Araguaia Mission – An Accessible Escape Room for Visually Impaired Students

DIY HP Manual

Team iGEM USP-Brazil - Human Practices Project

Glycosy-N-ation (2025)

October 2025

Summary

Introduction

Mission Araguaia was designed to bring science closer to visually impaired students through an inclusive and playful experience. The event is a midday experience combining four complementary educational fronts:

1. **Theoretical Classes** – Classes with 3D print or home-made models about basic cell and molecular biology.
2. **Escape Room** – an immersive storyline challenge.
3. **DNA Lesson and Extraction** – a hands-on molecular biology experiment.
4. **Cell Biology and Clay Modeling** – tactile activity to explore cells and fungi.

All the students watch the first theoric classes about molecular and cell biology, then they are divided into three groups. They have a little interval and after it, they rotate between the three activities, ensuring that every participant experienced all fronts.

It's important to notice the setup of the three interactive experiences must have a time for setup. We recommend a three hour setup before the classes begin.

General Objectives

1. Promote inclusion in science education.
2. Explain biological concepts through playful and tactile approaches.
3. Foster creativity and immersion in learning.
4. Demonstrate that science can be engaging and accessible to everyone.

Event Schedule

Time	Activity	Description	Location
3:00 hrs	Setup & testing	Preparation of rooms, materials, and escape puzzles	All areas

15 min	Reception of students	Welcoming and introductions	**Main Classroom**
20 min	Ice-breaking conversation	Sharing hobbies, interests, and goals for the day	**Main Classroom**
25 min	Introductory class: Proteins & DNA	Short lesson with tactile models	**Main Classroom**
25 min	Introductory class: Fungi	Short lesson on fungal diversity and tactile models of cells	**Main Classroom**
35 min (each) **1:45 hrs (total)**	Rotating activities (3 groups)	Groups rotate through the 3 educational fronts below	Escape Room Area, DNA Extraction Room, Cell Biology & Modeling Room
—----------	Front 1 – Escape Room	Immersive storyline-based biotechnology challenge	**Escape Room Area**
—----------	Front 2 – DNA Extraction	Hands-on experiment extracting strawberry DNA	**DNA Extraction Room**
—----------	Front 3 – Cell Biology & Clay Modeling	Tactile activity to model cells and fungi	**Cell Biology & Modeling Room**
15 min	Final interaction & interviews	Students share impressions and reflections	**Main Classroom**
20 min	Dismantling	Team disassembles and organizes materials	All areas

30 min	Interview with coordination	Feedback session with school staff	**Staff & Coordination Room**

Educational Interactive Experiences

Front 1 – Escape Room (Storyline-based)

Creative Process: Plot (scenario) created for the challenge.

To create the plot, it was necessary to meet a few requirements, including:

1. The mission had to be based on concepts involving **synthetic biology**;
2. Even participants with partial or full vision must be blindfolded to ensure equal conditions for everyone and to encourage engagement in sensory challenges, rather than purely visual ones.
3. The plot had to be set in your home country to **increase immersion**;
4. The students must use synthetic biology to their advantage, along with what was learned in previous classes;

For this, it was decided that the game's context should be based on a futuristic world where it was already very easy to genetically manipulate organisms, as well as express recombinant proteins in a laboratory. This would facilitate the creation of a fictitious laboratory, since the equipment in it is more technological and allows us to advance steps during the experimentation.

To feature synthetic biology as the protagonist in the story, we created a scenario in which a disease was discovered and the students - sent by iGEM - were on a mission to discover a vaccine for it and prevent it from spreading. We used all the ideas and created a detailed story that takes place in Brazil, more specifically, in the Araguaia National Park.

To expand this concept to your home country or region, it will be recommended to use very known natural places, with a high biodiversity. Some examples is Grand Canyon at United States, Berchtesgaden National Park at Germany or Zhangjiajie national forest park (湖南张家界国家森林公园) at China. These are some examples

that can be useful for local communities to apply. However, any natural space can be used for your plot.

The storyline:

"Year: 2087. Decades of mineral exploration and industrial pollution have left deep scars on the Brazilian cerrado. Near Araguaia National Park, an old environmental research station was reactivated after the discovery of a highly resistant wild fungus, named *Aspergillus araguaiensis*.

