EVIDENCE OF UNDERSTANDING

BIOLOGY

OKLAHOMA
LIBRARY OF DIGITAL RESOURCES

Thank you to the following educators for their work in curating digital resources:

Shawn Beard, Sand Springs Public Schools

Eman Beck, Norman Public Schools

Nicole Keenan, Norman Public Schools

Chanda Peters, Woodward Public Schools

Gina Shepherd, Merritt Public Schools

Krista Steiner, Clinton Public Schools

Susan Wray, Oakdale Public Schools

Tamara Yeldell, Broken Arrow Public Schools

GETTING TO KNOW OKLDR

WHO IS OSSBA?

The Oklahoma State School Boards Association (OSSBA) works to promote quality public education for the children of Oklahoma through training and information services to school board members. The Association is a leader among leaders in Oklahoma education and a visible presence in the local school districts and throughout the state.

The OSSBA was created in 1944 to provide support for local school board members with a variety of information, assistance, and representation services. OSSBA reaches every school board member through training opportunities. It creates and encouraged effective leaders to promote public education and cultivates productive alliances with governing bodies. OSSBA trains school board members to participate in an effective and supportive manner to provide direction for educational innovation and improves public perception of education in Oklahoma by sharing strategies and tools with our member school districts to focus on the success of Oklahoma public education.

OSSBA works with school boards to demonstrate the impact they have on student achievement. We work to provide meaningful two-way communication of advocacy, services, and training activities to local boards of education and their stakeholders. Other services we provide that have a direct impact on student achievement include strategic planning and superintendent searches. Our legal team provides free legal information to the school districts.

WHY OKLDR?

In the summer of 2016, OSSBA set out on a journey assist teachers in the integration of technology into their classrooms. The Oklahoma Library of Digital Resources (OKLDR) became a collection of digital content resources selected by Oklahoma educators to support the Oklahoma Academic Standards. The resources were curated by teachers from school districts across Oklahoma. Each collection contained a variety of learning resources, such as videos, apps, pdf documents, and websites, and are designed so that teachers can then build their lesson plans. The resources helped bridge the digital equity gap among students while helping schools make the most of limited resources.

After collaborating with educators, school and district leaders for a couple of years, OKLDR has been enhanced in the following ways:

- Resources are now an Open Education Resource (OER) "book" format, making it easier to use and accessible on multiple devices.
- Resources map to ESSA expectations for evidence of student understanding and students' mastery of the academic standards.
- Tools are now agnostic and can be used on multiple devices.
- Lessons are now focused on student engagement through the use of technology. The first OKLDR version focused on teacher resources. **This is a major change**.
- To prioritize student learning, teacher resources are now located at the back of each book.

HOW TO USE THIS BOOK

The Oklahoma Academic Standards for this lesson are grouped together by key topics. Sometimes you will see only one standard, but other times you will see a grouping of standards.

Evidence of Understanding is the key. This is the concept you want your students to master that reinforces the standards. Mastery means deeper understanding, not just "skim the surface" learning.

Digital Tools are the recommended applications and/or tools for the lesson. Think of this element as the "supplies box."

In Practice is a suggested activity to engage the students to demonstrate mastery of the standard. You will notice that this is just one suggested lesson, and sometimes there might be a second lesson. The suggested lesson, developed by Oklahoma teachers, is meant to give you a starting point. You might decide to use the lesson or it might give you an idea of something else you could do to teach the concept.

MOVING FORWARD

As you can see the OKLDR book has been designed to inspire educators to have students demonstrate their understanding of the Oklahoma Academic Standards through the use of technology as a productivity tool. While educators have limited time in the day to plan and research high quality content, this book is a jumping off point, with suggested peer-reviewed activities and resources.

While you might encounter extra white space in the book, it is intentional for growth. As you integrate the activities into your lessons, you are encouraged to send us student work samples that might be included in the book, as well as additional activities and resources that could be included in future revisions.

