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Required science courses can be fun, too: using an escape room as an instructional tool.

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Introduction

Certain science courses are mandatory in all undergraduate engineering programs. For example, biomedical engineering majors typically require at least one semester of Anatomy and Physiology (A&P). A&P comes with a lot of new vocabulary and the discussion of many complicated cellular processes, which can make it challenging for the instructors to keep students interested. To make the course material more appealing to engage with, an A&P activity was developed at the Wentworth Institute of Technology in the shape of an escape room. An escape room is a collaborative game in which participants solve a series of puzzles or riddles to eventually accomplish a specific goal, typically the escape from a locked room, in a limited amount of time. Escape rooms have become popular commercialized entertainment in recent years and have also found their way into higher education, for example, in computer science [1], healthcare [2] [3] [4] and special education [5]. In educational escape rooms, the riddles are based on material that is specific to the class, and students must either employ their existing knowledge or acquire new knowledge through puzzle solving. Studies have shown that these educational tools can enhance learning by strengthening existing knowledge [1] [4] and lead to active engagement of students in the classroom [1] [6].

At the Wentworth Institute of Technology, the Anatomy & Physiology (A&P) instructor created an educational escape room that focusses on A&P concepts that are often difficult for students: homeostasis, the neuronal action potential, and the anatomy and functions of the brain. The pilot was developed as a physical escape room, located in a lab space. After their experience, students were asked to complete an optional, anonymous Likert-scale-type survey which included questions to assess their perception of the educational value of the escape room activity and their level of enjoyment. For subsequent semesters, the physical escape room activity was converted into a virtual escape room. Another problematic physiological concept was added: the synthesis and action of hormones.

Escape room designs

<u>The physical escape room (pilot)</u>

The original escape room was created as a physical escape room that was set up in the A&P lab space. The escape room activity consists of three puzzles which can be completed in any order. The two parts (“clues”) that make up each puzzle are hidden in the space and must be located by the participants. Clues that belong together are marked with the same symbol. Each puzzle yields a letter code when solved. The letter codes are then copied into a spread sheet on a computer that was provided for the activity. Each correct letter code returns a one-digit number in the spread sheet. All three one-digit numbers in the correct order are necessary to open a safe. The safe,

which resembles a small book (The New English Dictionary), is hidden in plain sight and alluded to in the spreadsheet ("Now you are ready to learn a new English word.") after all three one-digit numbers are obtained. Each puzzle has three slightly different versions that the instructor can choose from. Letter codes resulting from puzzles are usually in lowercase format but may also be entered in the spreadsheet in uppercase format.

Puzzle A: Homeostatic control loops (**Figure 1**). The task is to position the components of a homeostatic control system loop into appropriate blank spots on a graphic. Correct positioning reveals star-shaped markings on the graphic that, when connected via line drawing, form six uppercase letters (non-sensical). The code must be read from the worksheet in the same direction in which such a control system operates, as indicated by the arrows between the item boxes.

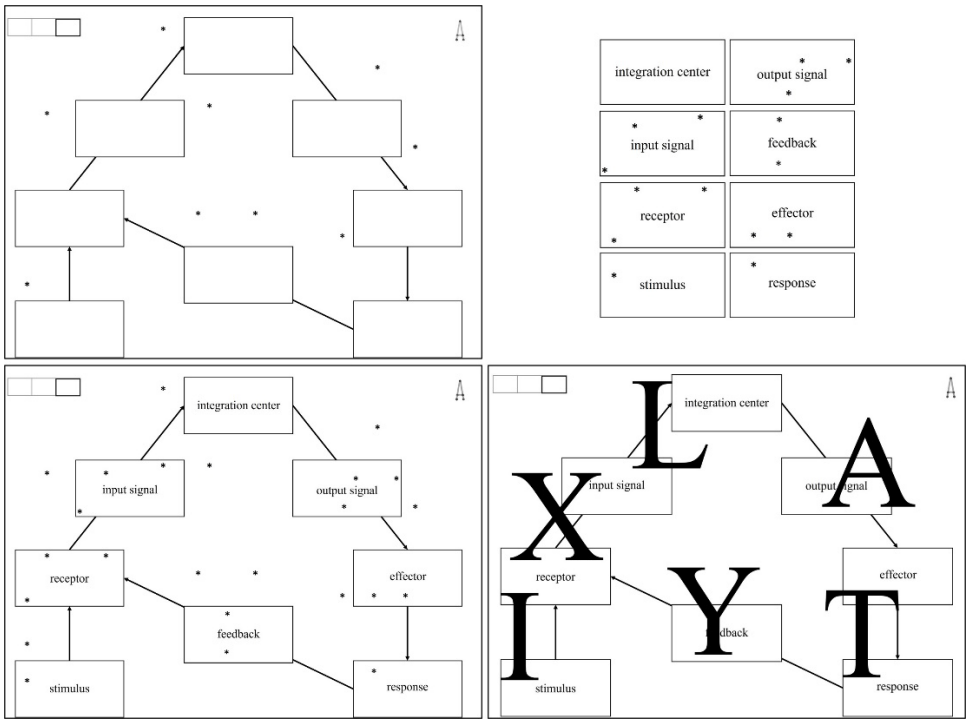
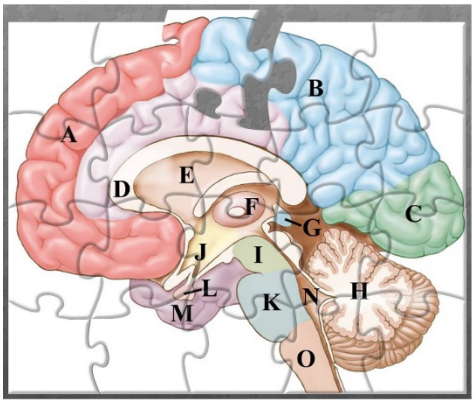