This microorganism, present in the region for decades, has developed an unusual resistance to antifungal agents, likely caused by prolonged contact with industrial waste. Intrigued, a group of scientists began the genetic sequencing of the fungus in search of answers—and found a possible solution: an inhibitory glycoprotein with the potential to be used as a vaccine antigen.

But, before they could complete the research, a leak occurred in the laboratory. All the scientists were exposed to the spores and hospitalized in a deep coma. The surrounding area was isolated by the government and considered a biological risk zone.

Without the researchers, the only chance to develop the vaccine is to recover the modified strain that was in the final stages of development. For this, a new team of young scientists, sent by iGEM, was summoned to enter the laboratory, collect genetic data from the inhibitory glycoprotein, and assemble a functional expression vector to complete the mission.

However, there is a critical challenge: the fungus spores are small enough to pass through the protective equipment in less than 25 minutes. This is the maximum time you have to enter, recover the strain, and assemble the genetic structure necessary for its expression."

Inicial Guidelines:

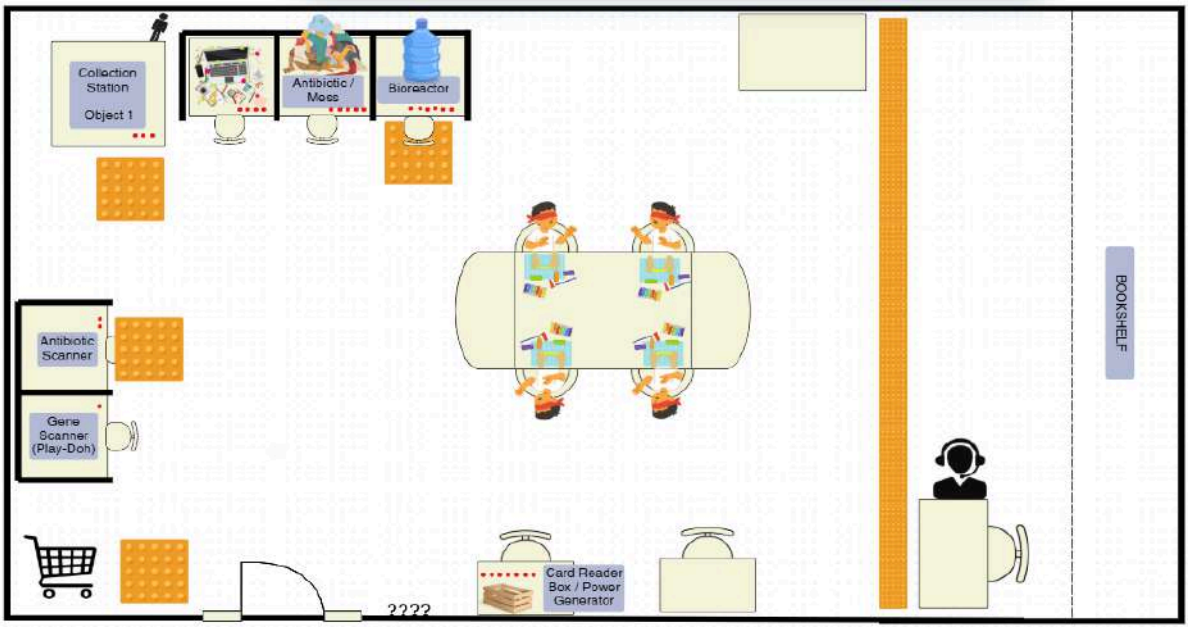
To ensure smooth progress throughout the activity, two organizers must always be present in the Escape Room:

- **Room facilitator** – responsible for placing objects at the collection station and guiding students around the room when necessary.
- **Sound and communication facilitator** – responsible for controlling sound effects, background music, and the pre-recorded storyline instructions. In

addition, any communication not included in the script must be delivered through this facilitator.

To boost engagement, we award internal prizes at the end of the day. Every team receives a prize, and the fastest team to solve the puzzle chooses their preferred prize. The remaining teams select in order of completion time.

