CanSat Final Paper – SCAMSAT

THE MASTERMINDS BEHIND NETHERLANDS GREATEST CANSAT

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1.0 Abstract

SCAMSAT, a soda can-sized satellite, was developed to detect insect movement and analyze descent behavior, a leap forward in space exploration. It featured innovative engineering, including a compact PVC design, IR sensor, FPV camera, and hexagonal parachute, enabling stable landings and live data transmission during testing. Although recovery after launch was unsuccessful, the project demonstrated strong engineering and proved that affordable satellite designs can contribute meaningfully to scientific research and education. Supported by four sponsors and a school-wide outreach plan, the project was financially viable and proved that low-cost satellites can support real scientific research and education, with all essential parts of our design enabling a solution for both missions.

2.0 Mission overview

2.1 Primary Mission

Our team is dedicated to collecting air temperature and pressure data during descent using a BMP-280 sensor. We used APC-220 transmitters for real-time transmission to our ground station. The mission successfully met CanSat standards, integrating and testing.

2.2 Secondary Mission

Despite the continued challenges and expenses of space exploration, we collectively are motivated by the extraordinary possibility of extraterrestrial life. Our team aims to carry forward this motivation in our secondary mission: demonstrating attraction and detection of life-forms through IR and video Data to aid the search for extraterrestrial life.

3.0 Cansat Design

3.1 The Design Refer to 8.2.1 for images

The SCAMSAT body is divided into two sections: The upper compartment houses electronics, while the lower is designed for insect placement. Built using a rigid ∅60 mm PVC pipe and 3D-printed caps, the structure ensures durability and compactness. At its core lies an Arduino UNO, a High Discharge LiPo Battery Nano-Tech 1.0 100mAh 25-50C, and essential components arranged to minimize vibration and optimize space. The middle cap features an IR Proximity Sensor and a FPV camera (5V 170°), streaming insect activity via the Rush FPV Tiny Tank VTX powered by a 5V voltage divider. An APC-220 module transmits data to the ground station, where it's received using a Yagi antenna. A hexagonal parachute enables stable descent and efficient landing. This thoughtful design integrates all components seamlessly to ensure mission success.

3.2 Relevant Testing Refer to 8.2.2 for images

During testing, we prioritized evaluating critical performance metrics to ensure SCAMSAT's reliability. A descent test from 15.4 meters confirmed the parachute's effectiveness, achieving a controlled velocity of 15 m/s. The parachute demonstrated exceptional durability by withstanding a 100N force test without any damage. To simulate launch vibrations, we mounted the CanSat on a 1 meter radius bicycle wheel, calculating a speed of 3.77 rotations per second for 20G acceleration. Impressively, the CanSat endured up to 4 rotations per second, remaining structurally intact with no visible or internal damage, validating its resilience against launch conditions. These rigorous tests provided more than just data; they reinforced our confidence in SCAMSAT's design and functionality, assuring us that the CanSat was fully prepared for its mission.

3.3 Highlight Refer to 8.2.3

Key achievements include successfully operating the FPV camera, designing a compact and efficient body, and staying on schedule. Our PR team documented progress and engaged the community on Instagram, while sponsor support allowed us to represent our team with branded hoodies.

4.0 Results

4.1 Scientific and Technical Findings

Our CanSat performed well in testing, with successful descent, parachute performance, and vibration resistance. During testing, everything worked fine as we were connected to a constant power supply. However, during launch, the battery didn't last long enough to capture data, likely due to miscalculations on power usage. This taught us the importance of ensuring adequate battery supply. After launch, we realized the need for a voltage divider for the camera and, with the new camera, adjusted space considerations. These lessons will help optimize our design and power management for future missions.