Figure 1 *setup and solution of the homeostatic control loop puzzle. The puzzle is composed of two clues: the handout with blank spaces (top left) and the inserts (top right) that are provided as single cutouts. Correct fitting reveals star-shaped markings (bottom left), which can be traced to reveal letters (bottom right).*

Puzzle B: The action potential (**Figure 2**). The task is to sort a strip sequence into the correct order to describe events of an action potential at the axonic cell membrane. Descriptions of the start and the end event of an action potential are included in a handout and space was left between start and end for participants to insert the strip sequence. A 10-letter code (non-sensical) is taken from letters throughout the strip sequence, which stand out by being bolded and underlined. The code must be read on the worksheet from top to bottom, as indicated by an arrow on the left.

start	**In the initial segment of the axon, the cell membrane potential is at resting value. Leak ion channels are open. Voltage-gated ion channels are closed. The sodium-potassium pump is active.**
1	A strong depolarizing gra**d**ed potential arrives at the axon hillock.
2	In the ini**t**ial segment of the axon, voltage-gated sodium ion channels open.
3	Sodium ions diffuse into the cell in higher **v**olume than at rest.
4	The cell membrane becomes more positive than the resting membrane potential and moves fart**h**er away from the resting value (depolarization)
5	In the initial segment of the ax**o**n, voltage-gated sodium ion channels close and voltage-gated potassium ion channels open.
6	Potass**i**um ions diffuse out of the cell in higher volume than at rest.
7	The cell membrane is more positive than the resting membrane potential but the potential moves to**w**ards the resting value (repolarization)
8	The cell membrane is more negative than the **r**esting membrane potential (hyperpolarization).
9	In the initial segment of the axon, voltage-**g**ated potassium ion channels close.
10	In the initial segment, the sodium-potassium pump, and ion diffusion through leak channels re-esta**b**lishes the resting membrane potential.
end (cont.)	**The strong depolarizing graded potential from the initial segment arrives at the axon segment following the initial segment.** **etc**

Figure 2 *design of the action potential puzzle, including the solution. 10 strips, each containing the description of a specific event during an action potential on an axonic membrane, must be placed onto a worksheet which provides 10 empty spaces between the descriptions that mark the beginning and the end of an action potential. Bolded and underlined letters result in the code for this puzzle when read from top to bottom.*



Coordination and fine-tunes skeletal muscle movement with the help of output from the primary motor cortex and input from proprioceptors.	
Computation of auditory information and the interpretation flavors.	
Regulation of the sleep-wake cycle via melatonin.	
First and primary location for the secretion of cerebrospinal fluid.	
Primary motor area for the control of movement that involves the skeletal muscles. Also, the location that determines your personality and your ability to learn and create declarative memory.	
Activation of the autonomic nervous system via hormones that are tropic to the anterior pituitary gland, thus maintenance of body temperature, osmolarity, reproductive functions, metabolism. Communication with the medulla oblongata via interneurons.	

Figure 3 *design of the brain puzzle. A virtual 20-piece jigsaw puzzle (left) must first be assembled. Specific brain regions are labeled with capital letters. The worksheet (right) must be completed by inserting letters from the jigsaw puzzle that matches each brain region whose function is described in the worksheet. The code for this puzzle is read from top to bottom.*

Puzzle C: Brain regions and their functions (**Figure 3**). The first task is to complete a jigsaw puzzle of a schematic of a brain in lateral view. Selected brain regions were labeled with single uppercase letters in the jigsaw puzzle. The second task is matching functions to brain regions. Participants receive a list of functions for six of the brain regions that were labeled in the jigsaw puzzle. A 6-letter code (non-sensical) is taken from the brain regions that need to be located based on their function. The code must be read from the worksheet from top to bottom, as indicated by an arrow on the right.

The escape room was offered during the Fall 2019 semester to all students who were enrolled in A&PI (total of 42 students). To participate in the escape room activity, students could sign up for a 35-minute time slot in groups of two or three. During all attempts of the escape room, the lab door remained unlocked, and participants were able to abandon the activity at any time. Therefore, "escaping" meant the successful completion of the activity, rather than being able to physically leave the lab space. An instructor was present in the room but did not provide help. Students were allowed to use A&P textbooks that were stored in the lab but had no other resources available. Students who successfully "escaped" in the allotted time received bonus points towards their A&P course grade. If they were unsuccessful, they could sign up for another attempt with reduced time (25 minutes). The setup for the escape room was kept in place for a period of two weeks, during a time when the lab space was not used for instruction.

The virtual escape room

Based on the physical escape room, a virtual version [7] was created using Google Sites with integrated links to Google office applications and other websites that offered resources free of charge. The virtual escape room activity consists of four puzzles. Three of those puzzles are conceptually identical to the puzzles in the physical escape room and one new puzzle was added. Each yields a password which, when entered correctly, unlocks the next puzzle; therefore, they must be completed in order. If a password is entered incorrectly, a message appears, and the participant can try again; the number of attempts is unlimited. URL links on the site connect to all clues of the puzzles, most of which are masked as images. The site also contains a link to a document ("notebook") that provides hints how clues must be used to find solutions. The escape room is built around a narrative: The participant and a non-player character are locked in a lab space of a mad scientist and must find a way out. While they are searching the lab, they encounter several problems.
(See the appendix for a walkthrough of the virtual escape room.)

Puzzle 1: password for the thermostat (design similar to **Figure 1**). The task is to assemble a virtual jigsaw puzzle whose motif are the components of a homeostatic control system loop, which in the narrative is likened to room temperature regulation via a thermostat. The assembled image reveals star-shaped markings that, when connected via line drawing, form six uppercase letters (non-sensical). The code must be read from the image in the same direction in which such a control system operates, as indicated by the arrows between the components of the homeostatic loop.