Escape room Setup and Instructions:

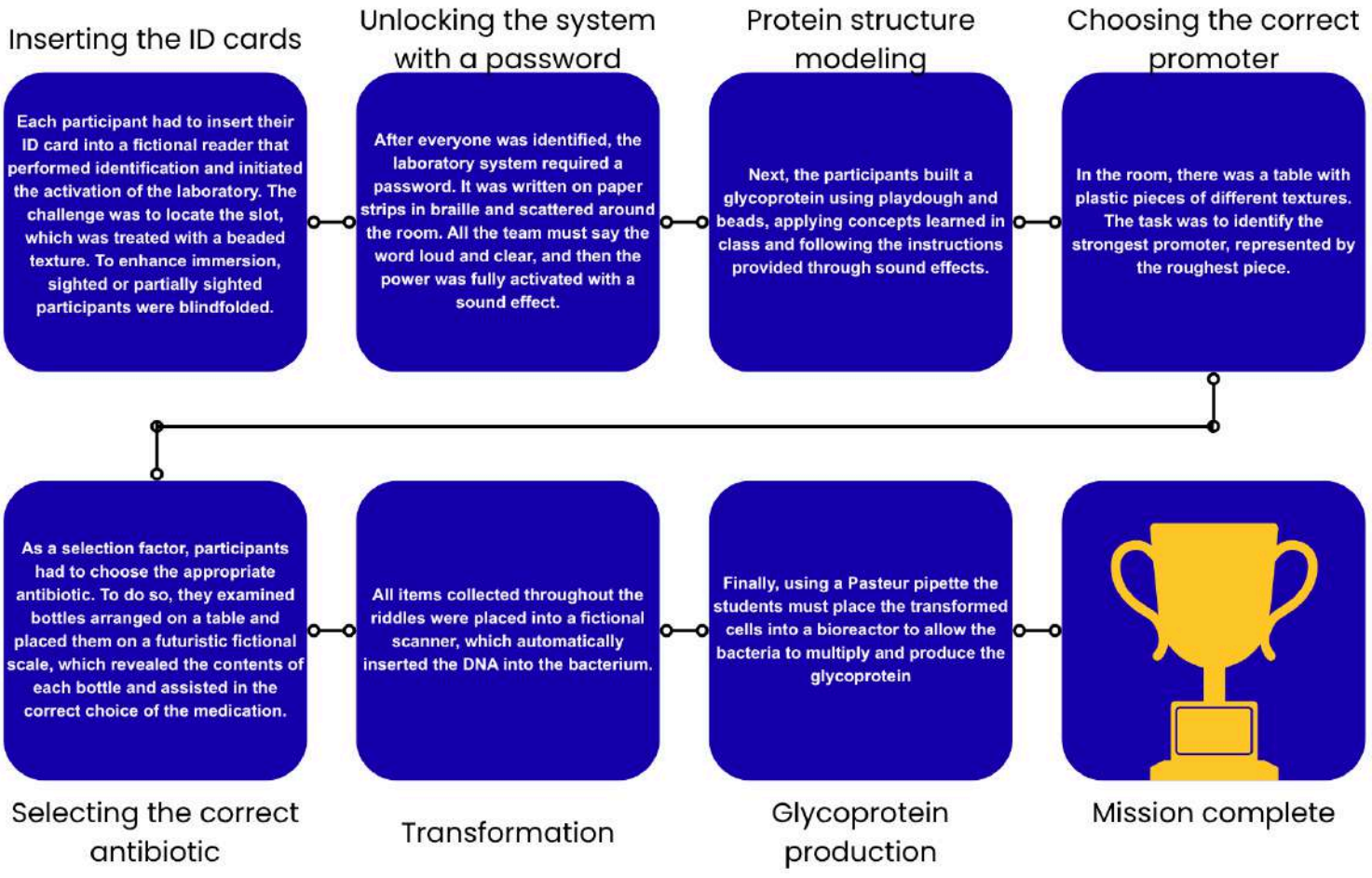


On one side, several stations are set up, beginning with a collection station with the room facilitator, followed by areas focused on antibiotic (water) microtube with random objects that will be a big and confusing mess to confuse and make the students search for the antibiotic, a bioreactor (a 5L gallon, a bucket, or any object the students can touch and feel), an antibiotic scanner (home made scanner with usual artesanal materials), and a gene scanner that uses playdough for a tactile experience. At the center of the room, a large table hosts a maximum of four participants to start the Escape room. Along the other side stay the sound facilitator, between he and the students have a physical block that can be a wooden skewer at the floor for the students to feel or even a chair wall, but must have a barrier between the sound facilitator and the students. The sound facilitator sits at a desk with headphones, acting as a guide or moderator for the activity. On the other edge of the room, you must include a card reader connected to a power generator (Wooden box), which are lock-and-key challenges.