Next Steps:

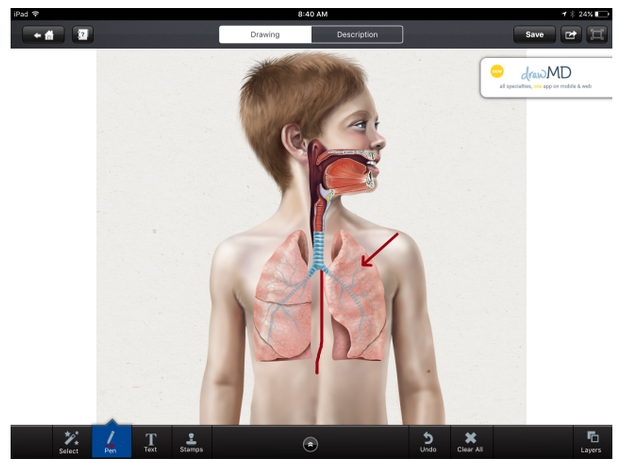
- We would love to add samples of student work to the activities, so please send the work to: okldr@ossba.org.
- If you would like to be involved in future course creation, or know teachers who would like to be involved, please contact us at: okldr@ossba.org.
- See anything that needs to be changed or enhanced? Contact us at: okldr@ossba.org.

STRUCTURES AND PROCESSES

CELL SPECIALIZATION

HS-LS1-1 Students who demonstrate understanding can:

Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.



Evidence of Understanding

Students will be able to identify and describe evidence to construct an explanation that all cells contain DNA, DNA contain regions of cells called genes, those genes contain instructions that code for proteins, and that groups of specialized cells (tissues) use proteins to carry out functions essential to the organism. Students should also use reasoning to understand that gene sequence affects protein function which then in turn affects function of body tissues.

Digital Tools

- *Presentation* - Keynote, Google Slides, Microsoft PowerPoint
- *Content* - Cell and Cell Structure App, Draw MD
- *Podcast* - Opinion, Anchor , Voice Record Pro App
- *Interactive Whiteboard* - Educreations , Whiteboard: Absolute Board, Show Me, Google Jamboard, Explain Everything

In Practice

- As an extension, students can explore genetically linked diseases such as Crohn's disease or sickle cell anemia to further their understanding how altering the structure at the DNA level affects the function of a specialized cell and causes the symptoms of the disease they choose.
- Student groups can conduct research using digital resources and use a podcasting application to conduct interviews with members of their community (can be patients or medical professionals) that may be directly or indirectly affected by the disease they choose to explore.
- Students can then use an interactive whiteboard application to record a presentation with models and explanations to present their findings to their class.
- They can use a content application like Draw MD to illustrate and label how their disease affects the human body to enhance their digital presentation.

CELL ORGANIZATION/INTERACTION

HS-LS1-2 Students who demonstrate understanding can:

Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Evidence of Understanding

Students will be able to develop a model where they can identify and describe the relevant parts of body systems in multicellular organisms. They should also be able to describe and make connections regarding the relationships between systems and how they affect each other.

Digital Tools

- *Sketch* - Sketch, DoodleNotes, Sketches School, Absolute Board, Google Draw, Sketchbook
- *Content Video* - Cellular Specialization Bozeman Science
- *Interactive Website* - Organization of Cells
- *Story Telling* - *Canva Comic Strip Maker*, *Powtoon*, *Comic Strip - Comic Maker*, *Book Creator*

In Practice

- Students will explore the structural organization of organisms starting with atoms, molecules, macromolecule, organelles, cells, tissues, organs, organ systems, and organisms using the CK12 activity: Organization of Cells.
- After receiving relevant instruction, students can extend their learning by highlighting a specific system and creating a narrative story using a story telling application about the components of the system and its relationship with its "neighbors".

BIOFEEDBACK AND HOMEOSTASIS

HS-LS1-3 Students who demonstrate understanding can:

Plan and conduct an investigation to provide evidence of the importance of maintaining homeostasis in living organisms.

Evidence of Understanding

Students will be able to develop an investigation plan about a phenomena that includes the idea that feedback mechanisms maintain homeostasis. Students should demonstrate their ability to describe the data they will collect, how the data will be used as evidence, and why the data is relevant to the purpose of their investigation.