Puzzle 2: which syringe should you take? (design similar to **Figure 2**). In the narrative, the participant must neutralize a creature, who is threatening the non-player character, by injecting the creature with a chemical. This is accomplished by determining the order of the events during an action potential at the axonic cell membrane. The puzzle provides the start and the end event of an action potential. The in-between events are listed in a jumbled order and must be sorted. A

10-letter code is taken from letters throughout the sequence once sorted correctly, which stand out by being bolded and capitalized. The code must be read from top to bottom, as indicated by an arrow on the left. In this puzzle, the solution spells out a word, the name of a muscle relaxant.

Puzzle 3: Deactivate Steve (design similar to **Figure 3**). In the narrative, the participant must turn off a creature who has been stimulated accidentally. This is achieved by deactivating the creature's brain. One of the clues is an interactive, three-dimensional representation of a human brain, on which selected brain regions are labeled with single uppercase letters. A second clue is a list of functions for six of the brain regions that were labeled on the brain. A 6-letter code (non-sensical) is taken from the brain regions that need to be located based on their function. The code must be read in a particular order, as indicated in the "notebook".

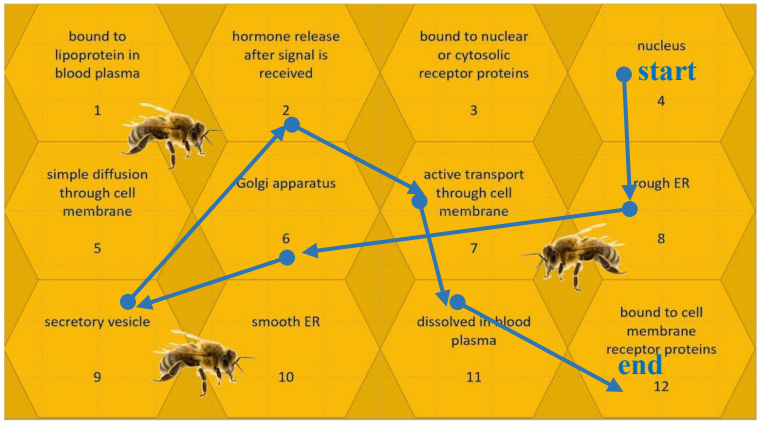


Figure 4 *hormone synthesis puzzle, with solution (blue arrows). The puzzle is composed of numbered tiles that each list a cellular component or process that is involved in the synthesis and action of hormones. The participant must select those that apply to only peptide hormones.*

Puzzle 4 (final)*: number code for exit* (**Figure 4**). In the narrative, the participant must open a door with a numbered door lock to escape the lab. The clue leads to a tiled image, with tiles listing different cellular structures and events that are involved in hormone synthesis and action. The task is to identify those cellular structures and events that are needed to describe the synthesis and action of peptide hormones and bring them in the correct order. All tiles are also numbered and will result in a 10-digit number code when sorted correctly. The code must be read in the order relevant for the task.

The virtual escape room was first offered as part of the A&PI course in Fall 2020 and has since been an integral part of this course. An entire 110-minute lab period is dedicated to this activity. Participation is optional. The course instructor is present in the room to provide help. Furthermore, students are allowed to use their lecture notes and internet resources during the activity. Students can earn bonus points towards their A&P course grade on a sliding scale – the more puzzles they solve, the more points they receive.

Problems encountered and possible solutions

The physical escape room

The escape room attempted to recreate the experience participants would have in a commercial escape room, which is typically done in a small group that is isolated ("locked") in a space. The time slots students could sign up for had to be scheduled outside of regular class hours, which in turn meant that students and the course instructor had to dedicate extra time to it. Several laboratory personnel also volunteered to staff the escape room. Their teamwork, and the fact that class sizes at this institution are small, made it possible to offer enough time slots for all interested students to attempt the escape room at least once. The activity was set up in the A&P lab space because there was no other room available. Since much of the A&P equipment and materials could not be cleared out just for the escape room, the room was "cluttered", which made it more difficult and time-consuming for students to locate the clues for the puzzles. Instead of limiting participation to two to three students at a time, a large-scale escape room could be created in which all puzzle components are multiplied, and directly given to the participants rather than hidden. It might diminish the "real" escape room experience, but it would be more suitable for a classroom setting.

As the final goal of the escape room, participants had to open a safe with a three-digit number code. One digit was acquired from each of the three puzzles. This setup meant that one of the numbers could easily be obtained through trial-and-error once the two other digits were determined. Therefore, participants only had to complete two of the riddles, and possibly even only one if participants were dedicated to the trial-and-error method. If the purpose of an escape is educational, this development is unfortunate. One possible way to avoid this would be to make the final escape goal the assembly of a relevant object for which all parts are needed, rather than a short number code.

The digital escape room

This escape room required participants to solve riddles in a particular order as one completed puzzle unlocked the next. This was done to make the riddles part of the overall narrative, which takes the shape of a story the participants follow along. When students got stuck on a puzzle, they often became frustrated and felt discouraged. The course instructor was present throughout the activity to assist in those situations. This particular escape room might not be suitable as an activity that students can work on independently, although it can be argued that it forces students to work together and to be exposed to the same learning activity at the same time [1]. Moments like these give the opportunity for instructors to review difficult material with students at a time when it is applied, rather than as part of a recap in the next class session.

Assessment of the escape room pilot

For the pilot of the escape room, students were asked to complete an optional Likert scale-type survey after each experience. The survey was provided on a sheet of paper upon exiting the space. Students could complete it immediately or later. All completed surveys were collected at the end of each day and scored only after the two-week period during which the escape room activity was offered. In the survey, participants were asked to define their level of agreement with several statements which were meant to gauge their overall experience and their perceived educational value of the escape room activity (**Table 1**).