Before the students begin the activity, everyone sits at the central table, where the following important instructions are given:

- All participants will complete the Escape Room blindfolded, except for those who are already fully blind.
- All students are invited to touch and memorize the objects placed on the central table.
- The room facilitator explains the purpose of these objects, demonstrates how to use Pasteur pipettes, and shows how to assemble the glycoprotein using playdough and beads.
- Each student receives a lab coat, handed to them by the room facilitator.
- The room facilitator provides a description of the room layout and the location of each station.
- Every team has 3 helps in the entire puzzle

Puzzle Sequence:



Audio Script:

All audio segments may be pre-recorded or performed live, using a robotic voice modulation for the Chief Scientist and AI segments. Futuristic background sounds and effects should accompany the narration for immersion. The final audio cue is the “mission accomplished” announcement.

The full narrative script is included at the end of this document for reference. Facilitators should follow timing cues and trigger SFX and olfactory effects as indicated. Minor adjustments may be made during the activity to accommodate participants’ pace.

Materials:

- 5L jug/bucket (bioreactor);
- Microtubes with water (5);
- Decoy objects (mixed);
- Bins (optional for collector table);
- Playdough (multi-color);
- Mats/boards/wipes (For tactile);
- Project boxes (2);
- Lockbox + padlock/combination lock, wooden box (generator);
- Headphones, timer/stopwatches, speaker (optional);
- Tape (gaffer/duct/masking), zip ties, scissors/knife, screwdrivers;
- Signage & clue cards (large-print + Braille), bump dots;
- Table (4 chairs), extra chairs, partitions/barrier materials;
- Cleaning & safety supplies (wipes, sanitizer, first-aid);
- Any decoration object you find useful.

Keep in mind that adaptations always must be made during the planning and execution of the event!

Front 2 – DNA Lesson and Extraction

The second front wants to teach molecular biology basics, connect them to real-life experiments and close them more to a scientist's life. It’s optional, but if you want we saw great experience with braille protocols for them to do it again at home. We print a few copies to make them know how a scientific protocol works.

It is crucial to tell them every visual aspect, so it is important to say the colour of materials, how it looks like, the interface, etc. Every visual aspect of the experiment is really important to be described by the facilitator.

Materials:

- Ripe strawberries
- Table salt (NaCl)
- Detergent
- Commercial alcohol (98%)
- Plastic ziplocks
- Bamboo skewer
- Plastic cup
- Sieve
- Spoon

Protocol:

1) Prep the strawberries

Remove the green tops from 3 strawberries. Place them in a ziplock bag and mostly seal it.

2) Mash in the ziplock

Squish by hand until you get an almost homogeneous paste. This is going to be a sensitive experience, which is very important. Talk about how it feels as you feel it.

3) Make extraction solution (in a cup)

In a plastic cup, mix something around 150 mL water + 1 tablespoon detergent + 1 teaspoon salt. Stir gently with the spoon to avoid foam.

4) Combine with strawberries

Open the Ziplock and add about 1/3 of the solution (~50 mL). Reseal and mix gently for 30–60 s. The students can gently mix with the hand above the ziplock to feel the solution.

5) Incubate

Let sit for 10 minutes at room temperature, massaging the bag occasionally (still avoiding foam).

6) Strain

Place the sieve over a clean plastic cup. Pour the bag contents into the sieve. Use the spoon to press the pulp lightly and collect the filtrate (liquid) in the cup.

7) Set the aqueous layer

In the cup, keep about 2–3 cm (~three fingers) of filtrate. Help participants identify the correct level; at this step, your guidance is essential. Count the seconds carefully—they will be important for replication at home.

8) Add alcohol (do not mix)

Tilt the cup and slowly pour cold 98% alcohol down the side so it forms a separate top layer, describe it to them. Use 2 volumes alcohol : 1 volume filtrate (e.g., 2 spoonfuls of alcohol per 1 spoonful filtrate). Do not mix. Wait ~3 minutes—whitish clouds/threads should appear at the interface. Tell them what is happening, describe with the most details as possible.

9) Spool the DNA

Use the bamboo skewer to gently roll at the liquid–alcohol interface and spool the white threads—that's DNA. Place the spooled DNA in participants' hands so they can feel its stringy, gelatinous texture. If available, compare it to a 3D model to link the tactile experience to the double helix and higher-order DNA packing (helix → nucleosomes → chromatin). This hands-on moment helps learners grasp both the material properties (sticky, cohesive fibers) and the structural organization of DNA.

