



CONTEXTUALIZED e-LEARNING TOOL: IMPROVING GRADE 7 LEARNERS' PERFORMANCE IN PLANT AND ANIMAL CELLS STRUCTURES AND FUNCTIONS

Alfeche, Christy B.; Babor, Reynold P.; Diaz,
Antoneth I.

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Alfeche, Christy B.

Bunga National High School
Department of Education, Schools Division of Toledo City
email: christy.alfече071@deped.gov.ph

Babor, Reynold P.

Bunga National High School
Department of Education, Schools Division of Toledo City
email: reynod.babor071@deped.gov.ph

Diaz, Antoneth I.

Bunga National High School
Department of Education, Schools Division of Toledo City
email: antoneth.igpit@deped.gov.ph

Abstract

This action research examined the use of a Contextualized e-Learning Tool in improving Grade 7 learners' performance of plant and animal cell structures and functions at Bunga National High School during the School Year 2023–2024. The digital resource—featuring localized content, animations, quizzes, and simulations—was designed to address persistent difficulties in cell biology competencies identified through diagnostic assessments. Guided by a descriptive quantitative method within a pre-experimental design, the study focused on 22 learners whose baseline performance consistently fell below 50%.

After implementation, post-test results showed substantial changes in learner performance, with over 90% of participants reaching proficiency across the targeted objectives. Mean scores improved from pretest ranges of 27.27 to 40.34 to posttest results exceeding 90%, including 97.16 in identifying differences between plant and animal cell structures. Increases were also observed in tasks requiring higher-order thinking, such as comparing organelle functions (from 30.13 to 90.91) and explaining cellular energy processes (from 35.61 to 96.97), indicating stronger engagement with abstract concepts. The results suggest a shift in classroom dynamics—from traditional delivery to interactive, learner-centered experiences—highlighting how digital tools may influence conceptual understanding and student participation. These patterns resonate with Gericke and Grace's (2018) emphasis on the potential of interactive learning to clarify complex scientific content, and reflect the vision of DepEd Order No. 10, s. 2024, advocating for the integration of ICT in instruction. This study contributes to the ongoing conversation on technology-mediated strategies for addressing persistent learning gaps in Science education.

Keywords: *Action Research, Contextualized e-Learning Tool, Pre-Experimental Approach, Cell Biology, Cebu, Philippines*

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Context & Rationale

Biology is a foundational science subject that explores the structures and processes of living organisms, yet it remains one of the most challenging areas for junior high school students to master—particularly in the topic of plant and animal cells. At Bunga National High School, competencies related to cellular biology have consistently emerged as the least learned, as reflected in five years of diagnostic assessments and monitoring reports. The difficulty lies in the abstract and complex nature of cellular structures and functions, which traditional teaching methods often fail to effectively communicate. Lectures and rote memorization, while conventional, do not fully engage students nor cater to diverse learning styles. This gap in engagement and comprehension underscores the need for an innovative teaching tool. Hence, this action research focused on developing and implementing a contextualized e-learning tool aimed at improving students' conceptual understanding, retention, and application of plant and animal cell concepts. The issue is not only academically significant but also timely and educationally relevant, especially in an era where digital tools are becoming integral to instruction.

Several studies validate the need for interactive and technology-based approaches to teaching biology. Domdey et al. (2018) emphasized the value of digital learning platforms in allowing students to explore cell structures independently and more thoroughly. Gericke and Grace (2018) also highlighted that abstract scientific concepts become more accessible when presented through interactive learning materials. According to Esti and Heru (2019), biology education is most effective when it includes real biological objects and dynamic instructional materials. These findings are consistent with current Department of Education directives, particularly DepEd Order No. 10, s. 2024, which advocates for integrating Information and Communications Technology (ICT) into the teaching-learning process. The literature collectively suggests that when students are given access to visual, interactive, and engaging tools, their performance and interest in complex subjects such as cell biology significantly improve.

Despite these existing insights, a notable gap persists in localized, contextualized tools specifically designed for junior high school learners in public school settings. Most available digital resources are generalized and often do not reflect the socio-cultural and academic contexts of Filipino learners. Furthermore, there is limited empirical data on the direct impact of these tools on learner performance within the K to 12 curriculum. In Bunga National High School, the absence of tailored, interactive resources continues to hinder learners' ability to fully engage with biology content. This gap presents a critical opportunity for action research to introduce a targeted intervention that not only addresses academic underperformance but also contributes new knowledge on the efficacy of contextualized e-learning materials in a real classroom setting.

To address this gap, the study developed and implemented a **Contextualized e-Learning Tool** focusing on plant and animal cells. The tool featured locally relevant content, gamified assessments, simulations, and visual animations that aligned with the Most Essential Learning Competencies (MELCs). By offering a multisensory learning experience, the tool aimed to

bridge the gap between abstract cellular concepts and tangible understanding. This innovation sought to transform the learning environment from passive to interactive, fostering deeper comprehension and higher-order thinking. Post-intervention results demonstrated a substantial increase in learners' test scores, reflecting not only improved mastery of content but also heightened student engagement. The study proves significant as it offers a replicable model for enhancing instruction in complex science topics. It contributes to both theory and practice by providing empirical evidence on how localized digital interventions can improve learning outcomes and foster educational innovation in public schools.

Innovation and Strategy

To address persistent learning gaps in understanding plant and animal cell structures and functions among Grade 7 students at Bunga National High School in Toledo City, Cebu, Philippines, this action research introduced the **Contextualized e-Learning Tool**—a digital innovation designed to transform traditional instruction into an engaging, student-centered learning experience. This tool specifically targets diverse learner needs by offering multimodal content: visual learners benefit from detailed diagrams, animations, and video clips; auditory learners engage with narrated explanations and audio summaries; and kinesthetic learners interact with simulations and gamified tasks. Developed using the **ADDIE instructional design model**—which includes the phases of Analysis, Design, Development, Implementation, and Evaluation—the intervention was carried out over a one-week instructional period. It involved Grade 7 students who previously scored below 50% in diagnostic tests on cell biology concepts.