Table 1 *Selected results of the Likert-survey, which 30 students completed after their first attempt (unshaded columns), and 21 students completed after their second attempt (shaded columns).*

statement	mean (stdev)		strongly agree (1)		agree (2)		neutral (3)		disagree (4)		strongly disagree (5)	
Knowledge of the A&P class material was essential to successfully complete the escape room.	1.37 (0.55)	1.29 (0.45)	67%	71%	30%	29%	3%	0%	0%	0%	0%	0%
The escape room was fun for me.	2.17 (0.90)	1.95 (0.65)	27%	24%	37%	57%	30%	19%	7%	0%	0%	0%
The puzzles were too difficult.	3.1 (1.01)	2.95 (0.59)	10%	0%	13%	10%	37%	60%	37%	15%	3%	0%
We were not given enough time to complete the escape room.	2.77 (1.12)	3.14 (0.83)	13%	5%	33%	14%	20%	43%	30%	38%	3%	0%
I got frustrated.	2.77 (1.05)	2.95 (1.00)	7%	5%	43%	33%	23%	29%	20%	29%	7%	5%
I would like to see something like this as part of the lecture or lab as a(n) _												
a. graded activity	3.64 (1.15)	3.81 (1.24)	9%	13%	5%	0%	23%	13%	41%	44%	23%	0%
b. ungraded activity	2.57 (1.09)	2.50 (1.12)	10%	17%	52%	33%	19%	11%	10%	17%	10%	6%
c. extra credit activity	1.17 (0.37)	1.19 (0.39)	83%	81%	17%	19%	0%	0%	0%	0%	0%	0%
I recommend other students to participate.	1.47 (0.56)	1.33 (0.47)	57%	67%	40%	33%	3%	0%	0%	0%	0%	0%
If I had the chance, I would try this escape room again.	1.33 (0.47)	1.62 (1.09)	67%	67%	33%	19%	0%	5%	0%	5%	0%	5%

In the pilot run (physical escape room), among the 16 groups (42 students) attempting the escape room, 11 groups (27 students) were unsuccessful and were offered the chance to repeat the same activity with reduced time. 8 groups (21 students) returned for the second attempt, among which 4 groups (12 students) succeeded. The student survey was not repeated for the digital escape room and no further data regarding level of enjoyment was collected. Anecdotal evidence revealed that students feel challenged by this activity, but still find it enjoyable and relevant. Furthermore, the success rate increased. For example, in the most recent run of this activity (Fall 2023), all participating students (n=26) completed all puzzles of the escape room.

Escape rooms as instructional tool

At the Wentworth Institute of Technology, the Anatomy & Physiology (A&P) instructor developed an escape room as an activity with the aim of allowing students to apply and practice their knowledge of challenging A&P class material in an engaging and appealing way. As part of the invitation to the escape room, students were told that they would need to know about certain material coming into the activity, although the exact topics were not revealed. The participating students concurred that the escape room activity was a significant application of previously learning material (**Table 1**). While the students in this study were not asked whether they thought they knew the material better because of the activity, students in a study performed by Eukel et al. [4] self-assessed that their knowledge of the material had improved. Furthermore, students perceive escape rooms as a more effective learning activity than traditional lecturing [5]. In hindsight, disclosing the relevant topics prior to offering an escape room activity certainly would have been helpful because it would have given students the opportunity to review the course material. In reference to their educational escape room, López-Pernas et al [1] reported that some students regretted not preparing better for the activity, albeit knowing about the topic of the escape room beforehand.

While some students became frustrated, the escape room was overall an enjoyable experience for the students, even more so when they came back for a second attempt (**Table 1**). Most students considered the escape room a worthwhile class activity, although they are hesitant about wanting such as activity as part of their course grade. Rather, it should stay as is: an extra credit opportunity (**Table 1**). López-Pernas et al [1] suggested using escape rooms as graded items because it would provide motivation for students to study the material beforehand, provided the students have been informed about the relevant topics. However, whether students successfully complete an escape room can also be influenced by the design of the puzzles. In this escape room, students who returned for a second attempt found the puzzles somewhat easier to solve the second time around (**Table 1**). It is unclear whether repeating the escape room made the material appear less difficult, or if students had a better understanding of the puzzle design, having experienced the puzzles before. It is challenging to design puzzles such that they make sense to participants as much as they do to the designer.

Summary

The pilot of this escape room activity was set up in a lab space. The clues for the puzzles were physical objects that students could manipulate, such as a handout they could write on, or sticky labels that they could move around. Furthermore, the students had to search the lab space for those clues, which were hidden in drawers, dangling from hooks, or stuck to a wall. On the one hand, it gives the feeling of a real escape room experience, similar to commercial escape rooms. On the other hand, using physical setups may require dedicated space, may limit the number of participating students to small groups only, and possibly limits the time a group of participants has available for the activity. Provided all participants have a computer (and internet access), digital escape rooms are more accessible than physical escape rooms and can be done in a classroom or remotely. They can be used as an activity for multiple student groups at the same time. Lastly, there are many free, web-based resources that can be used to create a virtual escape room, which is opportune for institutions with small budgets.

