

Student Exploration: Photosynthesis Lab

By Nidhi Karavadra

Gizmo Warm-up

During **photosynthesis**, plants use the energy of light to produce **glucose** ($C_6H_{12}O_6$) from **carbon dioxide** (CO_2), and water (H_2O). Glucose is a simple sugar that plants use for energy and as a building block for larger molecules.

A by-product of photosynthesis is oxygen. Plants use some of the oxygen they produce, but most of it is released. In the *Photosynthesis Lab* Gizmo, you can monitor the rate of photosynthesis by measuring oxygen production.



- Observe the left pane closely. What do you think the bubbles are?
 - Oxygen gas.
- Select the **BAR CHART** tab. On the graph, notice the **Oxygen production** bar. Move the **Light intensity** slider back and forth. How does light intensity affect oxygen production?
 - As light intensity decreases oxygen production decreases and when the light intensity increases the production of oxygen increases too however after a certain % of light intensity (38%) oxygen produced stays the same.
- Experiment with the vertical **Temperature** slider (upper left) and the **CO₂ level** slider.
 - How does temperature affect oxygen production?
 - As the temperature increases the oxygen production increase however after 28 degrees the production of oxygen starts to fall.
 - How does CO₂ level affect oxygen production?
 - As CO₂ level rise oxygen production increase however after 360 ppm oxygen produced stays the same
 - How does oxygen production relate to the rate of photosynthesis?
 - The higher the rate of photosynthesis is, the higher is oxygen production.
 - What is the formula for photosynthesis?
 - $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

Activity A:

Colored light

Get the Gizmo ready:

- Select the **COLOR** tab and the **BAR CHART** tab.
- Set the **Temperature** to 24°C, the **Light intensity** to 90%, and the **CO₂ level** to 1,000 ppm.



Introduction: Plants use a green pigment called **chlorophyll** to absorb light and convert its energy into a form that the plant can use. Chlorophyll gives plants their green color.

Answers For Student Exploration Photosynthesis Lab

Carolina Biological Supply Company



Answers For Student Exploration Photosynthesis Lab:

Student Centered Investigative Labs for Middle School Science Walter L. Saunders, 2003-06 This resource book is intended for experienced middle school science teachers who are seeking ways to incorporate a more student centered approach to investigative lab activities New teachers can also benefit from this manual This resource book is based upon a teaching philosophy known as the Learning Cycle In the Learning Cycle LC model of teaching science students work together in groups of three or four with limited teacher guidance to develop lab procedures for the investigation of questions which can be studied in the laboratory or field

Creating Project-Based STEM Environments Jennifer Wilhelm, Ronald Wilhelm, Merryn Cole, 2019-02-05 This book models project based environments that are intentionally designed around the United States Common Core State Standards CCSS 2010 for Mathematics the Next Generation Science Standards NGSS Lead States 2013 for Science and the National Educational Technology Standards ISTE 2008 The primary purpose of this book is to reveal how middle school STEM classrooms can be purposefully designed for 21st Century learners and provide evidence regarding how situated learning experiences will result in more advanced learning This Project Based Instruction PBI resource illustrates how to design and implement interdisciplinary project based units based on the REAL Realistic Explorations in Astronomical Learning Unit 1 and CREATES Chemical Reactions Engineered to Address Thermal Energy Situations Unit 2 The content of the book details these two PBI units with authentic student work explanations and research behind each lesson including misconceptions students might hold regarding STEM content pre post research results of unit implementation with over 40 teachers and thousands of students In addition to these two units there are chapters describing how to design one's own research based PBI units incorporating teacher commentaries regarding strategies obstacles overcome and successes as they designed and implemented their PBI units for the first time after learning how to create PBI STEM Environments the REAL way

Chapter Resource 5 Photosynthesis/Cell Response Biology Holt Rinehart & Winston, Holt, Rinehart and Winston Staff, 2004

Integrating Engineering and Science in Your Classroom Eric Brunzell, 2012 From the very first day you use them the design challenges in this compendium will spur your students too to jump right in and engage throughout the entire class The activities reinforce important science content while illustrating a range of STEM skills The 30 articles have been compiled from Science and Children Science Scope and The Science Teacher NSTA's journals for elementary through high school Integrating Engineering and Science in Your Classroom will Excite students of all ages with activities involving everything from light sabers and egg racers to prosthetic arms and potatoes Apply to lessons in life and environmental science Earth science and physical science Work well in traditional classrooms as well as after school programs Next time you need an engaging STEM activity you'll be glad you have this collection to help you blend meaningful and memorable experiences into your lessons As Editor Eric Brunzell promises By exposing students to authentic engineering activities you can help students uncover the profession that makes the world work