The innovation's implementation was carefully aligned with the curriculum and guided by a clear rationale: to bridge conceptual gaps through a dynamic, technology-integrated approach tailored to students' preferred learning styles, as identified by a VAK (Visual, Auditory, Kinesthetic) learning inventory. The tool featured structured modules including a home navigation page, interactive learning content, 3D virtual tours of cells, differentiated quizzes, and educational games—making abstract biological concepts more

concrete and accessible. While the scope of the intervention was limited to one content strand and a specific learner group, the strategy demonstrated strong plausibility in enhancing comprehension and retention. The tool's effectiveness was evidenced by a substantial

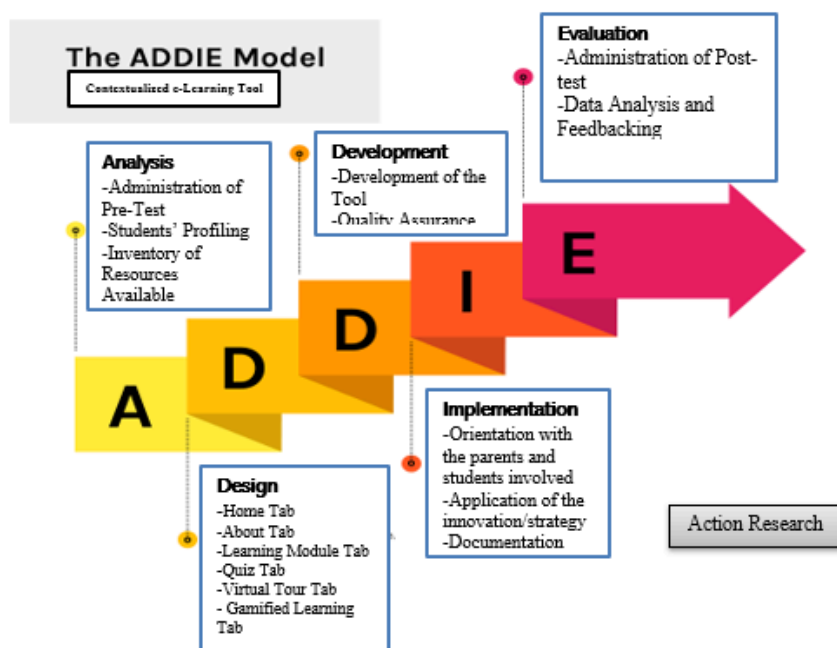


Figure 1. Process Flow Using the ADDIE Model

increase in post-test scores, validating its potential for wider application in Science Education.

ADDIE-Based Implementation of the Contextualized e-Learning Tool

This research utilized the ADDIE instructional design model—**Analysis, Design, Development, Implementation, and Evaluation**—as a framework for creating, piloting, and assessing the **Contextualized e-Learning Tool on Plant and Animal Cells**. The tool was designed to respond to the learning needs of low-performing Grade 7 students at Bunga National High School, Cebu Province, Philippines. It incorporated interactive, gamified, and multimodal features aligned with students' learning styles to improve their understanding of cell biology.

Analysis

The first phase focused on understanding learners' profiles, instructional gaps, and the feasibility of the intervention within the school context. Three key activities were conducted:

1. Administration of a Pre-Test

A diagnostic assessment on plant and animal cells was administered to identify the students' existing knowledge and misconceptions. Results showed that the average accuracy rate fell below 50%, highlighting significant conceptual gaps in understanding cell structure and function. This baseline data served as the foundation for evaluating learning gains after the intervention.

2. Students' Profiling Using the VAK Framework

Participants were classified according to their learning styles—visual, auditory, or kinesthetic—using the Learning Style Inventory (LSI) adapted from Middlesex Community College. This profiling informed the tool's design by ensuring that content delivery matched students' preferences while still promoting cognitive flexibility through exposure to multiple modes of learning.

3. Inventory of Available Resources

A resource mapping exercise assessed access to digital tools, internet connectivity, teacher readiness, and technical support systems. This helped identify strengths and constraints within the school environment and guided logistical planning to ensure successful deployment of the intervention.

Design

Guided by the insights from the analysis phase, the e-learning tool was designed with six key components accessible via a user-friendly interface:

- **Home Tab:** Serves as the landing page and provides an overview of the tool's features and navigation.
- **About Tab:** Outlines the tool's objectives, significance, developer information, and alignment with curriculum standards.
- **Learning Module Tab:** Presents lecture content, descriptions, trivia, and 3D models of animal and plant cells. Interactive visual aids, video narrations, and zoom-in features support deeper engagement.
- **Quiz Tab:** Offers multiple-choice and identification-type tests, with options to select difficulty levels (easy, average, difficult). This scaffolding promotes learner agency and differentiated assessment.
- **Virtual Tour Tab:** Enables students to explore three-dimensional, animated cell models. This fosters spatial and structural understanding of organelles and their functions.
- **Gamified Learning Tab:** Incorporates point systems, levels, and leaderboards to motivate participation and enhance retention through game-based tasks.

The modular design ensured content accessibility, intuitive navigation, and instructional clarity, supporting autonomous and guided learning.

Development

The development phase involved the actual creation and quality assurance of the Contextualized e-Learning Tool:

- **Content Development**
Instructional content was anchored on K–12 Science curriculum standards, specifically on the competency of differentiating plant and animal cells. Textual explanations, illustrations, and interactive activities were developed with user needs in mind.
- **User Interface and Experience Design**
A wireframe was designed to map user interaction, screen transitions, and multimedia integration. Careful attention was paid to student familiarity with technology and ease of use.
- **Pilot Testing and Iterative Improvement**
A pilot group of students tested the prototype, providing feedback on usability, functionality, and instructional value. Adjustments were made to refine user experience.
- **Expert Validation**
Content validity was established through reviews by Master Teachers and the Education Program Supervisor in Science, ensuring scientific accuracy and instructional alignment.

Implementation

The intervention was implemented over one week and comprised structured orientation, deployment, and monitoring activities:

- **Orientation with Parents**
Parents were briefed on the innovation’s purpose, processes, and expected outcomes. Their informed consent and involvement were solicited to support their children’s participation and adherence to schedules and protocols.
- **Orientation with Students**
Learners received guidance on the tool’s features, navigation mechanics, and intended learning outcomes. Expectations were clarified to ensure consistency and maximize engagement.
- **Application of the Innovation**
The contextualized e-learning tool was integrated into the regular Science lesson plan. It was used to facilitate instruction during all stages of the learning process:
 - *Activation of Prior Knowledge:* Activities such as KWL charts and word search puzzles introduced cell-related concepts.
 - *Developing and Deepening Understanding:* Learners explored interactive modules, videos, and cell models.
 - *Making Generalizations:* Discussions and application tasks enabled students to synthesize and relate learnings.
 - *Evaluation:* Students engaged in assessments embedded in the quiz and game tabs.
 - *Assignment:* Enrichment activities and extension tasks were provided to reinforce understanding.

Throughout the week, the teacher monitored student interaction, participation levels, and cognitive engagement. Logs, observation notes, and screen recordings supported implementation fidelity.

