

An online exploration
of the biotic
communities of
Arizona with an
emphasis on
Mathematics and
Technology

Exploring Biomes

Lesson 2: Biome Research

LESSON OVERVIEW

In this lesson, a short PowerPoint presentation introduces students to the biomes that scientists have defined. Then, groups of students use online resources to obtain information about one of the world's biomes and present the information to the class. Finally, the students take a test that they have developed.

SUGGESTED GRADE LEVELS

- 6 – 10

ENDURING UNDERSTANDINGS

- A number of characteristics, including elevation, latitude, and climate, are used to divide the world into biomes.
- Scientists have defined numerous biome classifications, but certain biomes, including rainforest, desert, and tundra, are commonly accepted.

OBJECTIVES

Students will:

- Work in groups to achieve an assigned task.
- Use online resources to find relevant information.
- Present information gathered during research.
- Identify the similarities and differences among world biomes.

ARIZONA DEPARTMENT OF EDUCATION STANDARDS

Grade	Science	Mathematics	Technology
6	S1-C3-03; S1-C3-04; S1-C4-01; S1-C4-03; S4-C3-01	S2-C1-02; S2-C1-03; S2-C1-07	1T-E2-02; 2T-E2-01; 2T-E2-02; 5T-E2-02; 5T-E2-03
7	S1-C4-01; S1-C4-03; S4-C3-01; S4-C3-06	S2-C1-03; S2-C1-04; S2-C1-08	
8	S1-C4-02; S1-C4-03; S4-C4-01	S2-C1-03; S2-C1-08	
High School	S1-C4-02; S1-C4-03; S4-C3-01; S4-C3-02; S4-C5-04; S6-C2-15	S2-C1-02; S2-C1-09	5T-P1-03; 5T-P1-04; 5T-P3-01

Note: The full text of these standards can be found in Appendix A.

TIME FRAME

- 3 – 5 days (45 minutes each day)



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MATERIALS

- Computer
- Multi-media projector
- Internet access
- *Biomes of the World* PowerPoint
- *Biome Research Guide* (one per group)
- Poster board, butcher paper, transparencies, or other presentation tools
- Markers
- *Oral Presentation Rubric* (one per group)

TEACHER PREPARATION

- Review the *Biomes of the World* PowerPoint and notes.
- Review the Web sites provided for grade level and content appropriateness.
- Divide the class into eight groups.
- Assign each group to one of the biomes mentioned in the PowerPoint.

SUGGESTED PROCEDURES

1. If Lesson 1 – Mapping Biomes was completed, discuss the results. How did you divide up the world? What difficulties did you have? How many biomes did you come up with? If Lesson 1 was not done, ask students to compare Arizona to Alaska. How are they similar? How are they different? Why are they different?
2. Introduce the purpose of today's lesson. Students will be looking at some biome classifications that many scientists use. Point out (as they may have discovered in Lesson 1) that there may be more than one way to divide the Earth, but there are some standard biomes that most people agree on.
3. Inform students that they will be viewing a short PowerPoint presentation. During the presentation, they should take some notes because they will be assigned to one of the biomes mentioned and will be required to research it in more detail.
4. Present the *Biomes of the World* PowerPoint. You may use the notes provided as discussion points.
5. Divide students into teams with approximately four members. Assign each team to research one of the biomes mentioned in the presentation.
6. Give a *Biome Research Guide* and *Oral Presentation Rubric* to each team and discuss the requirements. Inform teams that they will be using the Internet sites listed on the paper (if permitted, they can also search for additional sites). When they have enough information, they will develop a presentation to teach the class about their particular biome. In addition, they must write three questions about their biome that will be used for a test. They need to make sure that they provide the answers to the questions within their presentation.
7. Give the students a few days to put their biome presentations together.
8. Allow at least two days for presentations to take place.
9. Put together a test using the student-generated questions.