4.2 Beyond the 24-25 Cansat Competition Refer to 8.1 for Mic code, 8.3 for Yolov5

With AI playing an increasingly significant role in today's technology landscape, we see strong potential in applying it to future CanSat missions. We plan to explore using YOLOv5/YOLOv8 (by Ultralytics) open-source data; by implementing its code into our MIC, we aim to gather real time object detection of these life forms from our CanSat. This AI-powered analysis could also help identify environmental features or unusual patterns, enhancing the scientific value of our mission and supporting our discovery oriented goals.

5.0 Outreach

5.1 Engagement Refer to 8.2.4

Our outreach engaged students and space enthusiasts through Instagram, school collaborations, and creative content. This strategy elevated our visibility, inspired young minds, and made us the most-followed club at AICS, strengthening community support for space exploration.

5.2 Publications Refer to 8.2.5

We have actively worked on documenting and sharing our journey through multiple platforms. A behind-the-scenes video has been shared on the AICS Student Council Instagram page, and a feature is currently in progress on the school's Bulletin Board, highlighting our Engineering Science team and teachers. Additionally, we are contributing to the 2025 Yearbook, with a draft proof expected by the end of April. Our own SPAICS Instagram page remains highly active, showcasing regular updates, team highlights, and sponsor features. All publication materials and evidence can be found in the appendix.

6.0 Other Topics

6.1 Project Management

Our team follows a structured and collaborative workflow, with clear roles based on individual strengths. Weekly meetings, consistent communication, and hand on testing have kept the project on track. By adapting to challenges and building on each other's work, we've maintained steady progress.

6.2 Issues and Solutions

Several challenges were resolved during SCAMSAT's development. Voltage divider shorting was fixed with sticky tack insulation, while the LF33CV module converted the 7.4V battery into stable 3.3V and 5V outputs for the IR sensor and camera. Fragile soldering connections were strengthened with better techniques. A switch from an incompatible analog camera to a digital one, supported by a voltage divider, improved performance. Minor modifications to the parachute, including adding a swivel, enhanced stability, and its vibrant design ensured visibility. Each solution reinforced SCAMSAT's readiness for its mission.

6.3 Launch Day Experience

Our final launch, though thoroughly prepared, didn't go as expected, we were unable to retrieve any data or recover the CanSat. Despite this, the experience was incredibly valuable. It was an exciting and collaborative effort, and we learned a great deal from the challenges we faced; a key in improving our future missions.

7.0 Conclusions

SCAMSAT was a valuable learning experience. While our design worked well in testing, we faced setbacks during launch due to a power supply miscalculation, preventing data collection and recovery. The project taught us important lessons in energy management, component compatibility, and preparation. One of our proudest achievements was getting the camera to work, which was a major milestone for the team. Additionally, effective time management and strong teamwork, along with excellent mentorship and PR efforts, helped us secure sponsor support. Overall, it was a rewarding experience that has set the stage for future missions.