- **Documentation of Activities**
Photos, attendance logs, monitoring forms, and summary sheets were collected for accountability, transparency, and further analysis.

Evaluation

The final phase of the ADDIE model centered on assessing the impact of the innovation:

- **Post-Test Administration**
Upon completion of the intervention, a post-test identical in scope to the pre-test was administered. Results showed that over 90% of participants demonstrated significant gains in content mastery.
- **Data Analysis and Feedbacking**
Pre- and post-test data were consolidated and analyzed to determine the magnitude of improvement. Additionally, student feedback was collected through surveys and informal interviews, offering insights into user experience, perceived effectiveness, and suggestions for improvement.
- **Reflections and Future Directions**
Reflections focused on the innovation's strengths, such as improved motivation and conceptual clarity, as well as challenges like occasional connectivity issues. Lessons learned were documented, and recommendations for future implementation and scaling were outlined. The research team also identified opportunities for further study, such as testing the tool's applicability in other science topics or year levels.

Action Research Question

Will the use of a Contextualized e-Learning Tool in teaching plant and animal cells structures and functions improve the performance of Grade 7 learners at Bunga National High School during the school year 2023-2024?

Action Research Method

Research Design

This study employed a quantitative action research approach, which involves the systematic collection and analysis of numerical data to assess the impact of a specific intervention within the classroom context (Mills, 2018). Action research is practitioner-led and iterative, aiming to improve teaching and learning practices based on evidence derived from actual classroom experiences.

The use of a quantitative design was appropriate for this study, as the main objective was to measure the academic performance of Grade 7 students in understanding the differences between plant and animal cells before and after the implementation of a contextualized e-learning tool. Quantitative data from pre-test and post-test scores provided measurable evidence of learning gains attributable to the intervention.

Participants and/or Other Sources of Information

The **primary participants** of the study were **22 Grade 7 learners** from **Bunga National High School**, identified based on their low diagnostic test results in the targeted Science 7 competency: *"Differentiate plant and animal cells based on the presence or absence of organelles."* These students were selected using **purposive sampling**, as they represented the specific group of learners most in need of instructional support in the topic area.

Additional sources of information included:

- **The Science teacher**, who served as the intervention facilitator and provided formative feedback.
- **Learner products**, such as activity sheets and formative assessments conducted during the intervention week.
- **Documents**, including lesson plans and daily lesson logs that integrated the contextualized e-learning tool.

The inclusion of these participants and data sources was based on their direct involvement in and relevance to the implementation and evaluation of the innovation. Focusing on a specific learner group allowed for in-depth analysis of learning progress and instructional effectiveness, consistent with the localized and context-responsive goals of action research.

Research Instrument

The study employed a **researcher-developed 40-item multiple-choice test**, designed to assess students' understanding of the structure and function of plant and animal cell organelles. The test was used both as a **pre-test** (before the intervention) and a **post-test** (after the intervention). Test items were based on the **Most Essential Learning Competencies (MELCs)** and underwent **expert validation** by science educators to ensure content validity. A pilot test was also conducted to refine item clarity and difficulty. The use of a pre-test/post-test design aligns with best practices in educational action research for assessing learning gains. The quantitative nature of the test made it suitable for capturing measurable changes in student understanding, directly addressing the research question: *Does the use of a contextualized e-learning tool improve student performance in learning about plant and animal cells.*

Data Gathering Procedure

Pre-Data Gathering

Before the actual data collection:

- A **VAK learning style inventory** was administered to identify students' dominant learning modalities (Visual, Auditory, Kinesthetic). The findings were used to tailor the e-learning tool.
- A **research protocol**, including consent forms, was submitted to and approved by the **District Supervisor of Secondary Cluster 2** and the **Regional Research Committee (RRC)**.
- **Informed consent** was obtained from learners and their parents/guardians, outlining voluntary participation and data privacy provisions under Republic Act 10173 (Data Privacy Act of 2012).
- The Science teacher received **orientation and training** on using the contextualized tool to ensure fidelity of implementation.

Actual Data Gathering

During the intervention week:

- The **pre-test** was administered on the first day of the week-long lesson delivery, establishing baseline performance.
- The Science teacher **implemented the contextualized e-learning tool** throughout the week, integrating it into her **Daily Lesson Logs (DLL)** and conducting **formative assessments** after each session.

- The **post-test** was administered on the final day, measuring learning gains.

All data were gathered by the researcher in collaboration with the classroom teacher. Daily monitoring of student engagement and participation was also documented through observation logs.

Post-Data Gathering

After the intervention:

- All test scores were encoded into a **Summary Sheet**, which was used for statistical analysis.
- The data were **organized by test type (pre/post), learning competency, and student performance** to facilitate comparative review.
- These data were kept in **secured digital and physical formats**, accessible only to the researcher and authorized personnel.
Potential users of the data include:
 - **School administrators**, for instructional planning and policy decisions.
 - **Science teachers**, for professional development and curriculum enhancement.
 - **DepEd Region VII and SDO** research committees, to inform similar innovations.

Data Analysis

The study employed **descriptive statistical methods** to analyze the pre-test and post-test data:

- **Mean scores** were computed to determine the average performance before and after the intervention.
- **Percentage scores** were used to evaluate mastery levels for each sub-skill or learning objective.
- A **comparative analysis** between pre-test and post-test scores was conducted to determine if significant learning gains were made.

While no inferential statistics were applied due to the small sample size and the action research focus, the **use of descriptive statistics** provided sufficient insight into the impact of the innovation. Similar methods have been used in classroom action research to inform practical instructional decisions.

The analysis provided a clear picture of how the contextualized e-learning tool influenced student learning outcomes in cell biology. These findings were further triangulated with teacher observations and student outputs to enrich interpretation and ensure **validity through multiple data sources**.

Results and Discussion

Learners' Performance in Plant and Animal Cell Structures and Functions Before the Use of a Contextualized e-Learning Tool

The pre-intervention diagnostic data revealed critical learning gaps in students' understanding of plant and animal cells structures and functions, as evidenced by their overall low mean scores across five key learning objectives. The lowest performance was observed in identifying the major structural differences between plant and animal cells (27.27%), followed closely by comparing and contrasting organelle functions (30.13%) and energy acquisition (35.61%). These figures indicated that learners struggled not only with recalling factual content but also with applying conceptual understanding. In particular, they had difficulty recognizing organelle-specific roles, comparing processes like photosynthesis and respiration, and establishing structure-function

relationships. These insights confirmed the need for a responsive instructional approach that goes beyond traditional methods.

