

## PHOTOSYNTHESIS AND RESPIRATION RESOURCES

Videos, Web Pages, Books, and Peer-Reviewed Articles to supplement  
*The Power of Sunlight Teacher's Guide*



### PHOTOSYNTHESIS:

#### Videos:

<http://dendro.cnre.vt.edu/forestbiology/photosynthesis.swf> Interactive, stepwise animation detailing plant cell structures and the light reactions of photosynthesis, by Mike Tyree.

<http://www.neok12.com/php/watch.php?v=zX425c515e42660904500606&t=Photosynthesis> **Discovery of Photosynthesis** (2:28). Priestly's & Ingenhouse's early experiments on photosynthesis, from Discovery Education.

[http://teachertube.com/viewVideo.php?video\\_id=62625](http://teachertube.com/viewVideo.php?video_id=62625) **Photosynthesis** (3:20). Lyrics and music by Rhythm, Rhyme and Results.

#### Web Pages:

<http://www.angelfire.com/ab6/hershey/bio.htm> **About David R. Hershey.** Includes a list of publications relating to science education using plants from a biology education consultant and author. Many links are available within the list, but many are out-of-date; by David R. Hershey.

<http://www.actionbioscience.org/education/hershey.html> **Avoid misconceptions when teaching about plants.** Directly addresses fifty known misconceptions about plants in five different categories. Includes numerous misconceptions about photosynthesis; by David R. Hershey.

[http://www.fastplants.org/pdf/activities/exploring\\_photosynthesis.pdf](http://www.fastplants.org/pdf/activities/exploring_photosynthesis.pdf) **Exploring photosynthesis with Fast Plants.** Leaf disk floatation approach using samples from Fast Plants cotyledons, by Wisconsin Fast Plants.

<http://www.elbiology.com/labtools/Leafdisk.html> **The Floating Leaf Disk Assay for Investigating Photosynthesis (A Resource Page).** Full procedure with photos and reference list, by Brad Williamson with the Exploring Life Community.

<http://www.ftexploring.com/photosyn/photosynth.html> **FT Exploring Science and Technology: Photosynthesis: How Life Keeps Going.** Readings, diagrams, and photos on topics linked to photosynthesis, by David E. Watson at Flying Turtle.

<http://micro.magnet.fsu.edu/primer/lightandcolor/filtersintro.html> **Molecular Expressions™ Optical Microscopy Primer: Physics of Light and Color.** Describes the use and optics of light filters, and includes a Java-based interactive tutorial on absorption filters.

## PHOTOSYNTHESIS, CONTINUED:

<http://photoscience.la.asu.edu/photosyn/photoweb/> **Photosynthesis Online.** A massive compendium of online resources related to photosynthesis, including extremely detailed information about photosynthesis, scientific researchers working in this area, and educational resources. Hundreds of weblinks in all; by Larry Orr and Govindjee.

[http://www.accessexcellence.org/AE/AEC/AEF/1996/morishita\\_pictures.html](http://www.accessexcellence.org/AE/AEC/AEF/1996/morishita_pictures.html) **Photosynthesis Pictures are Worth more than a Thousand Words.** Inquiry activity involving the development of “starch pictures” based on photosynthetic activity; by C. Ford Morishita in the Access Excellence Activities Exchange.

<http://www.biotopics.co.uk/plants/photosy.html> **Photosynthesis - the most important process on earth?** Interactive lesson and questions based in the GCSE Biology syllabi used in UK. Mousing over the white space will provide answers; by Richard Steane.

<http://www.learner.org/channel/workshops/privuniv/pup02.html> **Private Universe Project in Science, Workshop Two: “Why are some ideas so difficult?”** Notes on a workshop addressing the question of why so many people have difficulty understanding the central concept of photosynthesis. Includes a video clip about student misconceptions about photosynthesis; by the Annenberg Foundation.

<http://www.clemson.edu/hort/sctop/bsec/bsec-06.php> **Regulation of Chrysanthemum Growth by Spectral Filters.** Research findings from a study for optimizing light filters. Indicates differences between red and far-red light in plant growth regulation; by Nihal C. Rajapaske & John W. Kelly.