8.0 Appendices

8.1 Code for MIC

8.1.1 Primary + IR Sensor

```
#include <SoftwareSerial.h>
#include <Adafruit_BMP280.h>
#define BMP280_ADDRESS 0x76
const int ProxSensor = 4; //Declaring where the Out pin from the sensor is wired
SoftwareSerial mySerial(3, 7);

int number = 0;

Adafruit_BMP280 bmp;  // I2C Interface

void setup() {

 Serial.begin(9600);

 mySerial.begin(9600);
  pinMode(ProxSensor, INPUT); // then we have the out pin from the module

 while (!Serial) delay(100);  // wait for native usb
 Serial.println(F("BMP280 test"));
 unsigned status;
 status = bmp.begin(BMP280_ADDRESS);
 if (!status) {
   Serial.println(F("Could not find a valid BMP280 sensor, check wiring or "
                    "try a different address!"));
   Serial.print("SensorID was: 0x");
   Serial.println(bmp.sensorID(), 16);
   Serial.print("        ID of 0xFF probably means a bad address, a BMP 180 or BMP 085\n");
   Serial.print("   ID of 0x56-0x58 represents a BMP 280,\n");
   Serial.print("        ID of 0x60 represents a BME 280.\n");
   Serial.print("        ID of 0x61 represents a BME 680.\n");
   while (1) delay(10);

   /* Default settings from datasheet.  */
   bmp.setSampling(Adafruit_BMP280::MODE_NORMAL,     /* Operating Mode. */
                   Adafruit_BMP280::SAMPLING_X2,     /* Temp. oversampling */
                   Adafruit_BMP280::SAMPLING_X16,    /* Pressure oversampling */
                   Adafruit_BMP280::FILTER_X16,      /* Filtering. */
                   Adafruit_BMP280::STANDBY_MS_500); /* Standby time. */
 }
}
/* This code is to use with Adafruit BMP280           (Metric)
* It  measures both temperature and pressure and it displays them on the Serial monitor  with
the altitude
* It's a modified version of the Adafruit example code
 * Refer to www.surtrtech.com or SurtrTech Youtube channel
```

```
*/

void loop() {
 unsigned long now = millis();
 static unsigned long timer = 0;
 unsigned long interval = 1000;
 if(now - timer >= interval)
 {
  timer = millis();
  Serial.print("Sending  ");
  Serial.println(now);
  mySerial.println(now);
 }
 if(mySerial.available() > 0)
 {
  Serial.print(char(mySerial.read()));
 }
 number++;
 String message = "APC220 test " + String(number);
 Serial.println(message);
 mySerial.println(message);

 Serial.print(F("Temperature = "));
 Serial.print(bmp.readTemperature());
 Serial.println(" *C");
 Serial.print(F("Pressure = "));

 Serial.print(bmp.readPressure() / 100);
 Serial.println(" Pa");
 Serial.print(F("Approx altitude = "));
 Serial.print(bmp.readAltitude(1006)); /* Adjusted to local forecast! */
 Serial.println(" m");
 Serial.println();

 //sending over apc
 mySerial.print(F("Temperature = "));
 mySerial.print(bmp.readTemperature());
 mySerial.println(" *C");
 mySerial.print(F("Pressure = "));

 mySerial.print(bmp.readPressure() / 100);
 mySerial.println(" Pa");
 mySerial.print(F("Approx altitude = "));
 mySerial.print(bmp.readAltitude(1000)); /* Adjusted to local forecast! */
 mySerial.println(" m");
 mySerial.println();
 if(digitalRead(ProxSensor)==HIGH)      //Check the sensor output if it's high
            {
```

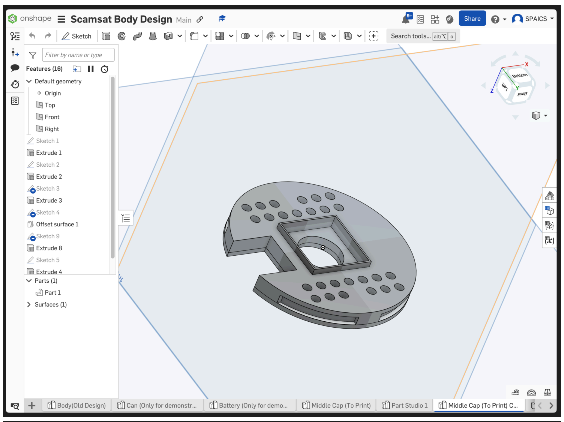
```
            }
 else
           {
             Serial.println("Lifeform Detected");
             mySerial.println("Lifeform Detected");
             delay(200);
                 // Turn the LED OFF if there's no signal on the ProxSensor
            }
 delay(1000);
}
```