To address these gaps, a contextualized e-learning tool was designed as an innovative intervention aimed at making abstract biological concepts more accessible and engaging. Rooted in the learners' needs and their local context, the tool incorporated visual aids, comparative frameworks, simulations, and interactive activities to scaffold their understanding. The integration of local examples and multimodal materials was deliberate, reflecting the action research principle of tailoring interventions to the learning environment. This approach also supports findings from Delos Santos et al. (2021) and Frederick-Jonah et al. (2022), which highlight the persistent challenge of teaching cell biology and the importance of prior knowledge and motivation. By grounding the innovation in actual student performance, the research maintained a clear link between data, action, and purpose.

Table 1

Learners' Performance in Plant and Animal Cell Structures and Functions Before the Use of a Contextualized e-Learning Tool

LEARNING OBJECTIVES	Test Item No.	No. of Correct Responses	% of Correct Response	Mean (m) of Correct Response
Identify the major differences in structure between animal and plant cells, including the presence or absence of specific organelles	1	9	40.91	27.27
	2	5	22.73	
	6	9	40.91	
	8	2	9.09	
	21	5	22.73	
	24	7	31.82	
	26	8	36.36	
Explain the functions of organelles found in plant cell and animal cells	30	3	13.64	35.91
	3	11	50.00	
	4	7	31.82	
	5	10	45.45	
	7	5	22.73	
	12	13	59.09	
	17	8	36.36	
	22	9	27.27	
Compare and contrast the structure and function of the major organelles found in plant and animal cell	25	5	22.73	30.13
	27	9	40.91	
	28	5	22.73	
	9	3	13.62	
	10	11	50.00	
	13	7	31.82	
Compare and contrast the ways in which animal and plant cells obtain and process energy	14	10	45.45	35.61
	29	5	22.73	
	32	11	50.00	
	34	6	27.27	
	11	12	54.55	
Evaluate the impact of these structural and functional differences of plant and animal cell on the behavior and characteristics of organisms possessing these types of cells	19	7	31.82	40.34
	20	4	18.18	
	31	6	27.27	
	36	12	54.55	
	38	6	27.27	
	15	10	45.45	
	18	5	22.74	
	23	9	40.91	
33	9	40.91		
35	13	59.09	40.34	
37	4	18.18		
39	11	50.00		
	40	10	45.45	

Reflecting on the baseline data, it is encouraging to note that students scored relatively higher (40.34%) on evaluating the behavioral implications of structural differences, suggesting some capacity for integrated thinking. This strength provides a starting point for deeper instruction, where learners can build on existing intuitive knowledge. The diagnostic findings not only validated the need for the intervention but also shaped the design of subsequent instructional strategies and assessment tools. This aligns with action research's cyclical nature—where identifying a problem leads to informed action, and that action is expected to yield new insights for further reflection and improvement. Thus, the pre-test served as both a diagnostic and a planning tool for enhancing the quality of science instruction in a meaningful and data-driven way.

Learners' Performance in Plant and Animal Cell Structures and Functions After the Use of a Contextualized e-Learning Tool

After implementing the contextualized e-learning tool, post-test results revealed substantial improvements across all targeted learning objectives in cell biology. The data shows a significant leap in performance, with mean scores ranging from **90.91% to 97.16%**, indicating a strong grasp of both foundational and complex cellular concepts. Specifically, learners achieved a **mean of 97.16%** in identifying the major structural differences between plant and animal cells, demonstrating their enhanced ability to recognize organelles like the cell wall and chloroplasts and appreciate their relevance. Similarly, a **mean of 94.09%** in explaining the functions of organelles suggests that students not only remembered but understood the roles of mitochondria, endoplasmic reticulum, and other structures in cellular processes. This indicates that the contextualized tool was successful in supporting both factual recall and conceptual understanding.

Higher-order cognitive skills were also developed, as evidenced by the **mean of 90.91%** in comparing and contrasting the structure and function of organelles. This task required analytical thinking, which the students performed commendably, though it also indicates room for deeper conceptual consolidation. Learners scored **96.97%** on comparing how plant and animal cells obtain and process energy, suggesting their grasp of the biological significance of photosynthesis and respiration improved. Lastly, a **mean of 94.32%** in evaluating the impact of structural and functional differences on organism behavior and characteristics confirms that students were able to apply their knowledge in real-world biological contexts. These results underscore the success of the intervention in promoting comprehensive and integrative learning.

The post-test data affirms the effectiveness of the contextualized e-learning approach not only in improving academic performance but also in cultivating critical thinking. This aligns with studies by Nakiyemba, as cited by Kolawole (2024), which support the use of immersive and interactive learning tools—such as simulations and gamified digital content—in enhancing motivation and retention in biology education. The innovation addressed known difficulties in teaching cell biology, as emphasized by Frederick-Jonah et al. (2022), by offering learners practical, engaging, and contextually relevant experiences. This reflection highlights the value of action research as a cycle of problem identification, targeted intervention, and evidence-based

refinement—ensuring that instructional strategies evolve directly from student needs and learning realities.

Table 2

Learners' Performance in Plant and Animal Cell Structures and Functions After the Use of a Contextualized e-Learning Tool

LEARNING OBJECTIVES	Test Item No.	No. of Correct Responses	% of Correct Response	Mean (m) of Correct Response
Identify the major differences in structure between animal and plant cells, including the presence or absence of specific organelles	1	22	100	97.16
	2	22	100	
	6	20	90.91	
	8	22	100	
	21	21	95.45	
	24	22	100	
	26	20	90.91	
Explain the functions of organelles found in plant cell and animal cells	30	22	100	94.09
	3	21	95.45	
	4	20	90.91	
	5	21	95.45	
	7	21	95.45	
	12	21	95.45	
	17	22	100	
	22	19	86.36	
Compare and contrast the structure and function of the major organelles found in plant and animal cell	25	21	95.45	90.91
	27	20	90.91	
	28	21	95.45	
	9	21	95.45	
	10	21	95.45	
	13	20	90.91	
Compare and contrast the ways in which animal and plant cells obtain and process energy	14	22	100	96.97
	29	19	86.36	
	32	21	95.45	
	34	16	72.72	
	11	20	90.91	
	19	20	90.91	
Evaluate the impact of these structural and functional differences of plant and animal cell on the behavior and characteristics of organisms possessing these types of cells	20	22	100	94.32
	31	22	100	
	36	22	100	
	38	22	100	
	15	21	95.45	
	18	21	95.45	
	23	21	95.45	
33	22	100		
35	18	81.82		
37	21	95.45		
39	22	100		
40	20	90.91		
MPS				94.69

Learners' Performance in Plant and Animal Cell Structures and Functions Before and After the Use of a Contextualized e-Learning Tool

The comparative data between pretest and post-test results highlight a significant positive shift in learners' performance following the implementation of contextualized e-learning tools. This intervention was designed to enhance comprehension of plant and animal cells through interactive and multimedia-rich content. Prior to the innovation, mean scores across all learning objectives were notably low, ranging from **27.27** to **40.34**, indicating

major gaps in conceptual understanding. After the intervention, scores dramatically increased, with all post-test means exceeding **90%**, the highest being **97.16** for identifying the structural differences between plant and animal cells. This surge in performance suggests that the e-learning tool effectively addressed misconceptions and bridged knowledge gaps that traditional instruction failed to close.

