**Abstract**

The structure and function of the cell is one of the essential topics in the biology classroom because it is one of the foundations for studying other topics in biology. Monocelly is a digital board game designed to help high school students identify and understand the structure and function of cells and the various organelles within them. This game was developed using Google Sheets to be easy to use and can even be modified by the teacher as needed to help students learn other materials using game-based learning designs.

**Key Words** Monocelly; game-based learning; cell structure and function.

**Introduction**

Studying the structure and function of the cell is often quite challenging for students because the material is abstract and requires students to identify the visual form and function of each part of the cell. It requires exciting learning activities to help students keep interested and motivated (Vijapurkar et al., 2014). Game-based learning (GBL) is one strategy that has been widely used in today’s learning activities. The implementation of the GBL strategy has been proven to show positive results in improving learning because it can increase students’ learning (Chen, 2017). In addition, game-based learning activities help prepare students for a more serious investigation into a contemporary scientific controversy (Allchin, 2021).

Monocelly is a digital board game based on Monopoly, which was created by Lizzie Magie and Charles Darrow in 1903. This learning activity is designed for high school students but can also be used for higher or lower grades by modifying the game’s content. Monocelly can be played online by a maximum of four players for one group. The players compete with their knowledge of the structure and function of cell organelles. To play this game, students need to have a Google account to access the Google Spreadsheet.

In this activity, the teacher’s role is to divide students into groups of four and then create a virtual room (for example, a breakout room if the learning uses Zoom Meeting®). When students play games in small groups, the teacher can monitor student activities by “walking around” between virtual rooms to ensure the game is going well and conducting a “stealth assessment” according to recommendations from Akram and colleagues (2018), by taking notes and assessing student behavior.

This game is effectively used at the confirmation stage in learning. At the beginning of the lesson, the teacher can conduct an initial discussion with students, for 15–20 minutes, about the concept of cell structure and function, and then they can play games at the confirmation stage. Before starting to play, it takes approximately 30 minutes to introduce the game to students, prepare computers and internet access, and ensure students understand the game’s rules.

**Preparation**

The board for Monocelly was designed by the authors and may be used, shared, and adapted with attribution for noncommercial purposes under the Creative Commons Attribution-NonCommercial 4.0 Generic (CC BY-NC 4.0) license. Access information for the game board is ahead. However, you can skip these steps and jump into the Instructions section if you are an experienced Google Docs user.

**Minimum Requirements**

To use Monocelly for learning, you will need the following:

- Internet access
- Google account for the teacher
- Google accounts for each student who will participate in the game
- Personal computer, laptop, or tablet

**Accessing the Game Board**

Follow these steps to access the game board:

1. Log into your Google account.
2. Go to https://uns.id/monocelly, and you will be prompted to “make a copy” of the game board onto your Google Drive.
Sharing the Game Board with Students

Now you can share the game board with your students:

1. Click the Share button (located in the upper right corner).
2. Click Shareable Link.
3. Set to Can Edit so students can play with the board.
4. Distribute the link to the students.

If necessary, spend some time teaching students prior to the lesson how to access and use Google Docs to complete the work and save it for future access. If you need more detail about getting started or troubleshooting, please check the Google Support page.

Instructions

Here is how to use Monocelly in the classroom.

Objective

Collect as many cell organelles as possible.

Game Setup

The teacher distributes the Monocelly board link to student groups in the breakout room (Figure 1). Each player chooses one of the four game tokens available on the board (Figure 2). Who gets which token and who will be the first running player can be determined randomly. Make sure each player has 7 ATP cards and 12 organelle cards as initial capital (Figure 3).

How to Play

1. The game’s starting position is with all players’ tokens in the Start box.
2. Press the Delete button on the keyboard for any empty part of the sheet, and the numbers on the dice will change randomly.
3. Play the token according to the number on the dice. Several things may happen when a player starts walking:
   - Organelle box: Guess the name of the organelle according to the clue in the organelle box by sacrificing one ATP card. If the answer is correct, the box will turn green, and the organelle will belong to the player marked with the player’s organelle card, and the ATP will be returned. However, when the answer is wrong, the box will turn red, and the player’s ATP will be forfeited (placed in ATP Storage).

Figure 1. The Monocelly game board.
Mystery box: Open the mystery card by sliding the mystery card cover on the board (Figure 4). Follow the instructions contained on the mystery card.

- Virus box: No running for one turn.
- Other player’s organelle box: Lose one ATP card.

The winner is the player who collects the most organelles. A player who runs out of ATP is declared a loser.