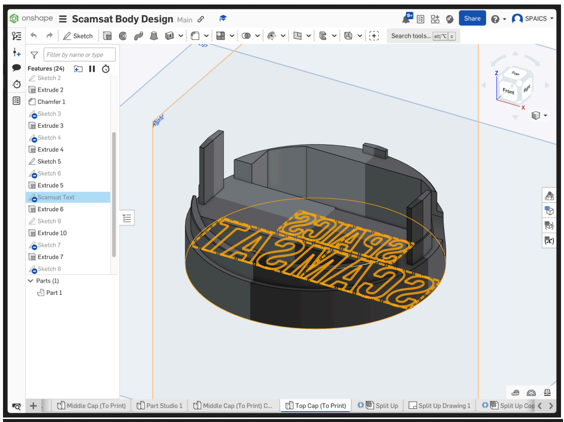
8.1.2 Ground Station

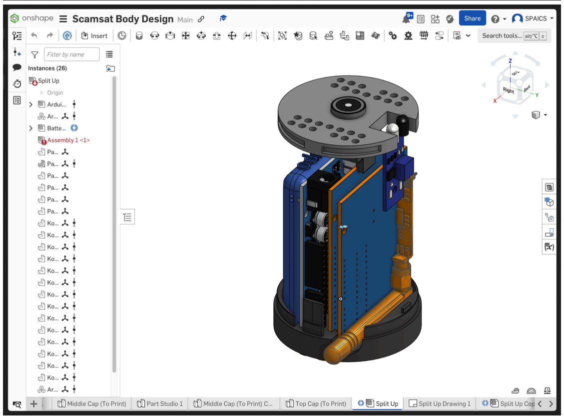
```
#include <SoftwareSerial.h>

SoftwareSerial apc(4,7);

void setup()
{
  Serial.begin(9600);
  apc.begin(9600);
}

void loop()
{
 unsigned long now = millis();
 static unsigned long timer = 0;
 unsigned long interval = 1000;
 if(now - timer >= interval)
 {
  timer = millis();
  Serial.print("Sending  ");
  Serial.println(now);
  apc.println(now);
 }
 if(apc.available() > 0)
 {
  Serial.print(char(apc.read()));
 }
}
```