References

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APPENDIX

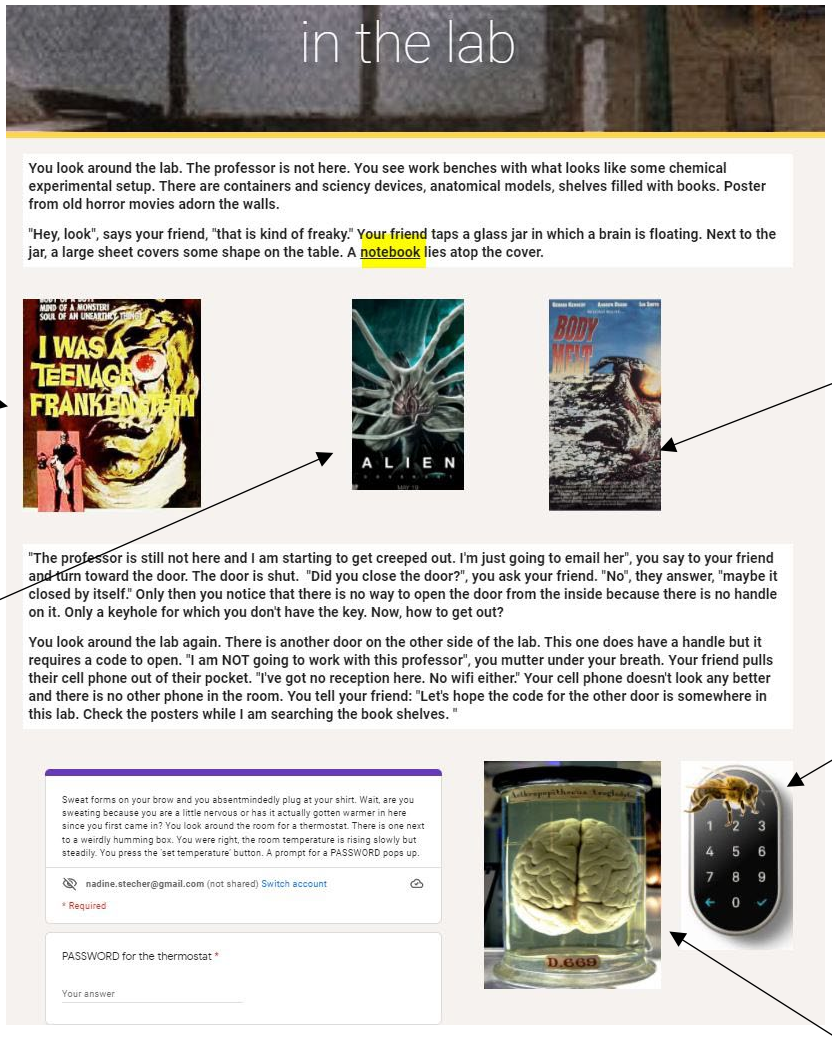
Anatomy & Physiology Escape Room “Apply at your own risk”

WALKTHROUGH

link: https://sites.google.com/view/apply-at-your-own-risk/enter?authuser=0

general guidelines

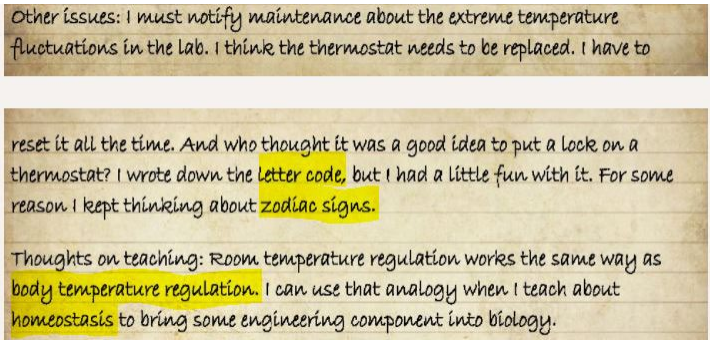
- The escape room activity contains 4 riddles that must be completed in order. Each riddle ultimately yields a password that must be entered on the form that is part of the google site. Entering the correct password for one riddle unlocks the next riddle.
- Number of attempts of entering passwords is unlimited. Time is unlimited.
- The google site contains links to all riddles; most of them are hidden behind the images on the page (**Appendix Figure 1**).
- The “notebook” contains hints to riddle solutions. Link is highlighted in **Appendix Figure 1**.
- All letter passwords are case sensitive. Capital letters only.
- The passwords for riddles 1 and 3 are jumbled letter sequences (meaning, not a word), riddle 2 solves to a specific term, and puzzle 4 is a number sequence.



Appendix Figure 1 *links to riddle are highlighted*

Riddle 1: PASSWORD for the thermostat: **IXLATY**

Clicking on the "Body Melt" movie poster leads to a jigsaw puzzle. After assembling the jigsaw puzzle (**Appendix Figure 3**), asterisks on the image (chart) must be traced to form

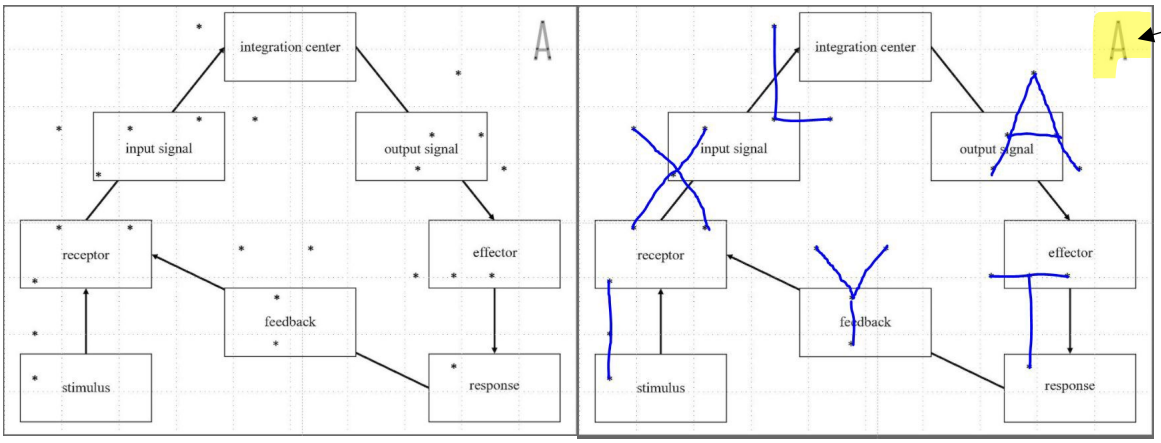

Other issues: I must notify maintenance about the extreme temperature fluctuations in the lab. I think the thermostat needs to be replaced. I have to reset it all the time. And who thought it was a good idea to put a lock on a thermostat? I wrote down the letter code, but I had a little fun with it. For some reason I kept thinking about zodiac signs.