Front 3 – Cell Biology and Artesanal Modeling

After the cell-biology lesson, students will explore cellular structures and fungal diversity through tactile, creative modeling. They will create <u>two types of models</u>:

1. **A complete eukaryotic cell**, using clay or playdough to place organelles and key features in the correct positions. This hands-on task quickly reveals whether learners grasp organelle identity, placement, and function, helping them internalize how a cell is organized and operates.

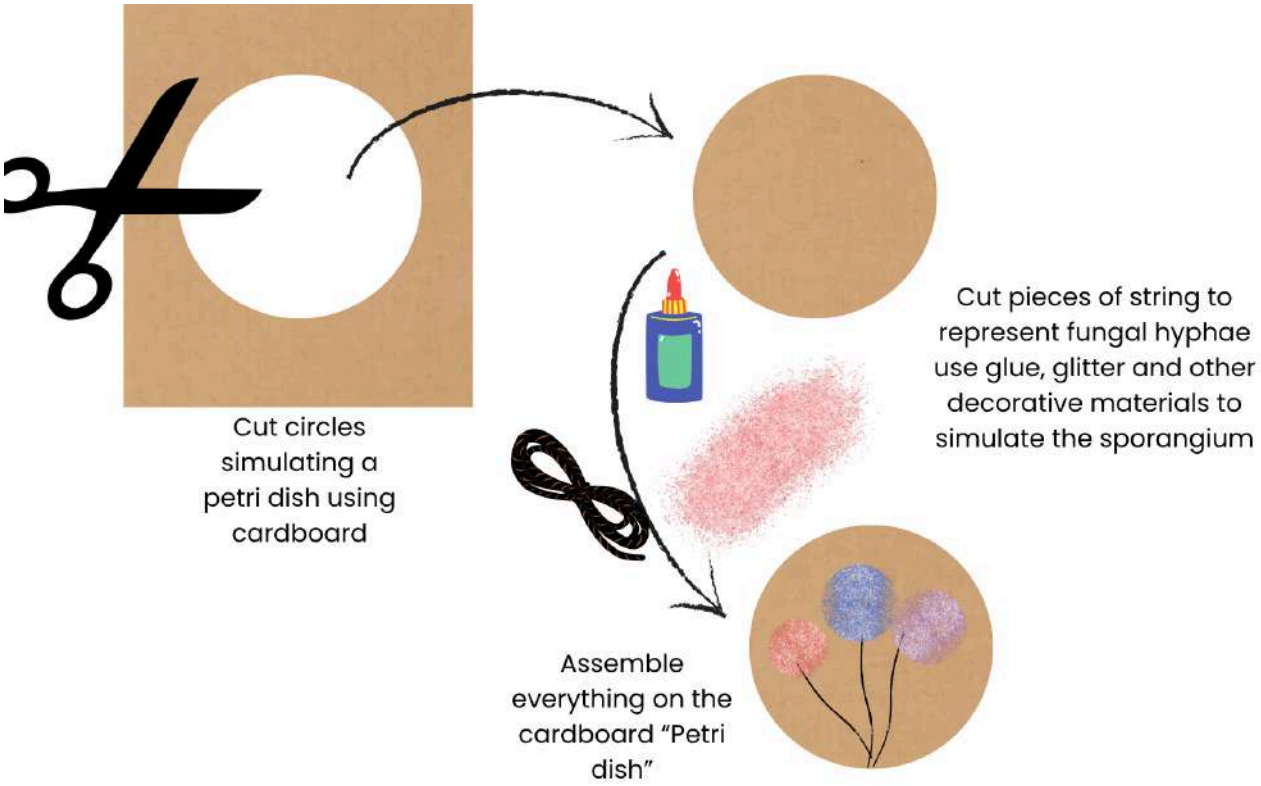
2. **An enlarged fungal model**, using clay or other materials to represent hyphae and sporangia. This allows students to explore normally microscopic structures by touch.