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ASSESSMENT

- Oral presentations using the rubric provided
- Student-generated test

EXTENSIONS

- Students can use their knowledge of biomes to analyze climate data from various cities and attempt to identify which biome it is in (see Appendix B)



Appendix A: Arizona Department of Education Standards – Full Text

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Science Standards

Grade	Strand	Concept	Performance Objective
6	1	3 – Analysis and Conclusions	3 – Evaluate observations and data reported by others 4 – Interpret simple tables and graphs produced by others
		4 – Communication	1 – Choose an appropriate graphic representation for collected data: <ul style="list-style-type: none"> • line graph • double bar graph • stem and leaf plot • histogram 3 – Communicate the results of an investigation with appropriate use of qualitative and quantitative information
	4	3 – Populations of Organisms in an Ecosystem	1 – Explain that sunlight is the major source of energy for most ecosystems
7	1	4 – Communication	1 – Choose an appropriate graphic representation for collected data: <ul style="list-style-type: none"> • line graph • double bar graph • stem and leaf plot • histogram 3 – Communicate the results of an investigation with appropriate use of qualitative and quantitative information
	4	3 – Population of Organisms in an Ecosystem	1 – Compare food chains in a specified ecosystem and their corresponding food web 6 – Create a model of the interactions of living organisms within an ecosystem
8	1	4 – Communication	2 – Choose an appropriate graphic representation for collected data: <ul style="list-style-type: none"> • line graph • double bar graph • stem and leaf plot • histogram 3 – Present analyses and conclusions in clear, concise formats
	4	4 – Diversity, Adaptation, and Behavior	1 – Explain how an organism’s behavior allows it to survive in an environment



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Science Standards Continued

Grade	Strand	Concept	Performance Objective
High School	1	4 – Communication	2 – Produce graphs that communicate data 3 – Communicate results clearly and logically
	4	3 – Interdependence of Organisms	1 – Identify the relationships among organisms within populations, communities, ecosystems, and biomes 2 – Describe how organisms are influenced by a particular combination of biotic (living) and abiotic (nonliving) factors in an environment
		5 – Matter, Energy, and Organization in Living Systems (Including Human Systems)	4 – Diagram the energy flow in an ecosystem through a food chain
	6	2 – Energy in the Earth System (Both Internal and External)	15 – List the factors that determine climate (e.g., altitude, latitude, water bodies, precipitation, prevailing winds, topography)

Mathematics Standards

Grade	Strand	Concept	Performance Objective
6	2	1 – Data Analysis (Statistics)	2 – Construct a histogram, line graph, scatter plot, or stem-and-leaf plot with appropriate labels and title from organized data 3 – Interpret simple displays of data including double bar graphs, tally charts, frequency tables, circle graphs, and line graphs 7 – Compare trends in data related to the same investigation
7	2	1 – Data Analysis (Statistics)	3 – Determine when it is appropriate to use histograms, line graphs, double bar graphs, and stem-and-leaf plots 4 – Interpret data displays including histograms, stem-and-leaf plots, circle graphs, and double bar graphs 8 – Compare trends in data related to the same investigation
8	2	1 – Data Analysis (Statistics)	3 – Determine the appropriate type of graphical display for a given data set 8 – Compare trends in data related to the same investigation



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Mathematics Standards Continued

Grade	Strand	Concept	Performance Objective
High School	2	1 – Data Analysis (Statistics)	2 – Organize collected data into an appropriate graphical representation 9 – Draw inferences from charts, tables, graphs, plots, or data sets