Digital Tools

- *Content Sketch* - Draw MD
- *Content* - Positive and Negative Feedback Loops
- *Sketch* - Sketch, DoodleNotes, Sketches School, Absolute Board, Google Draw, Sketchbook
- *Interactive Learning*- Nearpod

In Practice

- Student groups will use the examples provided in the content website Positive and Negative Feedback Loops as inspiration and use mind mapping applications to organize and refine the design and planning of their investigation.
- Student groups will use polling applications to formatively assess their class members about possible misconceptions they may have regarding the feedback loop they have chosen to investigate.
- Student groups can use a sketch or content application (draw MD) to illustrate the feedback loop mechanism.
- Students groups can then use an interactive learning application to present a lesson to the class about their investigation

CELLULAR GROWTH & DEVELOPMENT

HS-LS1-4 Students who demonstrate understanding can:

Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

Evidence of Understanding

Students will be able to illustrate and identify the role of mitosis and cell differentiation in the growth of the organism. They should be able to use a model to understand that differences in cell types are a result of gene expression and not different genetic material within the organism.

Digital Tools

- *Content Video* - Celular Growth & Development Video, Zebrafish Development
- *Animation* - Stop Motion Studio, Koma Koma , Lego Movie Maker
- *Sketch*- Sketches School, ibis, Absolute Board, Google Draw, Notability, Sketchbook

In Practice

- After receiving relevant instruction, students can view content video like the one on Zebrafish development to see how other organisms experience cell differentiation.
- As an extension on the process of mitosis, students can use clay, play dough, or digital sketches to make an animation using an animation application.
- As an extension on cell differentiation, student groups can choose a specific body system (circulatory, muscular, skeletal, etc..) and investigate how the different cell types are optimized for their function.
- Students can use a sketch application to sketch the different shapes and sizes of types of cells to illustrate the importance of cell differentiation.

ENERGY FLOW IN ORGANISMS

HS-LS1-5 Students who demonstrate understanding can:

Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

HS-LS1-6 Students who demonstrate understanding can:

Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

HS-LS1-7 Students who demonstrate understanding can:

Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are of energy.

Evidence of Understanding

Students will be able to understand that cellular respiration and photosynthesis are chemical processes that involve the storage of chemical energy through the conversion of chemical compounds. Students should understand that breaking bonds requires the absorption of energy and the formation of bonds requires the release of energy. Students should also understand that energy released in these chemical processes are used to drive other chemical reactions.

Digital Tools

- *Sketch* - Sketch, DoodleNotes, Sketches School, Absolute Board, Google Draw, Sketchbook
- *Story Telling* - Book Creator, Pages, Write About This

In Practice

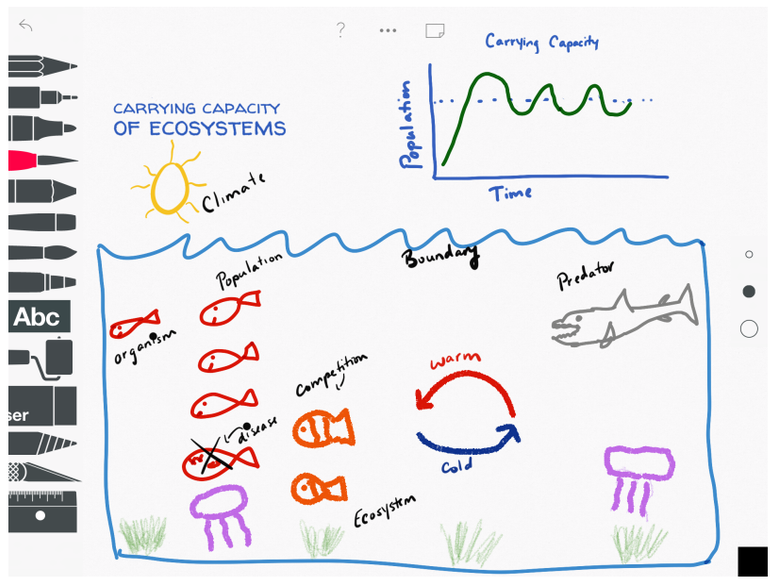
- After receiving relevant instruction, students can extend their knowledge of the two processes (photosynthesis and cellular respiration) by developing a story using a story telling application.
- Students can use a sketch application to create the models that integrate the chemical reactions occurring in each process.