Thoughts on teaching: Room temperature regulation works the same way as body temperature regulation. I can use that analogy when I teach about homeostasis to bring some engineering component into biology.

Appendix Figure 2 *notebook clue for THERMOSTAT riddle (Tuesday 5/12/2020)*

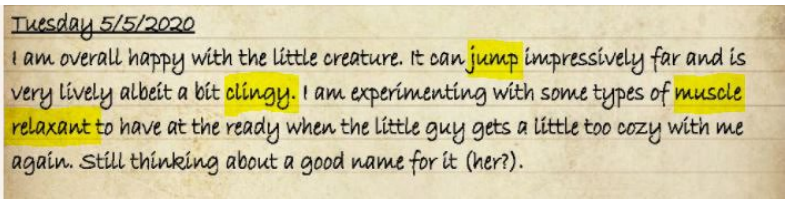
letters in the order in which the process of homeostatic regulation occurs (which is indicated by arrows on the chart).

Gives the clue that letters must be formed.



Appendix Figure 3 *a homeostatic control loop in form of a jigsaw puzzle leads to the password for the THERMOSTAT riddle. Jigsaw puzzle assembled (left) and with resulting password highlighted (right)*

Riddle 2: WHICH SYRINGE should you take? **CARISOPRODOL** (a muscle relaxant)


Tuesday 5/5/2020
I am overall happy with the little creature. It can jump impressively far and is very lively albeit a bit clingy. I am experimenting with some types of muscle relaxant to have at the ready when the little guy gets a little too cozy with me again. Still thinking about a good name for it (her?).

Appendix Figure 4 *notebook clue for the SYRINGE riddle*

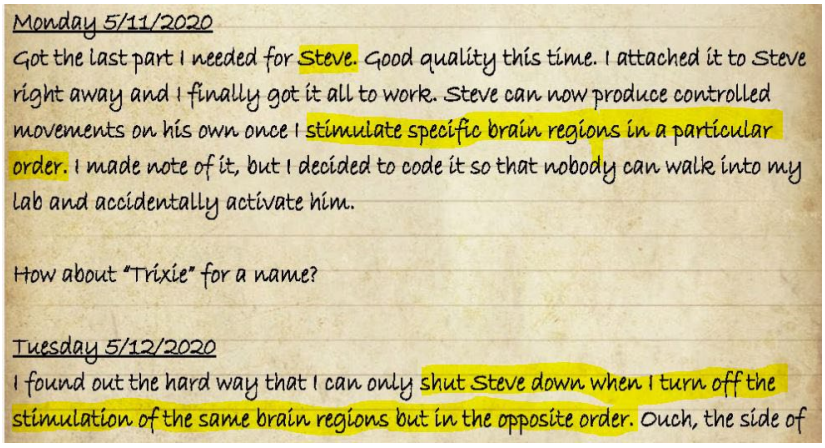
Clicking on the "Alien" movie poster will lead to a "to do list" that contains different event that occur during an action potential at the cell membrane of a neuron. The first and last events are labeled as such, while the other events are listed out of order. The correct order must be determined to reveal the password. (Note that the lines on the list cannot be physically manipulated to change their order.) Each event description contains one or two letters that are

capitalized and printed in bold. Once the correct order is determined, the bolded letters will yield the password (**Appendix Figure 5**).

		note to self: needs re-sorting for maximum efficiency
✓	order	Task
☐	start	**In the initial segment of the axon, the cell membrane potential is at resting value. Leak ion channels are open. Voltage-gated ion channels are closed. The sodium-potassium pump is active.**
☐	5	In the initial segment of the axon, voltage-gated sodium ion channels close and voltage-gated potassium i**O**n channels open.
☐	9	In the initial segment of the axon, voltage-gate**D** potassium ion channels cl**O**se.
☐	2	In the initi**A**l segment of the axon, voltage-gated sodium ion channels open.
☐	4	Locally, the cell membrane becomes more pos**I**tive than the resting membrane potential and moves farther away from the re**S**ting value (depolarization).
☐	7	Locally, the cell membrane is more positive than the resting membrane potential but the potential moves towa**R**ds the resting value (repolarization)
☐	10	In the initial segment, the sodium-potassium pump, and ion diffusion through leak channels re-estab**L**ishes the resting membrane potential.
☐	3	Locally, sodium ions diffuse into the cell in highe**R** volume than at rest.
☐	1	A strong depolarizing graded potential arrives at the axon hillo**C**k.
☐	6	Locally, **P**otassium ions diffuse out of the cell in higher volume than at rest.
☐	8	Locally, the cell membrane is m**O**re negative than the resting membrane potential (hyperpolarization).
☐	end (cont.)	**The strong depolarizing graded potential from the initial segment arrives at the axon segment following the initial segment. etc**

Appendix Figure 5 *the action potential sequence yields the password for the SYRINGE riddle.*

Riddle 3: DEACTIVATE Steve **JAEGMH**



Monday 5/11/2020

Got the last part I needed for Steve. Good quality this time. I attached it to Steve right away and I finally got it all to work. Steve can now produce controlled movements on his own once I stimulate specific brain regions in a particular order. I made note of it, but I decided to code it so that nobody can walk into my lab and accidentally activate him.