Technology Standards

Grade	Strand	Concept	Performance Objective
6, 7, 8	1	2 – Demonstrate increasingly sophisticated operation of technology components	2 – Retrieve and save information remotely (e.g., network servers, Internet, Intranet, peripheral devices)
	2	2 – Exhibit legal and ethical behaviors when using technology and information and discuss consequences of misuse	1 – Follow rules for deciding when permission is needed for using the work of others, (e.g., some sites specify whether permission is required or not, some work is in public domain) 2 – Obtain permission to use the work of others
	5	2 – Evaluate the accuracy, relevance, appropriateness, comprehensiveness and bias of electronic information sources	2 – Gather research from a variety of electronic sources and identify the most appropriate information for answering the research question 3 – Obtain permission, when appropriate, to use the work of others
High School	5	1 – Develop a research strategy to find accurate, relevant, appropriate electronic information sources	3 – Independently select appropriate electronic resources from school, community and the world (via online) to be used to locate information needed when presented with a problem to solve 4 – Evaluate the appropriateness and effectiveness of electronic resources (e.g., purpose, credibility of author)
		3 – Present research findings from electronic resources using academic models for citations and formats	1 – Utilize evaluation criteria (authority, accuracy, relevancy, timeliness) for information found on the Internet to present research findings



Appendix B: Making Climographs

1. Explain to students that a climograph summarizes a location's climate in one simple graph. The graph contains both the average temperature and the rainfall for that location during each month of the year.
2. To be consistent, all climographs should follow the same format. The months should always be located on the bottom of the graph. Precipitation or rainfall should be on the left vertical axis and is represented with a bar graph. The average temperature should be on the right vertical axis and is represented with a line graph. Of course, there should always be a legend explaining the graph. See Graph 1 for a climograph for Flagstaff.
3. In the tables below, there is climate data for five United States cities. Have the students practice making climographs using this data. *Note: temperatures are listed in degrees Fahrenheit.*
4. When they are familiar with the climographs for various biomes, students should try to identify in which biome each of these cities can be found.

Graph 1 Climograph for Flagstaff, AZ

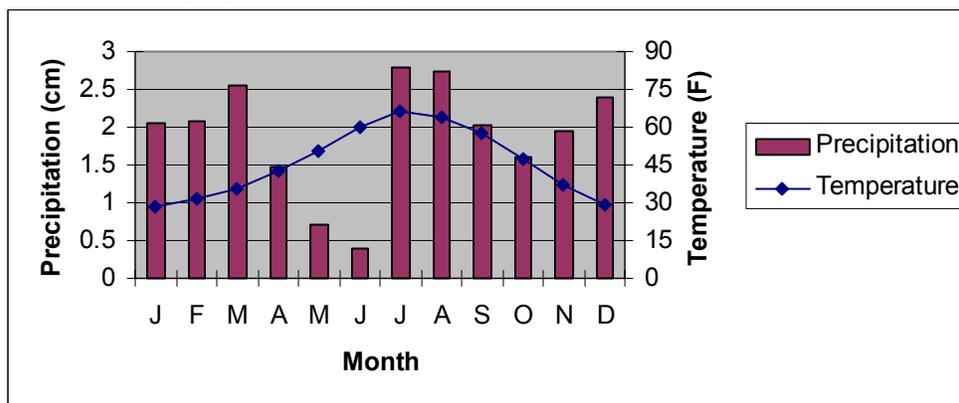


Table 1: Climate Data for Yuma, AZ

Temperature (F)	56.5	60.7	64.9	71.4	79.0	87.6	93.7	92.7	86.8	76.2	64.2	56.4
Precipitation (cm)	0.35	0.22	0.21	0.14	0.04	0.02	0.26	0.64	0.31	0.29	0.24	0.45

Table 2: Climate Data for Cold Bay, AK

Temperature (F)	28.6	27.4	29.9	33.3	39.6	45.7	50.5	51.5	47.7	39.6	34.4	31.0
Precipitation (cm)	2.84	2.27	2.16	1.97	2.29	2.10	2.52	3.24	4.41	4.34	4.19	3.67

Table 3: Climate Data for Lihue, HI

Temperature (F)	71.6	71.6	72.7	74.0	75.8	77.8	78.9	79.5	79.2	77.6	75.5	72.9
Precipitation (cm)	5.89	3.33	4.17	3.50	3.15	1.69	2.13	1.76	2.37	4.41	5.45	5.15