[http://timss.bc.edu/timss2003i/psi\\_g8\\_s\\_Photosynthesis.html](http://timss.bc.edu/timss2003i/psi_g8_s_Photosynthesis.html) **TIMMS Special Initiative in Problem Solving and Inquiry: Grade 8 Science.** A problem-solving question related to photosynthesis based on a diagram of an experimental setup. Link to similar questions on light filters also available; by Trends in International Mathematics & Science Study 2003.

<http://www.ext.vt.edu/resources/4h/virtualforest> **Virginia Cooperative Extension’s 4-H Virtual Forest.** Flash-based interactive lessons and simple quizzes, includes an exploration on photosynthesis.

[http://employees.csbsju.edu/ssaupe/biol115/van\\_helmont.htm](http://employees.csbsju.edu/ssaupe/biol115/van_helmont.htm) **Willows and Photosynthesis: Analyzing von Helmont’s Classic Experiment.** A brief paragraph of von Helmont’s writing along with questions about the experiment; by S.G. Saupe at the College of St. Benedict/St. John’s University.

### *Books & Articles:*

Amir, R., and P. Tamir. 1994. In-depth analysis of misconceptions as a basis for developing research-based remedial instruction: The case of photosynthesis. *The American Biology Teacher* 56(2): 94-100.

Barker, M., and M. Carr. 1989a. Teaching and learning about photosynthesis. Part I: An assessment in terms of students' prior knowledge. *International Journal of Science Education* 11(1): 49-56.

Barker, M., and M. Carr. 1989b. Teaching and learning about photosynthesis. Part II: A generative learning strategy." *International Journal of Science Education* 11(2): 141-152.

Eisen, Y., and R. Stavy. 1988. Students' understanding of photosynthesis. *The American Biology Teacher* 50(4): 208-212.

Fox, M., Gaynor, J.J., and J. Shillcock. 1999. Floating spinach disks – an uplifting demonstration of photosynthesis. *Journal of College Science Teaching* 28(3): 210-212.

### **PHOTOSYNTHESIS, CONTINUED:**

Hershey, D.R. 1995. *Plant Biology Science Projects: Best science projects for young adults*. New York, NY: John Wiley & Sons.

Roth, K. J., and C. Anderson. 1985. *The Power Plant: Teacher's Guide to Photosynthesis*. East Lansing, MI: Institute for Research on Teaching, Michigan State University.

Roth, K., Smith, E., and C. Anderson. 1983. *Students' conceptions of photosynthesis and food for plants*. East Lansing, MI: Institute for Research on Teaching, Michigan State University.

Smith, E., and C. Anderson. 1984. Plants and producers: A case study of elementary science teaching. *Journal of Research in Science Teaching* 21(7): 685-698.

Stavy, R., Eisen, Y., and D. Yaakobi. 1989. How students aged 13-15 understand photosynthesis. *International Journal of Science Education* 9(1): 105-115.

Storey, R.D. 1989. Textbook errors and misconceptions in biology: Photosynthesis. *The American Biology Teacher* 51(5): 271-274.

Tourtellotte, S.W. 1990. Biology and chemistry combine in photosynthesis: An interdisciplinary focus on a natural occurrence. *Journal of College Science Teaching* 19(5): 287-291.

Wandersee, J.H. 1983. Students' misconceptions about photosynthesis: A cross-age study. In Helm, H. and J. Novak, eds. *Proceedings of the International Seminar on Misconceptions in Science and Mathematics*. Ithaca, NY: Cornell University.

Weyers, J.D.B., Hogland, H-O., and B. McEwen. 1998. Teaching botany on the sunny side of the tree: Promoting investigative studies of plant ecophysiology through observations and experiments on sun and shade leaves. *Journal of Biological Education* 32(3): 181-190.

### **CELLULAR RESPIRATION:**

#### *Videos:*

<http://dsc.discovery.com/tv-shows/other-shows/videos/assignment-discovery-shorts-06-07-07-08-cellular-respiration.htm> **Assignment Discovery: Cellular Respiration** (1:45). Overview of cellular respiration, listing glycolysis, pyruvate oxidation, the Krebs cycle, and electron transport chain, by Discovery.