These improvements are particularly noteworthy in objectives requiring higher-order thinking. For instance, the leap from **30.13** to **90.91** in comparing and contrasting organelle structures and functions suggests that students gained not only factual knowledge but also analytical skills. Similarly, the increase from **35.61** to **96.97** in understanding how plant and animal cells obtain and process energy reflects an enhanced ability to grasp biochemical processes like photosynthesis and cellular respiration. This level of cognitive development aligns with Gericke and Grace's (2018) emphasis on interactive learning as a strategy for simplifying abstract scientific ideas. The results validate the e-learning tool's role in shifting students from passive receivers of content to active participants in constructing knowledge.

Reflecting on these outcomes, it becomes evident that the success of the intervention lies in its capacity to transform instruction from static to dynamic. The shift in performance supports the idea that when students are given access to interactive, contextualized materials, their engagement, retention, and conceptual understanding improve significantly. This is aligned with the intent of **DepEd Order No. 10, s. 2024**, which calls for the integration of ICT in the teaching-learning process to meet 21st-century learning needs. The data and student progress further confirm the necessity of rethinking biology instruction, especially for complex topics like cellular biology. Ultimately, this action research demonstrates how responsive, data-driven innovations can reshape learner outcomes and foster deeper, more meaningful learning experiences.

Table 3

Comparative Analysis of the Learners' Performance in Plant and Animal Cell Structures and Functions Before the Use of a Contextualized e-Learning Tool

LEARNING OBJECTIVES	Mean (m) of Correct Response (Pretest)	Mean (m) of Correct Response (Post-Test)
Identify the major differences in structure between animal and plant cells, including the presence or absence of specific organelles	27.27	97.16
Explain the functions of organelles found in plant cell and animal cells	35.91	94.09
Compare and contrast the structure and function of the major organelles found in plant and animal cell	30.13	90.91
Compare and contrast the ways in which animal and plant cells obtain and process energy	35.61	96.97
Evaluate the impact of these structural and functional differences of plant and animal cell on the behavior and characteristics of organisms possessing these types of cells	40.34	94.32

MPS**33.86****94.69**

Reflection

Teaching plant and animal cells presents several challenges for us, primarily because these topics are often perceived as tedious or overly complex by students. This disinterest can stem from the abstract nature of cellular structures and functions, making it difficult for learners to connect with the subject matter. Students often perceive lessons on plant and animal cells as unengaging, which can significantly hinder their interest and understanding of the topic. This lack of enthusiasm is reflected in diagnostic test scores, where students consistently struggle with identifying and differentiating between plant and animal cells. At Bunga National High School, this competency has emerged as the least learned among students for five years, pointing to a broader issue of instructional methods that may be failing to capture their attention. Traditional teaching approaches, which often rely heavily on rote memorization and passive learning, can contribute to this disengagement. As a result, students view the subject matter as mere facts to memorize rather than as a fundamental aspect of biology with real-world relevance. This disengagement not only affects their performance but also hampers their overall appreciation for biological sciences, emphasizing the need for more dynamic and interactive teaching strategies that can foster a deeper understanding of the cellular structures and their functions.

According to studies by Salleh et.al (2021) and Fauzi et al. (2018), which examined students' challenges with biology concepts at the high school level, concepts related to the cell are particularly challenging for students to grasp. Additionally, high school students struggle to understand biological ideas; all of the concepts related to cells are cited as being very challenging for students to grasp. According to Benjamin and Emanuel, as cited by Frederick-Jonah and Tobi (2022), students struggle with biology are caused by a number of factors including lack of resources and instructional materials. The scarcity of tailored digital resources specifically in teaching plant and animal cell, is the prevailing factor contributing to students' low mastery and poor ICT integration.

Interactive learning materials can significantly enhance student engagement and comprehension of biological concepts. By incorporating multimedia resources and simulations, we can transform abstract concepts into tangible experiences. Such tools allow students to visualize cellular processes and interact with them, fostering a deeper understanding of plant and animal cells. This hands-on approach not only makes learning more enjoyable but also encourages collaboration and critical thinking, essential skills in today's educational landscape. The Department of Education (DepEd) Order Number 10 series of 2024 emphasizes the integration of Information and Communications Technology (ICT) in the teaching-learning process, highlighting its critical role in modern education. This directive advocates for the use of ICT tools to create interactive and contextualized materials that cater to diverse learning styles and needs. By leveraging technology, educators can

provide dynamic and engaging learning experiences that resonate with students, effectively addressing the perceived complexities of biology. Thus, aligning with DepEd's vision, we can improve engagement and understanding in the classroom, ultimately fostering a more profound interest in the Sciences.

Action Plan

I. Rationale

The educational landscape is continuously evolving, with advancements in technology providing innovative ways to enhance teaching and learning processes. In particular, contextualized e-learning represents a significant opportunity to personalize and differentiate instruction, making it more relevant and engaging for students. The teaching of Biology, a subject deeply connected to real-world applications and students' lives, presents unique opportunities to harness contextualized e-learning. Despite the potential benefits, many educators face challenges in effectively implementing differentiated instruction in Biology, often struggling to meet diverse learning needs within a single lesson plan. This can lead to disengagement and gaps in understanding among students with varying abilities, interests, and backgrounds. By implementing contextualized e-learning strategies, the researchers aim to address students' diverse educational needs, enhance their motivation, and improve academic outcomes.

II. Objectives

- a. Conduct a pilot implementation of the developed e-learning material in selected Biology classes, collecting data on student engagement, motivation, and learning outcomes.
- b. Improve students' performance in Biology specifically in learning plant and animal cells.