Table 4: Climate Data for Wichita, KS

Temperature (F)	29.5	34.8	45.4	56.4	65.6	75.7	81.4	79.3	70.3	58.6	44.7	33.0
Precipitation (cm)	0.79	0.96	2.43	2.38	3.81	4.31	3.13	3.02	3.49	2.22	1.59	1.20

Table 5: Climate Data for Olympia, WA

Temperature (F)	38.0	41.1	43.8	47.5	53.2	58.7	62.9	63.3	57.9	49.7	42.5	38.2
Precipitation (cm)	8.01	5.77	4.95	3.29	2.09	1.63	0.82	1.29	2.26	4.31	8.05	8.12

Data provided by <http://www.mobot.org/education/02programsresources/mappingenvironment/mynaturalcommunity/front.htm>



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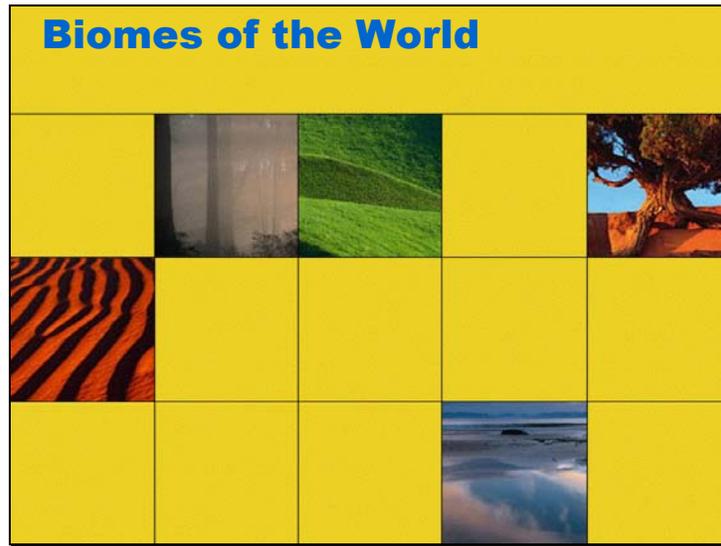
Appendix C: Worksheets and Overheads

The pages that follow contain the worksheets listed below:

- A. *Biomes of the World* PowerPoint – Use these notes to assist you in your presentation (14 pages)
- B. *Biome Research Guide* – A worksheet that provides all of the requirements for the group research project (1 page)
- C. *Oral Presentation Rubric* – One method for grading the group presentations (1 page)



Slide 1



Slide 2

What is a biome?

A BIOME is the largest geographic biotic unit, a major community of plants and animals with similar life forms and environmental conditions.

Tropical Rainforest	Grassland
Tropical Savanna	Temperate Deciduous Forest
Desert	Temperate Boreal Forest
Chaparral	Arctic and Alpine Tundra

A biome is a large geographic area containing similar plants and animals. This map shows the locations of some of the major biomes of the world.

Each biome can have distinguishing characteristics based on local factors. For example, within the desert biome, there may be hot, cold, and coastal deserts, each with slightly different climates.

It is possible to divide the biomes into smaller units that we call biotic communities, ecosystems, or habitats.



How are biomes formed?

Biomes are distributed across the Earth based primarily on climate. Therefore, in areas that are far apart, you will sometimes find similar plants and animals because the climate is similar.

One factor affecting climate is latitude. Typically, the farther you move north or south of the equator, the colder the temperature gets. Another factor affecting climate is elevation. The higher you go in elevation, the colder the temperature gets.

Biomes usually found at cold latitudes far from the equator are sometimes also found on high mountains at low latitudes. Typically, a climb of 100 feet in elevation is equivalent to traveling 600 miles northward.

Climate is a major factor in forming biomes because it is a major factor in controlling which living organisms survive.