ECOSYSTEMS: INTERACTIONS, ENERGY & DYNAMICS

INTERDEPENDENT RELATIONSHIPS IN ECOSYSTEMS

HS-LS2-1 Students who demonstrate understanding can:

Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales..



Evidence of Understanding

Students will be able to use mathematical representations to represent, support, and model how factors such as number and types of organisms, population changes, climate, resources, competition, etc. can affect the carrying capacity of ecosystems.

Digital Tools

- *Content Website* - Mekong catfish, Red list of threatened species
- *Sketch Application* - Sketches School, Notes, ibis, Absolute Board, Google Draw, Notability, Sketchbook
- *Word Processor* - Pages, Google Docs, Microsoft Word

In Practice

- Students will conduct research on a current endangered species with a focus on finding data on population decline and other factors to calculate carrying capacity.
- Using data and research as evidence, students (or student groups) will use a sketching application to create a model that illustrates factors and presents their data on their endangered species.
- An extension to this activity is that students can develop original solutions to the population decline and craft a letter using a word processing application to a government official urging action.

ECOSYSTEM DYNAMICS, FUNCTIONING & RESILIENCE

HS-LS2-2 Students who demonstrate understanding can:

Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

Evidence of Understanding

Students will be able to use mathematical representations to represent, support, and model how factors such as number and types of organisms, population changes, climate, resources, competition, etc. can affect the carrying capacity of ecosystems.

Digital Tools

- *Presentation* - Keynote, Google Slides, Microsoft PowerPoint
- *Sketch* - Sketch, DoodleNotes, Sketches School, Absolute Board, Google Draw, Sketchbook
- *Animation* - Stop Motion Studio, Do-Ink, Koma Koma,
- *Content* - Ecology of Ecosystems,Ecosystem ecology, Bozeman Biology: Genetic Drift

In Practice

- Students can further explore ecosystem dynamics including biotic and abiotic factors using a content website.
- Students can also conduct research on examples of ecosystems using this content reference website: Ecosystem ecology
- Students can also learn how external factors can effect ecological diversity in "Bozeman Biology: Genetic Drift" that focuses on genetic drift, bottleneck effect and founder effect.
- Students will create a model of a biome which will include biotic and abiotic factors focusing on biodiversity and populations using a sketch application.
- Students can also add visual representations of bottleneck effect, genetic drift and founder effect using a sketch or animation application.

CYCLES OF MATTER & ENERGY TRANSFER IN ECOSYSTEMS

HS-LS2-3 Students who demonstrate understanding can:

Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

HS-LS2-4 Students who demonstrate understanding can:

Use a mathematical representation to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

HS-LS2-5 Students who demonstrate understanding can:

Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

Evidence of Understanding

Students will have a conceptual understanding of the role aerobic and anaerobic respiration have in different environments by demonstrating the ability to model evidence and reasoning, and mathematical representations in their explanations. Students should be able to understand that the flow of matter and energy in and out of cells is driven by the energy captured by photosynthesis and cellular respiration whether it is by aerobic or anaerobic means.

Digital Tools

- *Simulation- Nitrogen Cycle Game*
- *Sketch* - Sketch, DoodleNotes, Sketches School, Absolute Board, Google Draw, Sketchbook
- *Mind Mapping* - Bubbl.us, MindMup, Lucid Chart, ReadWriteThink Venn Diagram
- *Gamification:* BloxelsEDU, Scratch

In Practice

- After receiving relevant instruction, students can extend their knowledge by playing the Nitrogen Cycle Game which will give them a chance to experiment with different variables to get a deeper understanding of how Nitrogen cycles through an ecosystem.
- Students can create a flow chart using a mind mapping or sketch application to represent the different locations they visited during the game as well as how the Nitrogen was exchanged.
- As an extension, students can then create their understanding of how Carbon cycles through the ecosystem using the Nitrogen Cycle game as a blueprint to create their own game using a gamification application like Bloxels

SOCIAL INTERACTIONS & GROUP BEHAVIOR

HS-LS2-8 Students who demonstrate understanding can:

Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce.