III. Implementation Scheme

Activities	Time Allotment/ Inclusive Dates	Person/s Involved	Budgetary Requirements	Accomplishment Indicators (MOVs)

A. PRE-IMPLEMENTATION PHASE				
Administration of pre-test	August 20, 2024	Researchers Students	500.00	Form XIV Pictures
Students' Profiling	August 27, 2024	Researchers	500.00	Learning Style Inventory

Objectives	Activities	Time Allotment/ Inclusive Dates	Person/s Involved	Resources Needed	Budgetary Requirements	Expected Output/ Target Outcome	Accomplishment Indicators (MOVs)
A. PRE-IMPLEMENTATION PHASE							
To identify available resources for intervention	Inventory of Resources Available	August 30, 2024	Researchers Students	Bondpaper	-	Identified available resources	Accomplished Inventory Form
To design a contextualized learning material	Designing e-learning material	January 2024	Researcher	Laptop	1,000.00	Sketch of the tool	Final design of the material
To develop e-learning and teaching material	Development of the contextualized e-learning material	February – August 2024	Researchers	Laptop Internet Connectivity	1500.00	Completed the elements of the Interactive Tool	Interactive Tool
To quality assure the tailored e-learning material	Quality Assurance of the Tailored Tool	August 2024	School QA Team	Bondpaper Printer Ink	500.00	Quality Assured Tool	Accomplished QA Tool
B. IMPLEMENTATION PHASE							
To inform the parents about the purpose of the action research	Orientati on with parents	September 2, 2024	Research ers	PPT Laptop Bondpape rs	500.00	Informed Parents	Accomplished Parents' Consent Attendance Sheet
To inform the target students about the purpose of the intervention and their role as participants.	Orientati on with students involved	September 2, 2024	Research ers	PPT Laptop Bondpape rs	500.00	Students will get oriented	Accomplished respondents' consent Attendance Sheet
To implement the proposed intervention to improve students' performance in learning plant and animal cell.	Applicati on of the interventi on	September 9- 16, 2024	Research ers	PPT Laptop Interactive Tool App Bondpape rs	1000.00	Improved performance	Formative assessment results Attendance Sheets Printed Online Scores Pictures
To monitor the implementation process	Docume ntati on of activities	September 9- 16, 2024	Research ers	Bonpaper Cellphone	200.00	To monitor student s' attenda nce and performan ce	Attendance Sheets Summary of scores Monitoring forms
C. POST IMPLEMENTATION PHASE							

To determine the result of the proposed intervention	Administration of post-test	September 17, 2024	Researchers	Bondpaper Printer and Ink	500.00	Improved Test Scores	Form XIV
To analyze and interpret the quantitative and qualitative data	Data Analysis and Feedbacking	September 19-30,2024	Researchers	Bondpapers Printer and Ink	1800.00	Computed Data	Tables with Interpretations and Implications

Prepare the remaining parts of paper for completion	write snop	October 2024	Researche rs	Laptop Printer Bondpaper	None	Accomplish ed remaining parts (Chapters 3-4)	Action Research report
Review entirely the work and submit for critiquing and evaluation	Paper review and Critiquing	October 2024	Researche rs Division researchn coordinato r	Completed paper	None	Submitted paper for critiquing and evaluation	Paper draft with corrections and comments
Finalize the paper and ensure the complete parts of the report	Preparatio n and submission of completed paper	October 2024	Researche rs	Completed paper	None	Evaluat AR ed Report	Action Research report Assessment Checklist AR Report
Present the results to colleagues and share the findings.	Research Disseminat ion	October 2024	Researche rs Teachers	Research Paper	2,000.00	Research presentatio n done with colleagues Accomplish ed reflection journals	Documentation Certification of Results' Dissemination
Present the paper to the Division Research Committee	Paper presentatio n	October 30, 2024	Researche rs Division researchn Committee	AR Report	None	Presented research paper and results	Documentation Certificate of research presentation
Present paper to the Regional Research Committee	Paper presentatio n	November 2024	Researche rs Regional researchn Committee	AR Report	None	Presented research paper and results	Documentation Certificate of research presentation
Present the paper to AR conference or research Congress.	Paper presentatio n	December 2024	Researche rs	Research paper	None	Presented research paper and results in a conference forum	Documentation Letter request for research presentation Certification of Results' Dissemination Certificate of research presentation
Refine the research papers' content and implementation for adoption and replication by other research environment or study setting.	Research Refinement Innovation Developme nt	December 2024	Researche rs	ICT Resources	None	Refined research report and developed innovation report	Research and Innovation Innovation Report Form Innovation Evaluation Form
Validate or Research and innovation Outputs	validation of researchn and innovation	January 2025	Researche rs	ICT resources	None	validate researchn and innovation outputs	Researchn and innovation reports and outputs
Adopt and replicate research and innovation in different schools in the division.	Adoption and implement ation of research and innovation outputs	January 2025	Researche rs	ICT resources	None	Adopted, replicated, and implemented research and innovation output	Certification(s) of research results and innovation Output Adoption, replication, implementation, and utilization

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Financia Report
(First Tranche Liquidation)

Financia Report
(Last Tranche Liquidation)

Research Instrument

Name: _____ Date: _____ Score: _____

Multiple Choice: Read the statements carefully. Encircle the letter of your answer.

1. Which of the following organelles is found in plant cells but not in animal cells?

A. Chloroplasts	C. Nucleus
B. Mitochondria	D. Ribosomes
2. What structure is present in animal cells but absent in plant cells?

A. Cell wall	C. Centrioles
B. Central vacuole	D. Chloroplast
3. Which organelle is responsible for photosynthesis?

A. Chloroplasts	C. Mitochondria
B. Golgi apparatus	D. Ribosomes
4. Which organelle provides structural support in plant cells?

A. Cell membrane	C. Centrioles
B. Cell wall	D. Lysosomes
5. What is the main function of the central vacuole in plant cells?

A. Energy production	C. Protein Synthesis
B. Photosynthesis	D. Storage of water and nutrients
6. Which of the following is present in both plant and animal cells?

A. Cell wall	C. Chloroplasts
B. Central vacuole	D. Mitochondria
7. Which of the following is NOT found in animal cells?

A. Centrioles	C. Lysosomes
B. Chloroplasts	D. Nucleus
8. What organelle is involved in protein synthesis and is found in both plant and animal?

A. Chloroplast	C. Golgi Apparatus
B. Lysosomes	D. Ribosomes
9. Which of the following organelles is associated with cellular respiration in both plant and animal cells?

A. Chloroplasts	C. Nucleus
B. Mitochondria	D. Ribosomes
10. How do chloroplasts in plant cells contribute to the cell's energy production?