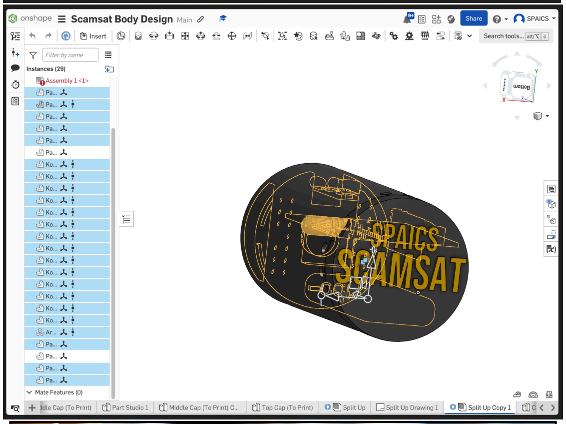
8.2 Additional Figures

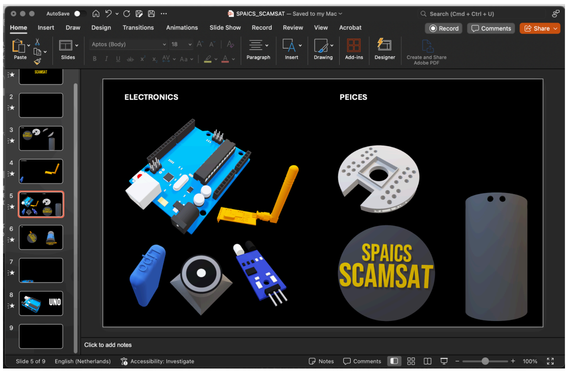
8.2.1 The Design

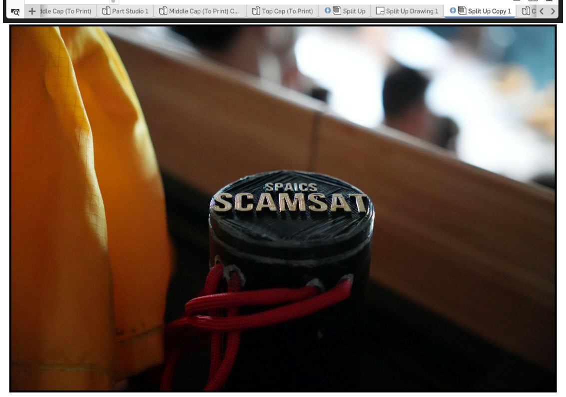




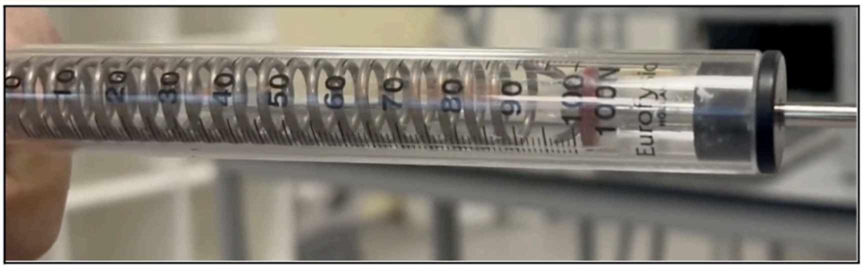


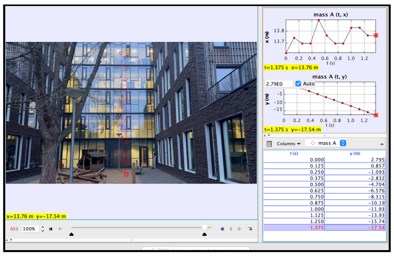


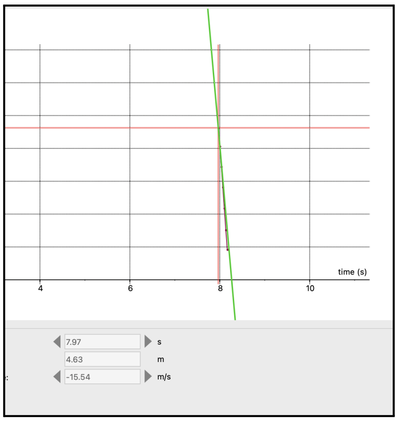




8.2.2 Relevant Testing







$$F_{cp} = \frac{mv^2}{r}$$

$$\omega = \frac{v}{r}, \therefore\ v = r\omega$$

$$F_{cp} = \frac{m(r\omega)^2}{r}$$

$$F_{cp} = mr\omega^2$$

$$20g = F_{cp} = 0.35 \cdot 1 \cdot \omega^2, \quad g = 9.81$$

$$\sqrt{\frac{20 \cdot 9.81}{0.35}} = \omega = 23.68 rad/s$$

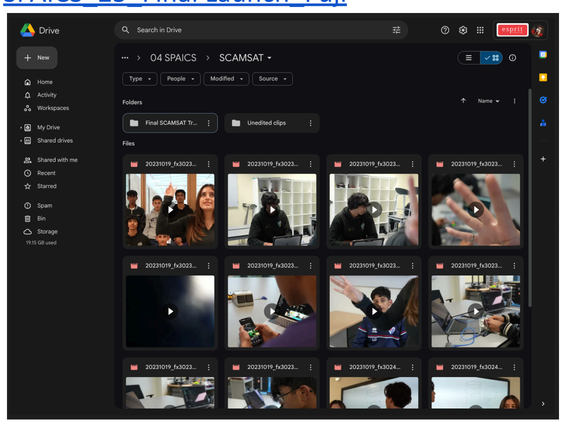
$$\frac{23.68 rad/s}{2\pi} = 3.77\ rotations/s$$