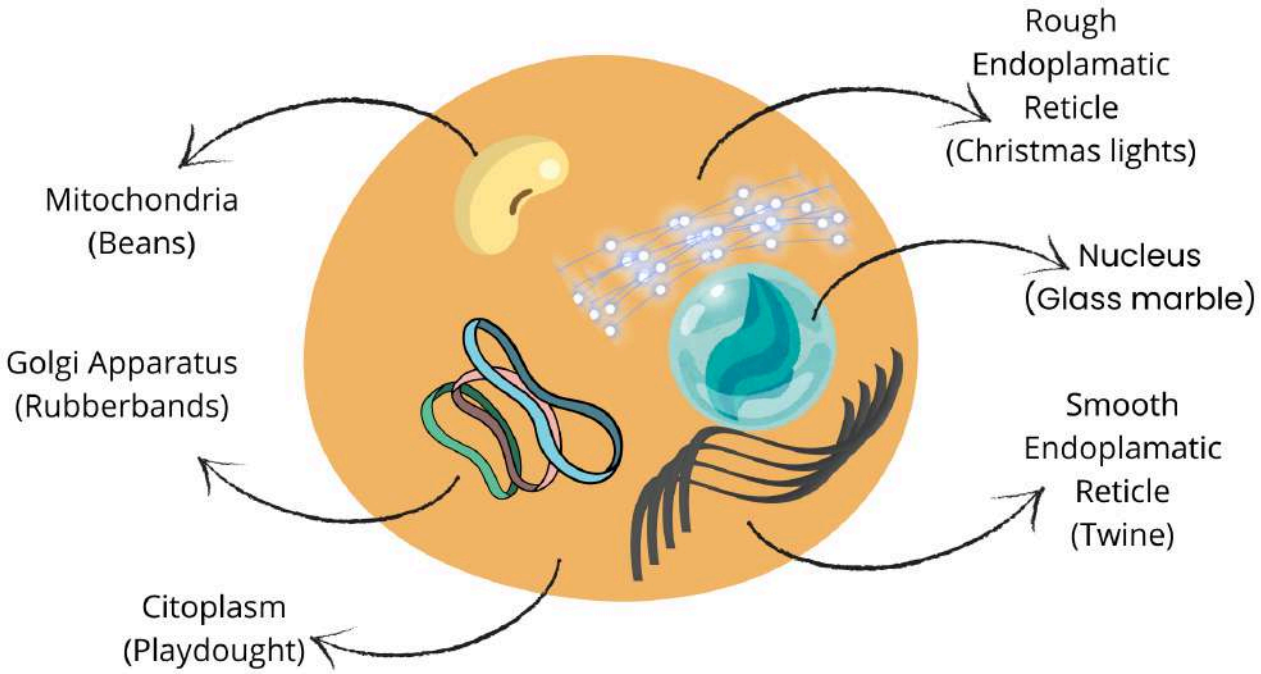
The facilitator's role is to coach for biological accuracy (e.g., correcting organelle shape, number, or location) and to orient students to the materials. Beyond that, modeling can be done independently. For inclusion, provide high-contrast mats, labeled trays (large print/Braille or raised symbols), and simple reference cards (e.g., "nucleus," "mitochondrion," "vacuole," "septate hyphae"). A quick gallery walk or two-minute share-out at the end consolidates learning and surfaces misconceptions for fast feedback.

Materials:

- Playdough of different colors
- Tactile diagrams of cells and fungi, 3D printed or homemade
- Diverse materials to simulate cell structures of different organisms
- Cleaning materials (wipes, paper towels)

Encourage creativity and comparison between student models and reality.





Organizational and General Tips

- Test all puzzles, experiments, and audio materials beforehand.
- Provide clear verbal explanations to complement tactile models.
- Keep rotation timing balanced but flexible.
- Assign one facilitator per group to ensure inclusivity. Ideally, each activity should have one person leading and coordinating, and at least one additional person providing support.
- Prepare backup materials (e.g., extra clay, strawberries).
- Listen to student feedback and take notes; since the event is rotational, you can improve execution in each subsequent round.
- Keep in mind that adaptations should always be made during planning and execution—never be inflexible!
- Stay calm. You don’t need to be an education specialist—minor issues may arise, but if you are well prepared, everything will go smoothly.

Supplementary material

Mission Araguaia – Escape Room Script (English)

Audio & Effects Numbering for Soundboard

Characters / Voice Style:

- **Narrator:** Deep, immersive voice. Guides the story and provides context.
- **Chief Scientist:** Friendly robotic voice (pre-recorded or live modulation). Provides instructions, encouragement, and mission updates.
- **AI Voice:** Robotic, alert tone for system messages and warnings.

This numbering system includes all audio segments—pre-recorded narration, live narration, sound effects, and olfactory cues—ready for use in the Escape Room.