Evidence of Understanding

Students will be able to distinguish between individual and group behavior (flocking, swarming, herding, schooling, etc..) and identify evidence that supports group behavior outcomes. Students will also be able to evaluate and critique evidence to distinguish between causal and correlational relationships to make claims about specific causes and effects related to individual survival.

Digital Tools

- *Content Video* - Social Interactions and Group Behavior
- *Video Editor*- Clips, WeVideo, Do-Ink, iMovie
- *Student Response*- Flipgrid, Seesaw

In Practice

- Students can explore the relationships between organisms in social interactions and group behavior in this video- Social Interactions and Group Behavior.
- As an extension, student groups will create videos using a video recording application demonstrating different types of social group behaviors.
- Students can then use a student response application like Flipgrid to engage their classmates in guessing the type of behavior the video depicts.

HEREDITY: INHERITANCE & VARIATION OF TRAITS

CELL STRUCTURE, FUNCTION, & DNA

HS-LS3-1 Students who demonstrate understanding can:

Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

HS-LS3-2 Students who demonstrate understanding can:

Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

Evidence of Understanding

Students should be able to use models of DNA to formulate questions that explain the cause and effect relationships between DNA, proteins, and the traits they code for. Students should also be able to use data to support arguments for how variation occurs and that it can be a result of new genetic combinations via meiosis, errors that occur via replication, and mutations caused by environmental factors.

Digital Tools

- *Content Video* - Chromosome Genetics, Genes and Diseases
- *Sketch* - Sketch, DoodleNotes, Sketches School, Absolute Board, Google Draw, Sketchbook
- *Content* - Draw MD

In Practice

- After receiving instruction, students can apply the principles they learned in content videos to genetically inherited diseases (sickle cell anemia, cystic fibrosis, etc..) by conducting digital research.
- Genes and Disease is a collection of articles that discusses genes and the diseases that they cause. These genetic disorders are organized by the parts of the body that they affect.
- Students can then model how a change in DNA causes a change in the function of proteins and cells in their chosen disease by using a sketch or content application like Draw MD.

INHERITANCE OF TRAITS

HS-LS3-1 Students who demonstrate understanding can:

Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

HS-LS3-2 Students who demonstrate understanding can:

Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

HS-LS3-3 Students who demonstrate understanding can:

Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Evidence of Understanding

Students will be able to use mathematics to describe the probability of traits and organize their data by frequency, distribution, and variation of expressed traits of a population. Students should also be able to recognize patterns to predict changes in trait distributions.

Digital Tools

- *Content* - Genes and Diseases
- *Presentation* - Keynote, Google Slides, Microsoft PowerPoint
- *Simulation website* - PHET-Gene Expression, Stickleback Genetic Cross
- *Digital profiles* - Farcebook, Twister , Snapsr, Simitator, iFakeText

In Practice

- Students will explore gene expression using this PHET Simulation-Gene Expression.
- As an extension, students can use photos of actual research specimens of sticklebacks to obtain their data and perform a mathematical analysis on the data collected along with additional data from the scientific literature. In the extension activity, students can use a chi-square analysis to determine the significance of their results.
- Students can then create a fake dating profile for the organism of their choice highlighting strong "attractive" traits and indicating parent traits (like a pedigree) using a digital profile application.

EVIDENCE OF ANCESTRY & DIVERSITY

HS-LS4-1 Students who demonstrate understanding can:

Analyze and evaluate how evidence such as similarities in DNA sequences, anatomical structures, and order of appearance of structures during embryological development contribute to the scientific explanation of biological diversity.

Evidence of Understanding

Students will be able to have a conceptual understanding of the role similarities in DNA sequences, anatomical structures, and order of appearance of structures have on common ancestry and diversity.

Digital Tools

- *Interactive Website - Homology vs Analogy*
- *Design tools -* Canva, Web Poster Wizard, Collage Maker

In Practice

- Students will explore an interactive website to gain a deeper understanding of analogous and homologous structures
- Students will use a design tool application to create a collage illustrating the evidence of common ancestry and biodiversity.