How about "Trixie" for a name?

Tuesday 5/12/2020

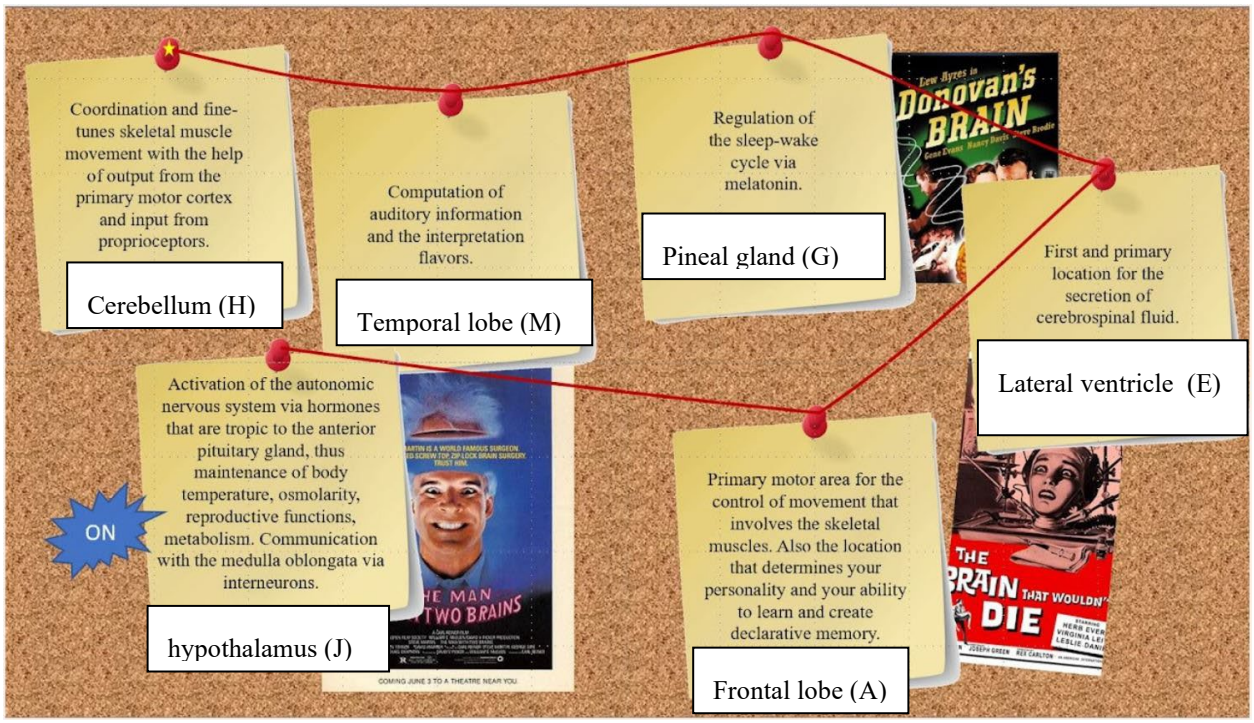
I found out the hard way that I can only shut Steve down when I turn off the stimulation of the same brain regions but in the opposite order. Ouch, the side of

Appendix Figure 6 *Notebook clue for the DEACTIVATE Steve riddle.*

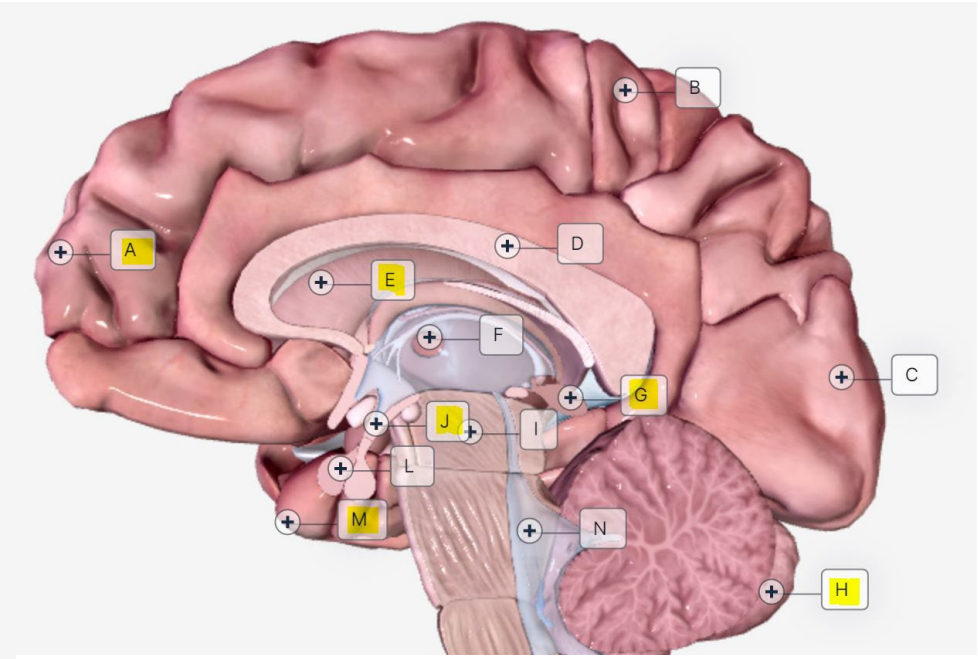
To solve this, two links are needed: the "I was a Teenager Frankenstein" movie poster (clue 3A), which leads to a pinboard onto which functions of brain regions are noted (**Appendix Figure 7**), and the picture of a brain in a jar (clue 3B), which leads to an animation of a brain with

lettered labels (**Appendix Figure 8**).