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1. Room Instructions (Pre-Mission)

Audio 1 – Voice (Narrator)
Welcome, Operators, to our mission. Before we begin, please listen to these guidelines.

Audio 2 – Voice (Narrator)
All objects and tools you need for the puzzles are on the tables. Nothing crucial will be on the floor—only the tactile flooring that guides you through the room.

Audio 3 – Voice (Narrator)
You have three hints available during the mission. Use them wisely. Each additional hint requested will result in a deduction in the final score.

Audio 4 – Voice (Narrator)
You will have 2 minutes to explore the environment and memorize the location of each station, identified by a raised number (the number of beads). Remember that only the supply cart and the power panel near the door are not numbered.

Audio 5 – Voice (Narrator)
When time is up, return to the starting point. Good luck, and may the fight for the future begin now!

Audio 6 – SFX (Timer / Countdown)

2-minute timer with audible seconds ticking

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2. Storyline Introduction

Audio 7 – SFX

Automatic door opening, gentle wind

Audio 8 – Voice (Narrator)

Year 2087. The Brazilian cerrado has never been so silent. You have just crossed the isolation zone of the abandoned Araguaia Biotech laboratory, in the heart of Tocantins. Outside, the invisible threat of *Aspergillus araguaiensis* hangs in the air—a lethal fungus resistant to everything we know.

Audio 9 – SFX

Low background alarm, lab ventilation, echoing footsteps

Audio 10 – Voice (Narrator)

An unprecedented epidemic forced the abandonment of this place. The scientists who worked here fell one by one, victims of the spores. Now, the hope of an entire region rests in your hands.

Element 11 – Scent (olfactory)

Activate the alcohol/eucalyptus aroma for story immersion.

Audio 12 – Voice (Chief Scientist, pre-recorded)

iGEM team, if you are hearing this, it means you have accepted the most important mission of your lives. You have less than 25 minutes before the spores bypass all protection. The future of thousands, maybe millions, depends on what you do here.

Audio 13 – Voice (Chief Scientist, pre-recorded)

Before anything else, put on your lab coats and protective masks. The power in the laboratory is off, but there is still a way to turn it back on.

(Pause here to allow participants to put on lab coats and masks)

Audio 14 – Voice (Chief Scientist, pre-recorded)

Observe carefully: among your lab coats, one pocket contains the key to a box in one of the carts. Inside, you will find employee cards, which are necessary to activate the power panel. Proceed carefully, but without hesitation. Once the cards are inserted, the lab's energy will come back online—but an exhaust system alert will trigger, and you will need to evacuate quickly.

Audio 15 – SFX
Tense background music begins

Audio 16 – Voice (Narrator)
You have only a few minutes. Every touch, every choice could be the difference between containing the epidemic… or letting the fungus spread beyond the cerrado.

After Door Opening

Audio 17 – Unitone robotized Voice (AI Voice)
"Card accepted, more cards needed" (bell)

Repeat audio 17 until every cards are used

Audio 18 – Unitone Robotized Voice (AI Voice)
"All cards passed, lab energy activated" (technology sounds)

Audio 19 – SFX
Alarm rises, then fades

Audio 20 – SFX
Ventilation hum, electronic beeps

Audio 21 – Unitone Robotized Voice (AI Voice)
Alert: Exhaust system malfunction detected. Immediate evacuation recommended after door unlock.

Audio 22 – Voice (Narrator, whispering)
The future of science—and perhaps humanity—depends on what you do next.

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3. Session 1: Finding the Glycoprotein Gene

Audio 23 – Voice (Chief Scientist)

Welcome to the main lab room. Here, you must assemble the genetic vector capable of producing the inhibitory glycoprotein against the fungus. The first step is to find the correct gene.

Audio 24 – Voice (Chief Scientist)

Listen carefully to the description transmitted via audio. Using playdough and beads on the central table, each of you should model the glycoprotein as instructed. Trust your sense of touch and creativity.

Audio 25 – Voice (Chief Scientist)

A glycoprotein can have various shapes. Use playdough to form it as a cord, a sphere, or any shape you find interesting. Attach beads to the surface—they represent sugars attached to the protein. Focus on texture differences: smooth protein regions versus raised sugars. This combination defines the glycoprotein.

Audio 26 – Voice (Chief Scientist)

Once the modeling is complete, place the sculpture on the scanner at Table 1. When correctly assembled, you will hear a digital beep.

(Pause here for sculpture placement – use a camera or coordinate with the support facilitator to confirm when all objects are correctly on the scanner.)

