can answer the questions. Encourage teamwork and assist each other in answering the questions.

- **How would you approach solving the problem?**

Sample Prompting Questions:

1) What knowledge/ skills would you need to acquire?
2) How would you ensure that the solution is safe for humans?
3) What kinds of people would you speak to in order to learn more about the problem?

- **What possible limitations are there currently to solving this issue?**

Sample Prompting Questions:

1. Why do you think this issue hasn't been solved yet?
2. Could you solve the issue with more knowledge or would you need other people's assistance (like government / a business)?
3. How would you finance your idea?
4. Could you outsource some of the development to someone else?

- **Can you brainstorm some ways of tackling these limitations?**

For this one, instead of prompting each girl, try and get the group to brainstorm on this together. Let the first girl speak and then get the rest of the group to help.

Main Activity

Exercise 1: Making a Pattern of Lights

Using the provided starter code blinkingLights.io and the provided reference sheet – students will try to achieve the following:

1) Get the first NeoPixel to glow red and experiment with its brightness
   a. Brightness = 255
   b. Brightness = 125
   c. Brightness = 0
2) Flash all the odd NeoPixels Red
3) Flash all the 10 NeoPixels in a different Colour
4) Change the NeoPixel colour once the program has started

Starter Code:

```
#include "Adafruit_CircuitPlayground.h"
int brightness = 255;


void setup() {
  Serial.begin(2000000);

  // Start the Circuit Playground Express


  //Set which NeoPixels you want to use and what colour you want them to be



  // Set the NeoPixels Brightness

}

void loop() {
  // Make changes to how they glow during the loop
  // only relevent for part 4: Change the NeoPixel colour once the program has started



  CircuitPlayground.strip.show();
  delay(50);

}
```

The solutions require a basic manipulation of the functions found in the reference sheet. Be able to explain the functions to the students and know how to implement a solution to each of these activities.

Exercise 2: Understanding the Light Sensor and The Serial Plotter

Using the provided starter code lightSensor.io and the reference sheet, students will try to detect changes in light intensity and plot these values on the screen.

Starter Code:

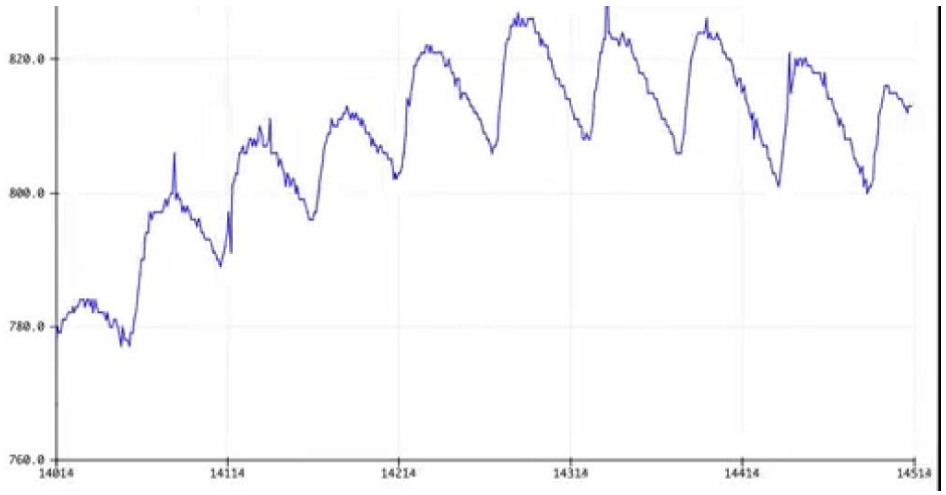
```
#include <Adafruit_CircuitPlayground.h>

int value;

void setup() {
  Serial.begin(2000000);
  CircuitPlayground.begin();
}

void loop() {
  // Read the light sensor signal.


  Serial.print("Light Sensor: ");

 // Print out the value of the light sensor to the screen

  delay(20);
}
```

Exercise 3: Putting It All Together

Using the starter code pulseWaves.io and the reference sheet, students will try to generate a pulse wave plot.

Starter Code:

```
#include "Adafruit_CircuitPlayground.h"

// Initialize variables.
int lightSensor = 0;
int ppg = 0;

void setup() {
  // How fast you read can make a difference.
  // Go as fast as your hardware can handle.
  Serial.begin(2000000);
  Serial.println("Circuit Playground Express PPG");

  // Start the Circuit Playground Express
  CircuitPlayground.begin();

  //1. Choose the NeoPixel closest to the light sensor and turn it on
  // You'll need to experiment with color


  //2. Set the Brightness to Maximum


  // Sets the Neopixels
   CircuitPlayground.strip.show();
}

void loop() {
  // 3. Read the light sensor signal.


  // 4. Since this is reflective photoplethysmography,
  // we need to subtract the signal to see the true waveform.
  //<...> // 1024 is ths max value possible.



  // 5. Print waveform to the serial console and plotter


  // Delay to allow the sensor to reset.
  delay(20);
}
```



Students are encouraged to try different light colours and different fingers to generate the desired waveform.

Try the following:

1) Different fingers on the light sensor
2) Try your ear lobe on the light sensor (get your partner to help with this)
3) Try different colours of light for the NeoPixels