[http://www.youtube.com/watch?v=00jbG\\_cfGuQ](http://www.youtube.com/watch?v=00jbG_cfGuQ) **ATP & Respiration – Crash Course Biology #7** (13:26). Details the role of ATP, then describes glycolysis, fermentation, Krebs cycle, & electron transport chain; quick index available at the end. Teachers will want to review for length & age appropriateness; by Hank Green with Crash Course!

<http://www.youtube.com/watch?v=3aZrkdzrd04&feature=youtu.be> **“Cell Respiration” – Cellular Respiration Song** (4:54). Impressive lesson on cellular respiration presented to the tune of Black Eyed Peas, by Mr. Hsu.

#### *Web Pages:*

<http://naturalsciences.sdsu.edu/classes/lab2.1/altern.html> **Biology Lessons Part 2: Population Biology. Lesson 2.1: Producers: How Do Plants Grow?** A quick summary table distinguishing naïve and scientific conceptions about respiration, dormancy, and photosynthesis, by Kathleen Fisher with San Diego State University.

### CELLULAR RESPIRATION, CONTINUED:

<http://www.imcpl.org/kids/blog/?p=9601> **Cell Respiration: Balloon Blow-Up.** Instructions for a simple classroom demonstration using a closed container of yeast to blow up a balloon, by the Indianapolis Public Library.

[http://www.vernier.com/experiments/bio-a/5a/cell\\_respiration\\_co2\\_and\\_o2/](http://www.vernier.com/experiments/bio-a/5a/cell_respiration_co2_and_o2/) **Cell respiration (CO<sub>2</sub> and O<sub>2</sub>).** Outlines an AP-level biology experiment from *Advanced Biology with Vernier* using Vernier oxygen and carbon dioxide probes, by Vernier Software & Technology.

<http://www.ck12.org/concept/Cellular-Respiration#all> **Cellular Respiration.** Teaching resources for this concept, including readings, video, activity, study aids, web links, and assessments. This link leads to the Cellular Respiration section, but the same website has similar pages for photosynthesis, glycolysis, Krebs cycle, and electron transport; by CK-12.

<http://www.sumanasinc.com/webcontent/animations/content/cellularrespiration.html> **Cellular Respiration.** Set of four animations: overview, glycolysis, Krebs cycle, and electron transport. The three core animations have embedded quiz questions; by Jay Phelan with Sumanas, Inc.

<http://pinterest.com/sciencestuff/cellular-respiration-teaching-materials/> **Cellular Respiration Teaching Materials.** A collection of quizzes, labs, activities, teaching plans, and powerpoint presentations on cellular respiration, by Amy Brown with Science Stuff.

[http://www.bio.indiana.edu/community/faculty/ICE\\_files/RespirationChallenge-All.pdf](http://www.bio.indiana.edu/community/faculty/ICE_files/RespirationChallenge-All.pdf) **Inquiry-Based Curriculum Enhancement: Respiration Challenge.** A set of college-level questions on cellular respiration aiming for a deeper understanding of the processes involved, by the Department of Biology, Indiana University Bloomington.

<http://facweb.northseattle.edu/csheridan/photrespoxygen.pdf> **Lab 4: Respiration & Photosynthesis in Plants.** Guided lab inquiry using oxygen probes to test hypotheses about cellular respiration & photosynthesis in an aquatic plant. Includes pre-lab and post-lab worksheets; by C. Sheridan with North Seattle Community College.

<http://www.learner.org/courses/essential/life/session7/closer4.html> **Life Science: Session 7; Cell Respiration.** Provides an overview of cellular respiration, using an experiment with a pitcher plant to illustrate the relationships among light, photosynthesis, and respiration; by the Annenberg Foundation.

<http://www.npr.org/blogs/krulwich/2011/09/14/140428189/lord-save-me-from-the-krebs-cycle> **Lord, save me from the Krebs cycle.** Editorial discussing the challenge of teaching complex biology concepts, by Robert Krulwich.