The Science

Teacher ,2006 **STEM Labs for Life Science, Grades 6 - 8** Schyrlet Cameron,Carolyn Craig,2017-01-03 STEM Labs for Life Science by Mark Twain includes 26 fun integrated labs that help students understand concepts such as life human body systems ecosystems This middle school life science book encourages students to collaborate and communicate to solve real world problems The STEM Labs for Life Science book for sixth eighth grades features introductory materials to explain STEM education concepts and provides materials for instruction and assessment Correlated to meet current state standards each lab combines the following essential STEM concepts communication creativity teamwork critical thinking The Mark Twain Publishing Company provides classroom decorations and supplemental books for middle grade and upper grade classrooms These products are designed by leading educators and cover science math behavior management history government language arts fine arts and social studies Carolina Science and Math Carolina Biological Supply

Company,2003 **Exploring Biology** Wilke,1996-04 **Lipids in Photosynthesis** Hajime Wada,Norio Murata,2009-11-07 Lipids in Photosynthesis Essential and Regulatory Functions provides an essential summary of an exciting decade of research on relationships between lipids and photosynthesis The book brings together extensively cross referenced and peer reviewed chapters by prominent researchers The topics covered include the structure molecular organization and biosynthesis of fatty acids glycerolipids and nonglycerolipids in plants algae lichens mosses and cyanobacteria as well as in chloroplasts and mitochondria Several chapters deal with the manipulation of the extent of unsaturation of fatty acids and the effects of such manipulation on photosynthesis and responses to various forms of stress The final chapters focus on lipid trafficking signaling and advanced analytical techniques Ten years ago Siegenthaler and Murata edited Lipids in Photosynthesis Structure Function and Genetics which became a classic in the field Lipids in Photosynthesis Essential and Regulatory Functions belongs with its predecessor in every plant and microbiological researcher s bookcase **Fuel for Thought** Steve Metz,2011 The concept of energy is central to all the science disciplines seamlessly connecting science technology and mathematics For high school and upper middle school teachers this compendium comprises inquiry based activities lesson plans and case studies designed to help teach increased awareness of energy environmental concepts and the related issues

Resources for Teaching Middle School Science Smithsonian Institution,National Academy of Engineering,National Science Resources Center of the National Academy of Sciences,Institute of Medicine,1998-04-30 With age appropriate inquiry centered curriculum materials and sound teaching practices middle school science can capture the interest and energy of adolescent students and expand their understanding of the world around them Resources for Teaching Middle School Science developed by the National Science Resources Center NSRC is a valuable tool for identifying and selecting effective science curriculum materials that will engage students in grades 6 through 8 The volume describes more than 400 curriculum titles that are aligned with the National Science Education Standards This completely new guide follows on the success of Resources for Teaching Elementary School Science the first in the NSRC series of annotated guides to hands on

inquiry centered curriculum materials and other resources for science teachers The curriculum materials in the new guide are grouped in five chapters by scientific area Physical Science Life Science Environmental Science Earth and Space Science and Multidisciplinary and Applied Science They are also grouped by type core materials supplementary units and science activity books Each annotation of curriculum material includes a recommended grade level a description of the activities involved and of what students can be expected to learn a list of accompanying materials a reading level and ordering information The curriculum materials included in this book were selected by panels of teachers and scientists using evaluation criteria developed for the guide The criteria reflect and incorporate goals and principles of the National Science Education Standards The annotations designate the specific content standards on which these curriculum pieces focus In addition to the curriculum chapters the guide contains six chapters of diverse resources that are directly relevant to middle school science Among these is a chapter on educational software and multimedia programs chapters on books about science and teaching directories and guides to science trade books and periodicals for teachers and students Another section features institutional resources One chapter lists about 600 science centers museums and zoos where teachers can take middle school students for interactive science experiences Another chapter describes nearly 140 professional associations and U S government agencies that offer resources and assistance Authoritative extensive and thoroughly indexed and the only guide of its kind Resources for Teaching Middle School Science will be the most used book on the shelf for science teachers school administrators teacher trainers science curriculum specialists advocates of hands on science teaching and concerned parents

, Teaching and Learning about Climate Change Daniel P. Shepardson, Anita Roychoudhury, Andrew S. Hirsch, 2017-02-17 Responding to the issues and challenges of teaching and learning about climate change from a science education based perspective this book is designed to serve as an aid for educators as they strive to incorporate the topic into their classes The unique discussion of these issues is drawn from the perspectives of leading and international scholars in the field The book is structured around three themes theoretical philosophical and conceptual frameworks for climate change education and research research on teaching and learning about global warming and climate change and approaches to professional development and classroom practice