**Conclusion**

Monocelly is an educational game that is fun, inexpensive, easy to use, and allows you to modify it for use in teaching other materials. Game-based learning using Monocelly can develop thinking skills in a fun way and improve the quality of the student’s learning process in terms of cognitive aspects and motivation. This can be seen in the enthusiastic look of the students competing to win the game.

In general, students and teachers who use Monocelly in learning enjoy the experience, which is the concept of the game. Students become more motivated to learn biology concepts because the learning activity was designed in a competitive manner.

**Supplemental Material**

You can access, copy, and modify Monocelly according to the needs of your classroom here: https://uns.id/monocelly.

**Acknowledgments**

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| Chapter Title | Chapter Title |
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| Dougherty Valley High School, San Ramon, CA | Northampton Area High School, Northampton, PA |
| Eastern Mennonite High School, Harrisonburg, VA | Olivet Nazarene University, Bourbonnais, IL |
| El Centro College, Dallas, TX | Palm Tree School, Fairfax, VA |
| Elkhart High School, Elkhart, IN | Panorama High School, Panora, IA |
| Emmett High School, Emmett, ID | Perkins High School, Sandusky, OH |
| Fairhaven High School, Fairhaven, MA | Pike High School Freshman Center, Indianapolis, IN |
| Florida SouthWestern State College, Naples, FL | Pikeview High School, Princeton, WV |
| Freedom High School, Freedom, WI | Putnam City High School, Oklahoma City, OK |
| George Washington High, Charleston, WV | Riverside City College, Riverside, CA |
| Gillette College, Gillette, WY | Salem High School, Salem, IN |
| Grafton High School, Grafton, WI | Saltsburg High School, Saltsburg, PA |
| Grand View University, Des Moines, IA | Seabury Hall, Makawao, HI |
| Grandville High School, Grandville, MI | Seneca East High School, Attica, OH |
| Greater Lowell Technical High School, Tyngsborough, MA | Sherando High School, Winchester, VA |
| Greater New Bedford Regional Vocational Technical High School, New Bedford, MA | Skyline High School, Sanmamish, WA |
| Greensburg Salem High School, Greensburg, PA | Snow College, Ephnaim, UT |
| Harmony School in Innovation, Katy, TX | Southeast Community College, Lincoln, NE |
| Heathwood Hall Episcopal School, Columbia, SC | South Central Jr Sr High School, Elizabeth, IN |
| Hillsboro High School, Hillsboro, OR | Southern Wells High School, Poneto, IN |
| Hilltop High School, Chula Vista, CA | Spague High School, Salem, OR |
| Holt High School, Holt, MI | St. Andrew's Episcopal School, Potomac, MD |
| The Independent School, Wichita, KS | St. Clair High School, St. Clair, MI |
| Interboro High School, Prospect Park, PA | State Library of PA, Lykins, PA |
| Kenmore West High School, Buffalo, NY | Stillwater High School, Stillwater, OK |
| Kent County High School, Wotton, MD | Stouffville District Secondary School, Whitchurch-Stouffville, ON, Canada |
| Kettle Run High School, Nokesville, VA | The Summit County Day School, Cincinnati, OH |
| Lake Metroparks, Concord, OH | Sunlake High School, Land O'Lakes, FL |
| Lakeville North High School, Lakeville, MN | Tiffin Columbian High School, Tiffin, OH |
| Lexington High School, Mansfield, OH | Unionville High School, Kennett Square, PA |
| Los Angeles High School, Los Angeles, CA | University Christian High School, Hickory, NC |
| Martin Luther College, New Ulm, MN | Ursuline Academy, Dedham, MA |
| Mary Persons High School, Forsyth, GA | Valley View High School, Archbald, PA |
| Marysville High School, Marysville, KS | Vincennes University, Vincennes, IN |
| McDowell Intermediate High School, Erie, PA | Visitation Academy - Saint Louis, St. Louis, MO |
| Metropolitan Community College, Omaha, NE | Walters State Community College, Morristown, TN |
| Midland Park High School, Midland Park, NJ | Western Piedmont Community College, Morganton, NC |
| Minnetonka High School, Minnetonka, MN | West Mifflin Area High School, West Mifflin, PA |
| Morganston, NC West Mifflin Area High School, West Mifflin, PA | Wheeling Park High School, Wheeling, WV |
| Moscow High School, Moscow, ID | Worthington Christian High School, Worthington, OH |
| Mount Abraham Union High School, Bristol, VT | York Community High School, Marion, IL |

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