<http://www.nclark.net/PhotoRespiration> **Photosynthesis & Respiration.** Collection of activities, labs, and links on photosynthesis & cellular respiration. Also links to a page on the same site listing National Science Content Standards relevant to these processes; by Nancy Clark.

<http://www.elbiology.com/labtools/Microrespirometers.html> **A Resource page for Microrespirometers.** A description of the use and underlying principles of microrespirometers, with full procedures and photos detailing assembly. Links at the end lead to documents for guided and extended lab inquiries using Fast Plants; by Brad Williamson with the Exploring Life Community.

<http://serc.carleton.edu/sp/pkal/mnscu/activities/38345.html> **Student Inquiry into Cellular Respiration.** Peer-reviewed, college-level POGIL activity for cellular respiration, by Barbara Fritz with the Mn-SCU-PKAL Partnership.

## CELLULAR RESPIRATION, CONTINUED:

### *Books & Articles:*

- Baines, A.T., McVey, M., Rybarczyk, B., Thompson, J.T., and H.R. Wilkins. 2003. Mystery of the toxic flea dip: An interactive approach to teaching aerobic cellular respiration. *Cell Biology Education* 3(1): 62-68.
- Briggs, B., Mitton, T., Smith, R., and T. Magnuson. 2009. Teaching cellular respiration & alternate energy sources with a laboratory exercise developed by a scientist-teacher partnership. *The American Biology Teacher* 71(3): 164-167.
- Brucker, W., Schorl, C., Lovato, A., Croteau, S., Veltri, C., Schapira, K., Brucker, B., Packer M., Armstrong, G., Collins, C., Peterson, A., Boakye, C., Paulo, J., Bradley, I., and A. Houry. 2012. *Cellular Respiration: Death & Destruction with a Side of alpha-ketoglutarate*. Providence, RI: Brucker Books.
- Çakir, Ö.S., Geban, Ö., and N. Yürük. 2002. Effectiveness of conceptual change text-oriented instruction on students' understanding of cellular respiration concepts. *Biochemistry and Molecular Biology Education* 30(4): 239-243.
- Else, M.J., Ramirez, M.A., and J. Clement. 2002. When are analogies the right tool? A look at the strategic use of analogies in teaching cellular respiration to middle-school students. In: *Proceedings of the Annual International Conference of the Association for the Education of Teachers in Science* (Charlotte, NC, January 10-13, 2002).
- Johnson, M. 1998. Learning about cellular respiration: An active approach illustrating the process of scientific inquiry. *The American Biology Teacher* 60(9): 685-689.
- Kao, H-L. 2007. A study of aboriginal and urban junior high school students' alternative conceptions on the definition of respiration. *International Journal of Science Education* 29(4): 517-533.
- O'Connell, D. 2008. An inquiry-based approach to teaching photosynthesis & cellular respiration. *The American Biology Teacher* 70(6): 350-356.
- Ross, P.M., Tronson, D.A., and R.J. Ritchie. 2008. Increasing conceptual understanding of glycolysis & the Krebs cycle using role-play. *The American Biology Teacher* 70(3): 163-168.
- Roth, K. J., Anderson, C.W., Hollon, R., and T. Blakeslee. 1985. *The Power Cell: Teacher's Guide to Respiration*. East Lansing, MI: Institute for Research on Teaching, Michigan State University.
- Rybarczyk, B.J., Baines, A.T., McVey, M., Thompson, J.T., and H. Wilkins. 2007. A case-based approach increases student learning outcomes and comprehension of cellular respiration concepts. *Biochemistry and Molecular Biology Education* 35(3): 181-186.
- Sanders, M. 1993. Erroneous ideas about respiration: The teacher factor. *Journal of Research in Science Teaching* 30(8): 919-934.
- Storey, R.D. 1991. Textbook errors & misconceptions in biology: Cell metabolism. *The American Biology Teacher* 53(6): 339-343.

Tamayo Alzate, O.E., and N. Sanmarti Puig. 2007. High school students' conceptual evolution of the respiration concept from the perspective of Giere's cognitive science model. *International Journal of Science Education* 29(2): 215-248.