BIOLOGICAL UNITY & DIVERSITY

NATURAL SELECTION

HS-LS4-2 Students who demonstrate understanding can:

Construct an explanation based on evidence that biological diversity is influenced by (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

Evidence of Understanding

Students should be able to use evidence to explain the influence of each of the four factors have on the number of organisms, behavior, morphology, or physiology in terms of competing for limited resources. Students will be able to identify and describe evidence supporting their explanations that individuals with traits that give a competitive advantage can survive and reproduce at higher rates than individuals without the traits.

Digital Tools

- *Simulation* - Peppered Moth Simulation
- *Presentation* - *Keynote*, *Google Slides*, *Microsoft PowerPoint*
- *Story Telling Application* - Book Creator, Pages, Write About This, Canva Comic Strip Maker, Powtoon, Comic Strip - Comic Maker

In Practice

- After receiving instruction, students can extend their learning by playing the peppered moth simulation to see how natural selection is manifested in a specific population.
- Student groups will create a "Hunger Games" futuristic scenario where they identify the physical environment, traits with advantages, types of limited resources available, and population diversity parameters.
- Students can use a presentation or story telling application to present their concept.

ADAPTATION

HS-LS4-3 Students who demonstrate understanding can:

Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.

HS-LS4-4 Students who demonstrate understanding can:

Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

Evidence of Understanding

Students will be able to analyze the shifts in numerical distribution of traits and use them as evidence to support explanations for adaptations. Students will also be able to use data to provide evidence for how specific abiotic and biotic differences in ecosystems contribute to gene frequency over time which leads to adaptation of populations.

Digital Tools _

- *Presentation* - Keynote, Google Slides, Microsoft PowerPoint
- *Content Website*- Evolutionary Errors

In Practice

- After receiving instruction, students will examine and research how adaptation has been reflected in movies (Examples are Waterworld, planet of the apes, X-men, etc..)
- Students will then present their ideas using a presentation application

EXTINCTION

HS-LS4-5 Students who demonstrate understanding can:

Synthesize, communicate, and evaluate the information that describes how changes in environmental conditions can affect the distribution of traits in a population causing: 1) increases in the number of individuals of some species, 2) the emergence of new species over time, and 3) the extinction of other species.

Evidence of Understanding

Students will be able to determine cause and effect relationships for how changes to the environment affect the distribution or disappearance of traits in species.

Digital Tools

- *Content website-* World Atlas: Timeline of Mass Extinction Events on Earth
- *Timeline Maker* - Visme, Sutori, myHistro

In Practice

- Use this article to introduction to the role of mass extinction in evolution for students to gain a general understanding.
- Students will create digital time line of the 5 major extinction events and choose one to describe how plant and animal ecology was impacted by these events.

RESOURCES

TEACHER

- Wilson's Life on Earth Textbook
- Cambridge IGCSE Biology Cells
- Cambridge: Cellular Hierarchy
- Autotrophs & Heterotrophs
- Punnett-Squares
- Ecosystems
- Book: River Delta
- TeachEngineering.org Activity: Constructing Sonoran Desert Food Chains and Food Webs
- TeachEngineering.org Lesson: Food Chains and Food Webs: Balance within Natural Systems
- Cambridge IGCSE Biology: Organisms and Their Environment
- Check 123 Video: Ecosystems
- HHMI BioInteractive Short Film: Some Animals are More Equal than Others
- Fox & Rabbit Lab: Limits to Population Growth
- Cat Fishin': Tracking Population Decline Using Biology & Algebra
- Learn Genetics: Independent Assortment & Probability

- World Atlas: Timeline of Mass Extinction Events on Earth
- Strawberry DNA Extraction
- Crash Course Video: DNA
- TedED Video: DNA - The Book of You - Joe Hanson
- DNA quiz on Biology Corner.Com
- DISCOVERING THE RELATIONSHIP BETWEEN OVERCROWDING AND THE SPREAD OF DISEASES
- Illuminating Photosynthesis
- Bozeman Science - Photosynthesis & Respiration
- Photosynthesis and Cellular Respiration Lab (with cubes)
- Photosynthesis and Cellular Respiration Cube Lab
- Geometry Tool: Glucose and ATP
- Ted-Ed: Nature's smallest factory: The Calvin cycle - Cathy Symington