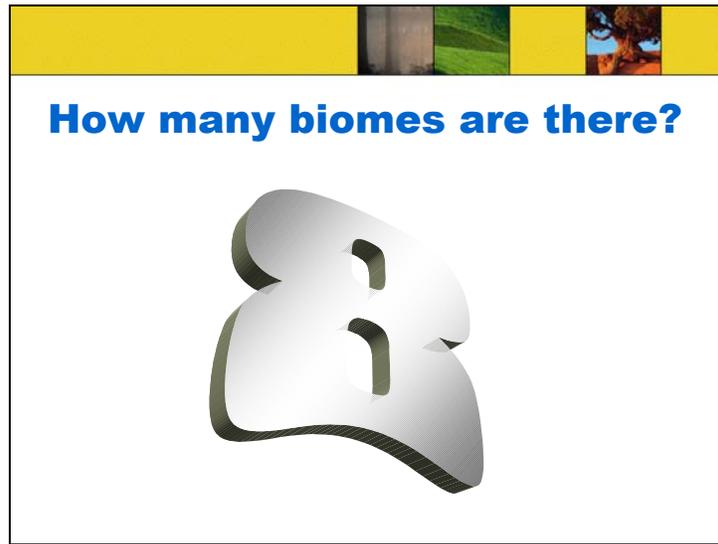
Most plants that live in cold climates have developed similar adaptations to the cold, and those adaptations are significantly different from the ones required to survive in warm climates.

As a result, areas with similar climates (on a global scale) have similar biotic communities and are therefore considered the same biome.

Climates change as we move north or south from the equator. As a rule, temperatures drop the farther you get from the equator. Therefore, many biomes are distributed along very distinct lines of latitude. For example, deserts are typically found around 30 degrees North or South latitude.

However, climate can also be affected by elevation. Thus, biomes that are typically found closer to the poles may also be found on mountains located near the equator.

Slide 4



For purposes of this class, we will consider there to be eight biomes...



How many biomes are there?

Although there is some disagreement among scientists on how to divide up the Earth's biomes, most can agree on the following eight:

- Tropical Rainforest
- Tropical Savanna
- Desert
- Chaparral
- Grassland
- Temperate Deciduous Forest
- Temperate Boreal Forest
- Tundra

...However, there is some disagreement among scientists about how many biomes there should be. Some argue that there are as few as five and others that there are as many as thirteen or more. For our purposes, we will focus only on the terrestrial (land) biomes. If we included aquatic, there would be even more.

The eight biomes represented here are pretty standard, but they are relatively generic. It is possible to divide these into smaller biomes. For example, we could break the tundra into arctic tundra and alpine tundra.



Tropical Rainforest

- Typically found near the equator
- Receives more than 200 cm of rain annually
- Temperatures typically fall between 20°C and 25°C for the entire year
- As many as 50% of all the world's animal species may be found here





Tropical Savanna

- Grasslands with a few scattered trees
- Experience a wet and dry season
- Hot temperatures
- Annual rainfall is between 50 and 127 cm
- More species of grazing mammals than any other biome





Desert

- Typically found between 25° and 40° latitude
- Receives less than 25 cm of rain each year
- Temperatures typically range between 20°C and 25°C but some extreme deserts can reach temperatures higher than 38°C and lower than -15°C





Chaparral

- Found between 32° and 40° latitude on the west coast of continents
- Receives between 35 and 70 cm of rain, usually in the winter
- Extremely resistant to drought and weather events





Grassland

- Because of the dry climate, trees are found only near water sources such as streams
- Usually receives between 50 and 90 cm of rainfall each year
- Summer temperatures can reach up to 38°C, and winter temperatures can fall to -40°C





Temperate Deciduous Forest

- Moderate climate
- Most trees will lose their leaves in the winter
- Temperatures range between – 30°C and 30°C
- Averages from 75 to 150 cm of precipitation
- Well developed understory





Temperate Boreal Forest

- Also known as Taiga
- Typically found between 45° and 60° North latitude
- Cold climate with summer rains
- Very few reptiles
- Limited understory
- Snow is primary form of precipitation (40 – 100 cm annually)