A. By breaking down glucose	C. By producing ATP in the mitochondria
B. By converting light energy into chemical energy	D. By synthesizing proteins
11. What is the primary function of lysosomes in animal cells?

A. Digestion of macromolecules	C. Photosynthesis
B. Energy production	D. Protein synthesis
12. Which organelle is primarily responsible for the synthesis of lipids and steroids in both plant and animal cells?

A. Golgi apparatus	C. Rough ER
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B. Ribosomes

D. Smooth ER

13. How do the functions of the central vacuole in plant cells differ from those of vacuoles in animal cells?

- A. Central vacuoles aid in cellular respiration
- B. Central vacuoles are involved in protein synthesis
- C. Central vacuoles store waste products
- D. Central vacuoles help maintain turgor pressure and store nutrients

14. Why do plant cells have a cell wall and animal cells do not?

- A. Animal cells have a central vacuole for structural support
- B. Animal cells have chloroplasts for structural support
- C. Plant cells need additional protection against pathogens
- D. The cell wall helps maintain cell shape and prevents excessive water

uptake in plants

15. What are the roles of mitochondria in plant and animal cells?

- A. Mitochondria produce oxygen
- B. Mitochondria are involved in protein synthesis
- C. Mitochondria convert light energy to chemical energy
- D. Mitochondria are responsible for cellular respiration and energy

production

16. How do chloroplasts and mitochondria complement each other's functions in plant cells?

- A. Both organelles produce oxygen
- B. Chloroplasts produce energy and mitochondria store it
- C. Chloroplasts synthesize proteins and mitochondria break them down
- D. Chloroplasts perform photosynthesis and mitochondria use glucose

for cellular respiration

17. How does the absence of a cell wall in animal cells affect their structure and function?

- A. Animal cells produce more energy.
- B. Animal cells synthesize proteins faster.
- C. Animal cells can change shape and move.
- D. Animal cells have a higher photosynthetic rate.

18. What is the significance of the large central vacuole in maintaining the homeostasis of plant cells?

- A. It aids in cellular respiration
- B. It stores genetic information
- C. It regulates temperature within the cell
- D. It stores nutrients and waste products

19. How does the presence of chloroplasts affect the energy needs of plant cells compared to animal cells?

- A. Plant cells depend solely on mitochondria for energy
- B. Chloroplasts allow plant cells to produce their own energy
- C. Plant cells rely more on cellular respiration than photosynthesis
- D. Animal cells have higher energy needs due to the presence of

chloroplasts

20. Which organelle is found only in plant cells and is involved in photosynthesis?

- A. Chloroplasts
- B. Lysosomes
- C. Mitochondria
- D. Ribosomes

21. What is the function of centrioles in animal cells?
A. Cellular division C. Photosynthesis
B. Energy production D. Protein synthesis
22. Which organelle is responsible for providing structural support to plant cells?
A. Cell wall C. Golgi apparatus
B. Centrioles D. Lysosomes
24. What structure is present in plant cells but not in animal cells?
A. Cell wall C. Lysosomes
B. Centrioles D. Mitochondria
25. Which organelle stores water and nutrients in plant cells?
A. Central vacuole C. Mitochondria
B. Chloroplasts D. Ribosomes
26. Which of the following is a common feature of both plant and animal cells?
A. Cell wall C. Chloroplasts
B. Central vacuole D. Mitochondria
27. What is the role of mitochondria in plant and animal cells?
A. Energy production C. Protein synthesis
B. Photosynthesis D. Structural support
28. Which organelle is involved in digesting macromolecules in animal cells?
A. Cell wall C. Lysosomes
B. Chloroplasts D. Ribosomes
29. What is the primary function of ribosomes in both plant and animal cells?
A. Energy production C. Protein synthesis
B. Photosynthesis D. Structural support
30. Which organelle is NOT found in plant cells?
A. Cell wall C. Lysosomes
B. Chloroplasts D. Nucleus
31. How do chloroplasts and mitochondria function differently in plant cells?
A. Both organelles produce proteins
B. Both organelles perform photosynthesis
C. Chloroplasts convert light energy to chemical energy and mitochondria produce ATP
D. Chloroplasts are involved in energy production, and mitochondria are involved in photosynthesis
32. What is the main difference between the vacuoles of plant cells and those of animal
A. Vacuoles in plant cells are smaller
B. Vacuoles in animal cells store genetic material
C. Vacuoles in plant cells are involved in photosynthesis
D. Vacuoles in plant cells maintain turgor pressure, while animal cell vacuoles primarily store waste.
33. Why is the presence of a cell wall important for plant cells but not for animal cells?
A. The cell wall aids in photosynthesis
B. The cell wall aids in cellular respiration
C. Animal cells use chloroplasts for structural support
D. The cell wall provides structural support in plant cells

34. How does the functions of the Golgi apparatus differ between plant and animal cells.
- The Golgi apparatus is absent in animal cells
 - The Golgi apparatus is involved in cellular respiration in animal cells
 - The Golgi apparatus packages and modifies proteins and lipids in both plant and animal cells
 - The Golgi apparatus is involved in photosynthesis in plant cells and protein synthesis in animal cells
35. How do the roles of the cytoskeleton differ between plant and animal cells?
- The cytoskeleton is absent in animal cells
 - The cytoskeleton is involved in photosynthesis in plant cells
 - The cytoskeleton is involved in energy production in animal cells
 - The cytoskeleton provides structural support in both plant and animal cells
36. Compare and contrast the roles of chloroplasts and mitochondria in plant cells.
- Both organelles produce proteins
 - Chloroplasts store nutrients, while mitochondria store waste
 - Both chloroplasts and mitochondria are involved in cellular respiration
 - Chloroplasts convert light energy to chemical energy while mitochondria convert chemical energy into ATP
37. What is the importance of the large central vacuoles in maintaining plant cell structure and function?
- The large central vacuole stores genetic material
 - The large central vacuole aids in cellular respiration
 - The large central vacuole provides structural support
 - The large central vacuole is involved in protein synthesis
38. What is the impact of the absence of chloroplasts on the energy needs of animal
- Animal cells do not require energy
 - Animal cells rely solely on cellular respiration
 - Animal cells use photosynthesis for energy production
 - Animal cells produce their own energy through chloroplasts
39. How does the presence of a cell wall in plant cells influence their interaction with their environment?
- The cell wall aids in cellular respiration
 - The cell wall makes plant cells more flexible
 - The cell wall is involved in protein synthesis
 - The cell wall provides protection against pathogens
40. What is the significance of centrioles in the cell division process of animal cells compared to plant cells?
- Centrioles are absent in animal cells
 - Centrioles are involved in photosynthesis in animal cells
 - Centrioles are involved in cellular respiration in plant cells
 - Centrioles are crucial for the formation of the mitotic spindle in animal cells, while plant cells use other structures to achieve cell division