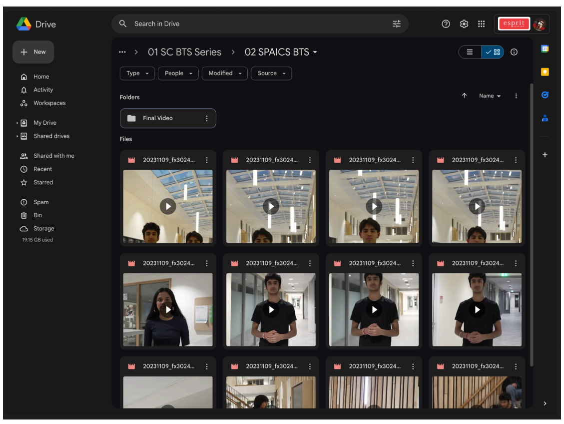
8.2.3 Highlight

https://youtu.be/qfUDfWPwsuQ?si=PS2NRsjJOPkSNugu

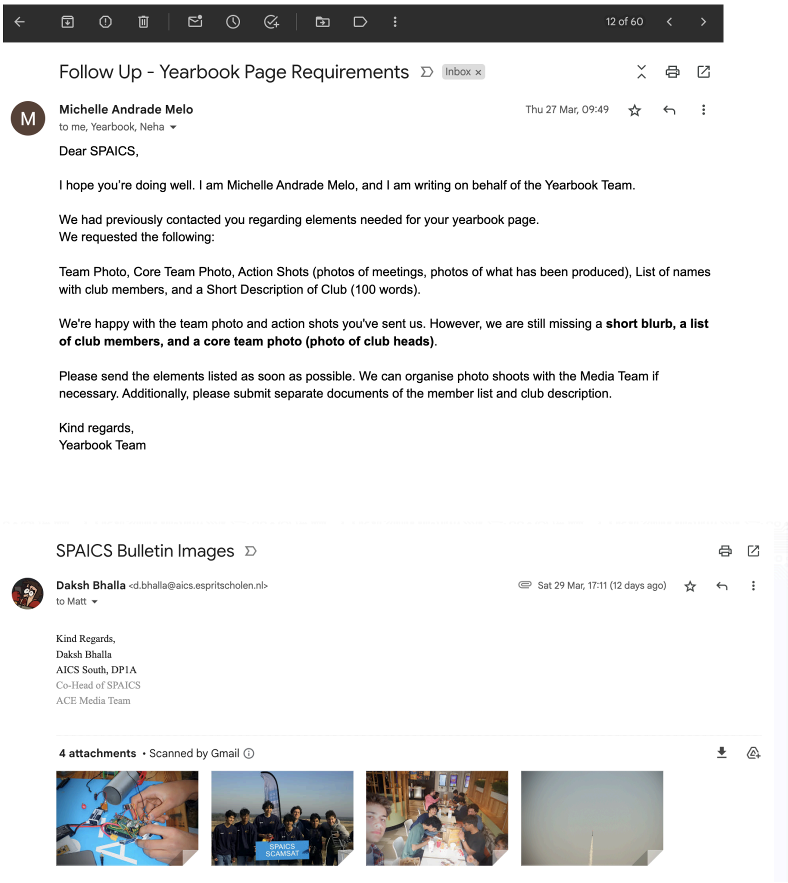
8.2.4 Engagement

https://www.instagram.com/spaics_?igsh=MXZ2Z3dmNmppa3JqOA==
https://linktr.ee/spaics_?fbclid=PAY2xjawJkL4lleHRuA2FlbQIxMQABpwr2Dck6PCKbFj90fTSmwHGFd_VenrIIGmk58Kx8VBJLOu_5VLN2VSaGZAYh_aem_wEJ8DaMixeZZAJlwt8c7XA
SPAICS_25_Final Launch_Canon
SPAICS_25_Final Launch_Fuji





8.2.5 Publications



Follow Up - Yearbook Page Requirements

Michelle Andrade Melo
to me, Yearbook, Neha
Thu 27 Mar, 09:49

Dear SPAICS,

I hope you're doing well. I am Michelle Andrade Melo, and I am writing on behalf of the Yearbook Team.