Reshaping Learning Ronghuai Huang, Kinshuk, J. Michael Spector, 2012-12-20 This edited volume with selected papers from distinguished experts and professors in the field of learning technology and the related fields who are far sighted and have his her own innovative thoughts on the development of learning technology This book will addresses the main issues concerned with the trend and future development of learning processes innovative pedagogies changes effects of new technologies on education future learning content Learning technology has been affected by advances in technology development and changes in the field of education Nowadays we cannot afford to sense the changes and then make adaption to it What we should do is to predict the changes and make positive and active reactions to help the trend go smoothly and in a more beneficial way This book aims to gather the newest

ideas on the frontiers and future development of learning education from the aspects of learning pedagogies and technologies in learning in order to draw a picture of learning education in the near future **Mapping Scientific Method** Gita Chadha,Renny Thomas,2022-07-19 This volume explores how the scientific method enters and determines the dominant methodologies of various modern academic disciplines It highlights the ways in which practitioners from different disciplinary backgrounds the humanities the natural sciences and the social sciences engage with the scientific method in their own disciplines The book maps the discourse within each of the disciplines that critiques the scientific method from different social locations in order to argue for more complex and nuanced approaches in methodology It also investigates the connections between the method and the structures of power and domination which exist within these disciplines In the process it offers a new way of thinking about the philosophy of the scientific method Part of the Science and Technology Studies series this volume is the first of its kind in the South Asian context to debate scientific methods and address questions by scholars based in the global south It will be useful to students and practitioners of science humanities social sciences philosophy of science and philosophy of social science Research scholars from these disciplines especially those engaging in interdisciplinary research will also benefit from this volume **Resources in Education** ,1994 The Software Encyclopedia 2001 ,2001 **Science Today: Problem or Crisis?** Ralph Levinson,Jeff Thomas,1997-01-02 What is science What is the purpose of science education Should we be training scientists or looking towards a greater public understanding of science In this exciting text some of the key figures in the fields of science and science education address this debate Their contributions form an original dialogue on science education and the gener **Learning & Teaching with Technology** Som Naidu,2003 Exploring the creative opportunities opened up by ICT in the modern classroom this text presents an authoritative survey of ICT s impact upon core teaching functions and draws from the experiences of leading practitioners in the field *Place-Based Science Teaching* Whitney Aragaki,Kirstin J. Milks,2025-09-16 Jumpstart your imagination and transform your science classroom by centering place based learning Identity community and place are tightly connected and can be leveraged to deepen science learning for students Place Based Science Teaching offers K 12 science educators an innovative approach to building learning experiences that embrace the rich and varied knowledge held by people both past and present about the places we call home This book helps teachers to foster greater personal investment of students in their learning as well as develop NGSS informed authentic problem solving and critical reasoning skills The book will also help teachers create and find joy in their classrooms by connecting lessons to local environments cultural heritage and global issues Written by nationally recognized STEM educators Whitney Aragaki and Kirstin Milks the book blends inspiring storytelling with practical frameworks and resources Chapters will take you behind the scenes into innovative classrooms detailing high impact standards aligned activities and sharing educator stories from diverse settings Grounded in cutting edge research and real world examples Place Based Science Teaching Introduces the Place Based

Science Teaching Framework that asks where are you when are you who are you and who are we together as a way to connect learning to local and global contexts Provides classroom ready lessons and case studies from many educational settings aligned with NGSS and centered on belonging access and engagement Offers strategies for virtual spaces and digital perspectives to enhance teaching in an increasingly online world Includes actionable reflection prompts designed to help teachers explore their own positionality and better connect with their students and communities This book will encourage educators and administrators alike to transform science learning into an opportunity for building empathy connection and hope Place Based Science Teaching is designed to help teachers foster a sense of place and stewardship among their students and address peace and justice focused solutions that encourage students to care for their communities think critically about global challenges and develop the agency to lead for generations to come

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2018 2019 exercise 3 determine using the simplex algorithm with bland's rule the optimal solution to the following linear programming problem max $s = x_1 + 3x_2 + 5x_3 + 2x_4$ $x_1 + 2x_2 + 3x_3 + x_4 \leq 3$ $2x_1 + x_2 + x_3 + 2x_4 \leq 4$ $x_1 + x_2 + x_3 + x_4 \leq 2$ $x_i \geq 0$ solution the problem in standard form is the initial tableau is min $s = x_1 + 3x_2 + 5x_3 + 2x_4$

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recognize the typical form of a linear programming problem formulate maximization linear programming problems graph feasible regions for maximization linear programming problems determine optimal solutions for maximization linear programming problems

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nov 5 1998 as a linear program a computer program can be used to solve the problem in this regard solving a linear program is relatively easy the hardest part about applying linear programming is formulating the problem and interpreting the solution linear equations all of the equations and inequalities in a linear program must by definition be

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$$\begin{aligned} \text{maximize } z &= 12x_1 + 18x_2 + 9x_3 \\ \text{subject to } x_1 + x_2 + x_3 &\leq 12 \\ 2x_1 + 3x_2 + x_3 &\leq 18 \end{aligned}$$

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formulate the appropriate linear programming problem solution a unknowns define x number of type a sheds produced each day y number of type b sheds produced each day
chapter 5 linear programming exercise 5a 1 ann and margaret run a small business in which they work together making blouses and skirts

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3 solve the model
4 implementation introduction