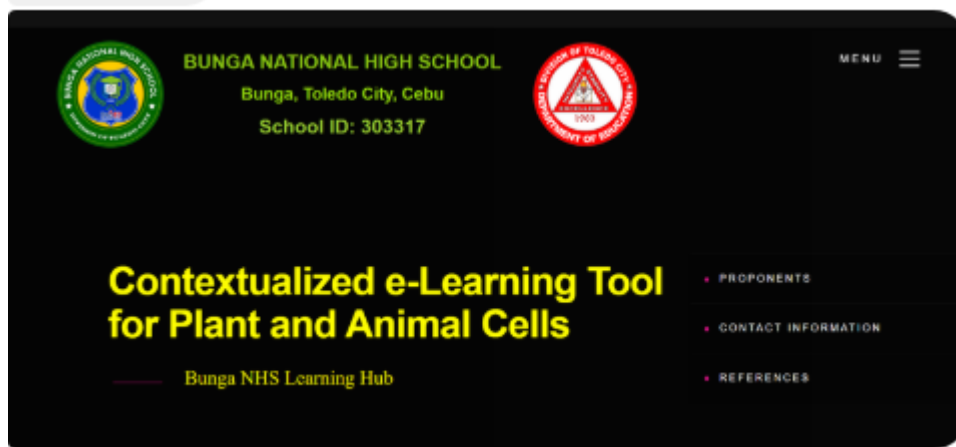
Prepared by:

Validated by:

Central Visayas

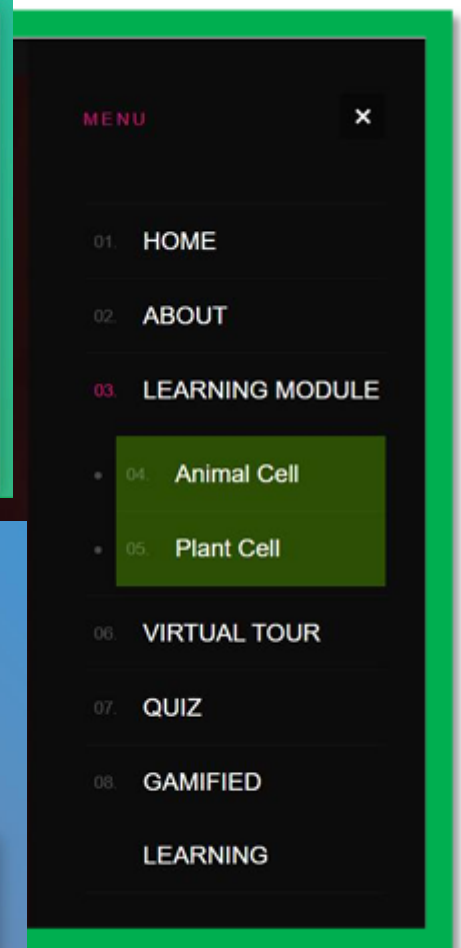
Table of Specifications

Screenshots of the Contextualized e-Learning Tool



INFORMATION

School ID	303317
Facebook Account	Bunga Nhs
Email Account	303317@deped.gov.ph
Address	Bunga, Toledo City, Cebu
Principal	Mrs. Christy B. Alfeche
Department of Education	Division of Toledo City



About Us

Hi-Tech Improvisation Material is an interactive digital tool designed to engage and educate the grade 7 learners diving into the intricacies of cellular biology. This hi-tech improvisation material has homepage and several tabs. For the Homepage, it bears its title: Hi-Tech Improvisation Material: An Interactive Tool in Teaching Plant and Animal Cell. This improvisation material contains menu bar namely, Home, About, Learning Module, Quizzes, Gamified Learning

HOME

Provides quick access to your homepage or a customizable start page. It displays the main feed or main page. It provides an overview of site activities.

Discover a new way of learning with us!

ABOUT

🔍 Animal Cell Trivia Time!

▶ 0:00 / 0:24

An adult human is estimated to have at least 70-100 trillion cells. There are about 200 types of cells spread in 4 different types of tissues in the human body. These cells form the structures of the human body and act together to help it function. It is truly amazing that all these trillions of cells came from a single cell and now make up our body. Isn't it amazing?

Major Parts

▶ 0:00 / 0:22

🔍 Plant Cell Trivia Time!

▶ 0:00 / 0:24

There are about 320,000 species of plants on Earth. Most of the species are located in tropical rainforest like our country, the Philippines. Aren't we lucky?

Major Parts

▶ 0:00 / 0:22

- **Cell Membrane**
 - Also known as plasma membrane or plasmalemma

VIRTUAL TOUR TAB



QUIZ TAB

Plant Cell Organelle Puzzle

Ribosomes	Nucleus	Golgi Apparatus
Vacuole	Mitochondria	Chloroplast
Cell Wall	Cell Membrane	Site of protein synthesis
Control center of the cell	Modifies, sorts, and packages proteins	Large storage compartment for water and nutrients
Energy producer of the cell	Site of photosynthesis	Surrounds and protects the cell
Rigid structure providing support and protection		

PRE-ASSESSMENT

Pre-Assessment on Plant & Animal Cell

Number of Questions:

5

Select difficulty:

Any Difficulty

Select time per question:

5 Seconds

Start Quiz

Post-Assessment on Plant & Animal Cell

Number of Questions:

5

Select difficulty:

Any Difficulty

Select time per question:


5 Seconds

Start Quiz

LABELING (ANIMAL CELL)

ANIMAL CELL ANATOMY


Label the Parts of the Animal Cell



Submit Answers

PLANT CELL ANATOMY

Label the Parts of the Plant Cell



Submit Answers

GAMIFIED LEARNING TAB

0:00 / 3:17

Deal or No Deal

BRIEFCASE 1	BRIEFCASE 2	BRIEFCASE 3	BRIEFCASE 4	BRIEFCASE 5	BRIEFCASE 6	BRIEFCASE 7	BRIEFCASE 8	BRIEFCASE 9	BRIEFCASE 10
BRIEFCASE 11	BRIEFCASE 12	BRIEFCASE 13	BRIEFCASE 14	BRIEFCASE 15	BRIEFCASE 16	BRIEFCASE 17	BRIEFCASE 18	BRIEFCASE 19	BRIEFCASE 20

Banker's Offer: \$0

Deal No Deal