We had previously contacted you regarding elements needed for your yearbook page.
We requested the following:

Team Photo, Core Team Photo, Action Shots (photos of meetings, photos of what has been produced), List of names with club members, and a Short Description of Club (100 words).

We're happy with the team photo and action shots you've sent us. However, we are still missing a **short blurb, a list of club members, and a core team photo (photo of club heads)**.

Please send the elements listed as soon as possible. We can organise photo shoots with the Media Team if necessary. Additionally, please submit separate documents of the member list and club description.

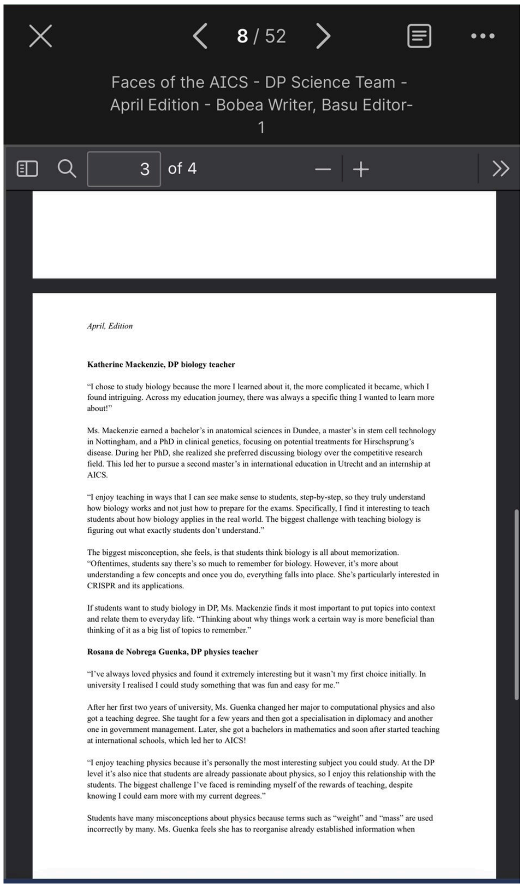
Kind regards,
Yearbook Team

SPAICS Bulletin Images

Daksh Bhalla <d.bhalla@aics.espritscholen.nl>
to Matt
Sat 29 Mar, 17:11 (12 days ago)

Kind Regards,
Daksh Bhalla
AICS South, DP1A
Co-Head of SPAICS
ACE Media Team

4 attachments • Scanned by Gmail



Faces of the AICS - DP Science Team - April Edition - Bobea Writer, Basu Editor-1

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3 of 4

April, Edition

Katherine Mackenzie, DP biology teacher

"I chose to study biology because the more I learned about it, the more complicated it became, which I found intriguing. Across my education journey, there was always a specific thing I wanted to learn more about!"

Ms. Mackenzie earned a bachelor's in anatomical sciences in Dundee, a master's in stem cell technology in Nottingham, and a PhD in clinical genetics, focusing on potential treatments for Hirschsprung's disease. During her PhD, she realized she preferred discussing biology over the competitive research field. This led her to pursue a second master's in international education in Utrecht and an internship at AICS.

"I enjoy teaching in ways that I can see make sense to students, step-by-step, so they truly understand how biology works and not just how to prepare for the exams. Specifically, I find it interesting to teach students about how biology applies in the real world. The biggest challenge with teaching biology is figuring out what exactly students don't understand."

The biggest misconception, she feels, is that students think biology is all about memorization. "Oftentimes, students say there's so much to remember for biology. However, it's more about understanding a few concepts and once you do, everything falls into place. She's particularly interested in CRISPR and its applications.

If students want to study biology in DP, Ms. Mackenzie finds it most important to put topics into context and relate them to everyday life. "Thinking about why things work a certain way is more beneficial than thinking of it as a big list of topics to remember."