Note that deactivating Steve is done in the opposite order of activating Steve. In other words, the password is the letter combination starting at "on" and ending with the red starred pin (**Appendix Figure 7**).



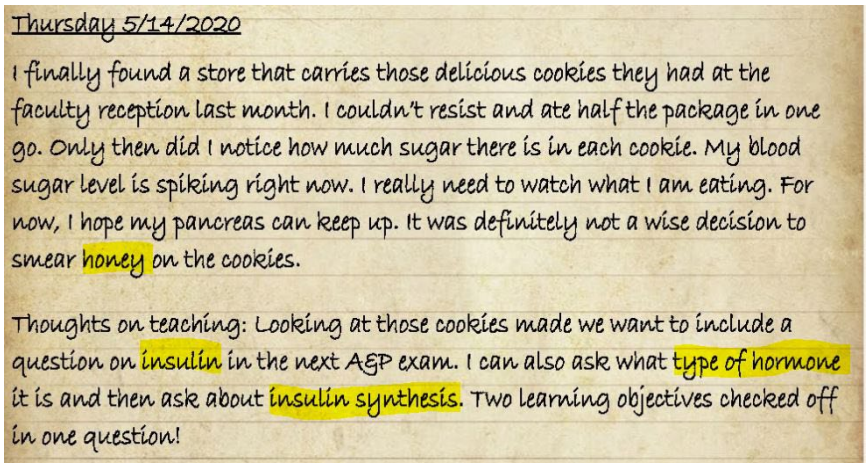
Appendix Figure 7 *functions of brain regions are clue A for the DEACTIVATE Steve riddle; solutions are added.*



Appendix Figure 8 *a labeled brain is clue B for the DEACTIVATE Steve riddle; solutions are highlighted*

Riddle 4: door lock **4869271112**

The link to the riddle is the picture of a number lock with a honey bee sitting on it, which leads to honeycomb with the titles of cellular structures and events that are involved in hormone synthesis (**Appendix Figure 10**). Not all options need to be used; insulin is a peptide hormone, therefore any structure or events pertaining to steroid hormones must be left out.

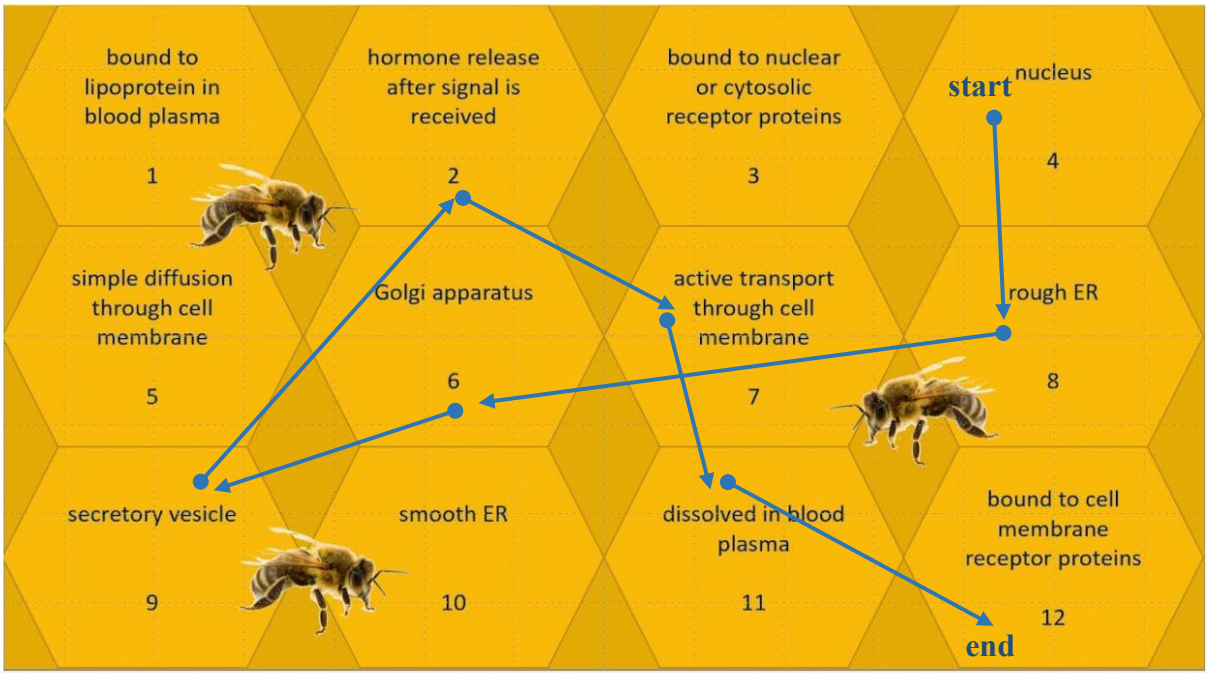


Thursday 5/14/2020

I finally found a store that carries those delicious cookies they had at the faculty reception last month. I couldn't resist and ate half the package in one go. Only then did I notice how much sugar there is in each cookie. My blood sugar level is spiking right now. I really need to watch what I am eating. For now, I hope my pancreas can keep up. It was definitely not a wise decision to smear honey on the cookies.

Thoughts on teaching: Looking at those cookies made we want to include a question on insulin in the next A&P exam. I can also ask what type of hormone it is and then ask about insulin synthesis. Two learning objectives checked off in one question!

Appendix Figure 9 *Notebook clue for the door lock.*



Appendix Figure 10 *peptide hormone synthesis is the clue for the door lock riddle. Solution is highlighted.*