Tundra

- Means treeless or marshy plain
- Characterized by permafrost – permanently frozen soil starting as high as a few centimeters below the surface – which severely limits plant growth
- Winter temperatures average – 34°C while summer temperatures usually average below 10°C
- Low precipitation (15–25 cm per year) but ground is usually wet because of low evaporation





Credits

- Text:
 - <http://www.physicalgeography.net/fundamentals/9k.html>
 - <http://www.ucmp.berkeley.edu/glossary/gloss5/biome/index.html>
- Pictures:
 - <http://www.worldbiomes.com/>
 - <http://www.ucmp.berkeley.edu/glossary/gloss5/biome/index.html>
 - <http://www.blueplanetbiomes.org/>
- PowerPoint:
 - Arizona Game and Fish Department, 2005

Biome Research

Your group has been assigned one of the biomes discussed in class. You will now become the teacher. You must use the Internet to research this biome, focusing on the required elements listed below. Once the research is complete, put the information together in an interesting and meaningful way for your classmates. Remember: you want this to be exciting. Don't just lecture. Get the class involved. Try to use at least one visual aid (overhead, computer, poster, etc.).

For your assigned biome, you must have:

1. A general description of the biome, including location, general climate, seasons, and plant and animal adaptations.
2. A world map with the global distribution of the biome clearly marked.
3. A representative climograph showing monthly precipitation and temperatures.
4. A vegetation profile (a typical side view of the biome) that shows the vertical distribution of plants, emphasizing any canopy or understory.
5. A food web containing animals and plants at the following trophic levels: producers, primary consumers, secondary consumers, top predators, and decomposers.
6. Pictures of the biome as well as common animals and plants found there.
7. Three questions that can be used on a test at the end of the presentations.

The following Web sites will provide you with background information:

The World's Biomes

<http://www.ucmp.berkeley.edu/glossary/gloss5/biome/index.html>

World Biomes

<http://www.worldbiomes.com/>

Land Biomes

<http://biology.about.com/od/landbiomes/a/aa061297a.htm>

Characteristics of Earth's Terrestrial Biomes

<http://www.physicalgeography.net/fundamentals/9k.html>

Earth Floor: Biomes

<http://www.cotf.edu/ete/modules/mse/e/earthsysflr/biomes.html>

World Builders: Introduction to Biomes

<http://curriculum.calstatela.edu/courses/builders/lessons/less/biomes/introbiomes.html>

The Virtual Zoo: Habitats

<http://library.thinkquest.org/11922/habitats/habitats.htm>

Introduction to Biomes

<http://www.runet.edu/~swoodwar/CLASSES/GEOG235/biomes/intro.html>



Oral Presentation Rubric

The following rubric will be used to evaluate your presentation. Use it as a guideline as you prepare.

CATEGORY	4	3	2	1
Organization	Information is presented in a clear, logical, and interesting manner that the audience can easily follow.	Information is presented in a clear sequence that the audience can follow.	Presentations jumps between topics and audience has difficulty following.	There is no sequence and the audience cannot follow.
Knowledge	Explanations show full knowledge, all required elements are included, and questions are answered appropriately.	Explanations are complete, all required elements are included, and questions are answered but lack detail.	Explanations are not detailed, some elements are missing, and answers to questions are incomplete.	No clear understanding of information, many missing elements, and questions are not answered.
Supporting Graphics and Materials	Graphics are highly visible and reinforce presentation.	Graphics are visible and relate to the presentation.	Graphics are difficult to see or are not very relevant to the presentation.	There are no graphics or supporting materials.
Eye Contact	Students maintain eye contact with the audience, rarely referring to notes.	Students maintain eye contact for most of the time but refer often to notes.	Students read most of the report and rarely look at audience.	Students never look at audience.
Mechanics	Rate and volume of voice is clear, appropriate language is used, and speaker is poised.	Voice is clear and most of the audience can hear, appropriate language is used, and speaker is somewhat poised.	Difficult to hear or understand speaker some words are not appropriate, speaker moves or rocks quite a bit.	Speaker mumbles, has poor word choice, and is constantly moving or rocking.