Rosana de Nobrega Guenka, DP physics teacher

"I've always loved physics and found it extremely interesting but it wasn't my first choice initially. In university I realised I could study something that was fun and easy for me."

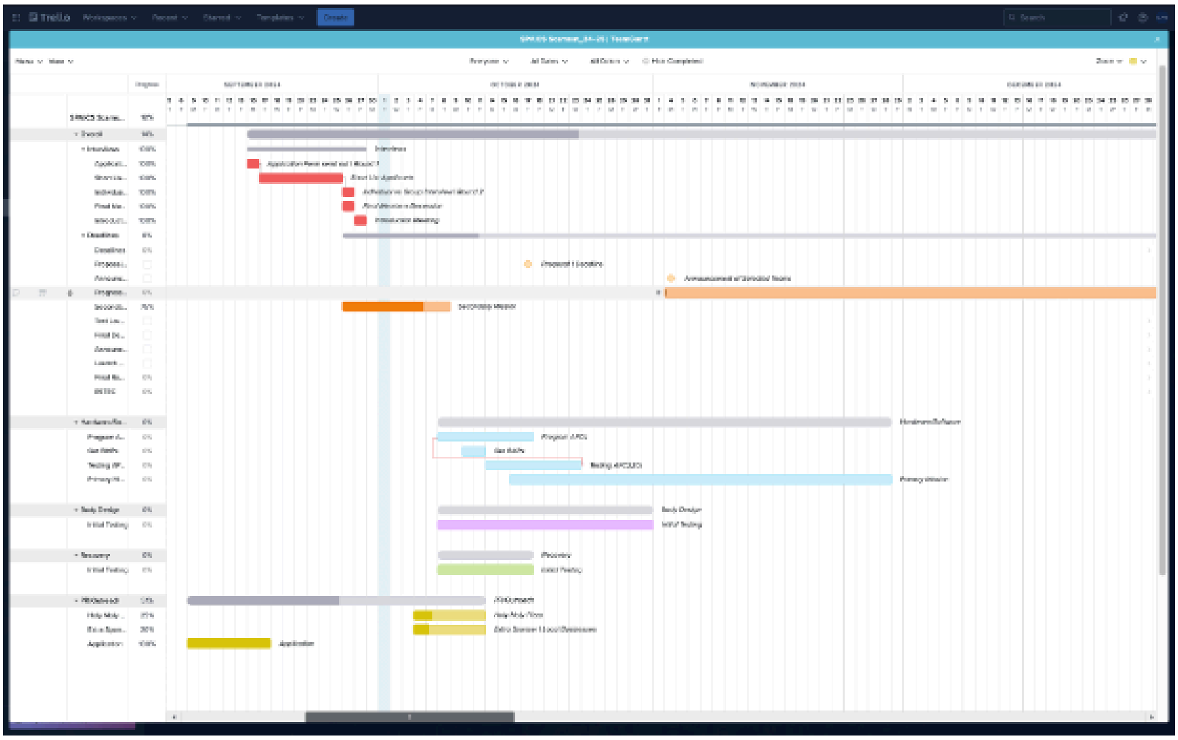
After her first two years of university, Ms. Guenka changed her major to computational physics and also got a teaching degree. She taught for a few years and then got a specialisation in diplomacy and another one in government management. Later, she got a bachelors in mathematics and soon after started teaching at international schools, which led her to AICS!

"I enjoy teaching physics because it's personally the most interesting subject you could study. At the DP level it's also nice that students are already passionate about physics, so I enjoy this relationship with the students. The biggest challenge I've faced is reminding myself of the rewards of teaching, despite knowing I could earn more with my current degrees."

Students have many misconceptions about physics because terms such as "weight" and "mass" are used incorrectly by many. Ms. Guenka feels she has to reorganise already established information when

Note: The Bulletin and Yearbook team do not have finished mockups of their publications yet.

8.2.6 Project Management



8.2.7 Launch Day Experience

8.3 References

https://github.com/ultralytics/yolov5