Audio 27 – SFX

Digital beep, piece placed on table

Audio 28 – Voice (AI Voice)

Gene constructed, place on Table 3!

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4. Session 2: Finding the Promoter

Audio 29 – Voice (Chief Scientist)

The next step is to select the correct promoter, responsible for activating glycoprotein production. You will find three puzzle pieces on Table 4, each with a different texture.

Audio 30 – Voice (Chief Scientist)

Slide your fingers across the pieces: the roughest piece represents the strongest promoter, essential for high-scale production in this case. Fit it next to the previously obtained glycoprotein gene.

Audio 31 – Voice (Chief Scientist)

Explore each texture carefully. When the correct promoter is found, store the piece carefully together with the other two pieces.

Audio 32 – SFX

Pieces snapping into place, gentle click

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5. Session 3: Finding the Antibiotic Resistance Gene

Audio 33 – Voice (Chief Scientist)

Now, you must ensure the modified bacterium survives the lab environment. Use the antibiotic specific to your vector.

Audio 34 – Voice (Chief Scientist)

In the reagent cabinet at Table 6, several bottles are available. Look for **kanamycin**, as the vector carries resistance to it.

Audio 35 – Voice (Chief Scientist)

To identify each bottle's content, place it on the scale at Table 2. Correct placement triggers a low beep and announces the antibiotic and concentration. Handle it carefully. Teamwork is essential for a quick escape.

Audio 36 – SFX

Low beep, followed by an audio announcement: "Correct antibiotic."

(You may also use alternative audio announcements indicating other antibiotics—such as Chloramphenicol, Ampicillin, Streptomycin, or Tetracycline—together with their concentrations, followed by the message: "Wrong antibiotic.")

6. Session 4: Plasmid Assembly

Audio 37 – Voice (Chief Scientist)

With the three components—glycoprotein gene, strong promoter, and antibiotic resistance gene—assemble the plasmid by fitting the puzzle pieces. Each correct fit brings you closer to the solution.

Audio 38 – Voice (Chief Scientist)

Finally, bring the plasmid with the antibiotic tube to the scanner at Table 1. When all is correct, you will receive instructions to advance to the bioreactor stage.

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7. Session 5: Bioreactor

Audio 39 – Voice (Chief Scientist)

You've reached the final stage. An improvised bioreactor is located at Table 6—the last barrier between science and the hope of containing the epidemic.

Audio 40 – Voice (Chief Scientist, encouraging)

Carefully take the bacterium with the plasmid ready to use in a microtube in Table 3. This symbolizes bacterial transformation, when the bacterium receives the new genetic material and is ready to produce the recombinant (glyco)protein.

Audio 41 – Voice (Chief Scientist)

Then, use the dropper–Pasteur pipette–to transfer the bacteria-plasmid mixture into the tactile bioreactor bucket. Follow the tactile markers guiding your hands to the correct opening. A low beep signals that the reaction has begun.

Audio 42 – SFX

Lid opening, liquid dropping, low beep, gentle stirring sound

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8. Optional audio - Final Minutes

Audio 43 – SFX

Soft countdown alarm, heartbeat in background

Audio 44 – Unitone robotized Voice (AI Voice)

10 minutes left

Audio 45 – Voice (Chief Scientist)

Attention, scientists! Only five minutes remain. You need to ensure the bioreactor is active, and time is short. Ensure glycoprotein production is complete before the exhaust system fails.

Audio 46 – Voice (Chief Scientist, final minute)

Only 1 minute left! Remember the responsibility you carry!

Completion

Audio 47 – Voice (Chief Scientist, emotional)

Congratulations, team! You did it! The glycoprotein was successfully produced. Now, carry the bioreactor out of the room before contamination by fungal spores. Humanity finally has hope!

Notes for Facilitators & Soundboard Setup:

- *Each audio is designed to be **triggered individually**.*
- *Pre-recorded narrations can be voiced by Chief Scientist or Narrator; AI voice segments may use a robotic modulator.*
- *Scent effects should be timed with the audio cues indicated.*
- *Adjust volumes and timing for immersive experience.*
- *Minor adaptations can be made during execution to accommodate participants' pace.*
- *Always use free copyright-free sound effects. Consider adding a subtle background soundscape to increase immersion (e.g., laboratory ambiance, electronic hum, or soft atmospheric tones, depending on the scene).*