

Drought in Georgia
Standards-Based Activities and Background Information
for Earth Science Teachers

Lesson 2
Who Shut Off My Water?
Cause and Effects of Drought

Teacher Background Information

Drier than normal conditions over time or at critical growing periods that result in water-related problems are the **cause** of drought. These problems produce a **variety of effects** that occur from water that is not distributed evenly throughout our world. Precipitation (rain or snow) falls in uneven patterns across the country. The amount of precipitation at a particular location varies from year to year, but over a period of years, the average amount is fairly constant. In the deserts of the Southwest, the average precipitation is less than 3 inches per year. In contrast, the average yearly precipitation in Atlanta, Georgia is about 50 inches.

The amount of rain and snow also varies with the seasons. In Georgia, for example, most of the yearly precipitation falls during winter, early spring, and in July. Even if the total amount of rainfall for a year is about average, short-term rainfall shortages can occur when moisture is critically needed for plant growth, such as in the early summer for crops like peanuts and cotton. When this happens, the **effect** is agricultural drought and can affect farmers in many ways. Farmers can be affected through crop losses, livestock reductions and, of course, economic losses that result from reduced crop yields and business services.

When rainfall is less than normal for several weeks, months, or years the **effect** can be hydrological drought. The flow of streams and rivers declines, water levels in lakes and reservoirs fall, and the depth of water in wells decreases. If dry weather persists water supply for human consumption can then become a problem. Drought is a natural hazard that cumulatively has affected more people in North America than any other natural hazard (Riebsame et al, 1991). The cost of losses due to drought in the United States averages \$6-8 billion every year but ranges as high as \$39 billion. The three-year drought of 1987-1989, was the most costly natural disaster documented in U.S. history.

http://www.ncdc.noaa.gov/paleo/drought/drght_history.html

Droughts in Georgia have severely affected municipal and industrial water supplies, agricultural productivity, stream and water quality, recreation at major reservoirs, habitat, hydropower generation, navigation, and forest resources.

<http://ga.water.usgs.gov/edu/qadroughts.html#drought>

NOTE: Web sites cited in this document were accessible as of February 2007.

Language: need references

- **affect** – (v) **have an influence on or effect a change in** (www.answers.com/topic/affect).
- **agriculture** – the science, art, and business of cultivating soil, producing crops and raising livestock; farming (<http://www.thefreedictionary.com/agriculture>)
- **annual rainfall** – the amount of rain that falls in a location over time. Annual rainfall would be rain that falls in a year. (<http://encarta.msn.com/dictionary-1861697873/rainfall.htm>)
- **drought** – (n) a period of drier than normal conditions that results in water-related problems. It is caused by a lack of precipitation at critical growing periods or may last long enough to affect hydrology (Moreland, 1993); (adj.) We are experiencing **drought** conditions.
- **drought severity** – the duration and intensity of the drought: usually measured using the Palmer Hydrological Drought Index (<http://wf.ncdc.noaa.gov/oa/climate/research/prelim/drought/palmer.html>)
- **effect** – something brought about by a cause or agent; a result
The power to produce an outcome or achieve a result; influence (<http://www.answers.com/topic/effect>)
- **hydrology** – the study of Earth's waters, including water's properties, circulation, principles, and distribution
(The Watercourse, Project WET Curriculum and Activity Guide, 2000, Bozeman, Montana.)
- **meteorology** – the study of the atmosphere, including weather and climate
(The Watercourse, Project WET Curriculum and Activity Guide, 2000, Bozeman, Montana.)
- **precipitation** – water falling, in a liquid or solid state, from the atmosphere to Earth
(The Watercourse, Project WET Curriculum and Activity Guide, 2000, Bozeman, Montana.)

Who Shut Off My Water? Cause and Effects of Drought

Key Words: affect, agriculture, annual rainfall, drought, effect, hydrology, meteorology, precipitation, severity (drought)

Desired Outcomes

Goals:

S6E3. Students will recognize the significant role of water in earth processes.

- b. Relate various stages of the atmospheric conditions to stages of the water cycle.

S6CS6. Students will use the ideas of system, model, change, and scale in exploring scientific and technological matters.

- a. Observe and explain how parts are related to other parts in systems such as weather systems, solar systems, and ocean systems including how the output from one part of a system (in the form of material, energy, or information) can become the input to other parts.

S6CS6. Students will communicate scientific ideas and activities clearly.

- b. Organize scientific information using appropriate tables, charts, and graphs, and identify relationships they reveal.

S6CS7. Students will question scientific claims and arguments effectively.

- c. Recognize that there may be more than one way to interpret a given set of findings.

S6CS9. Students will investigate the features of the process of scientific inquiry

- d. Scientists use technology and mathematics to enhance the process of scientific inquiry.

S6CS10. Students will enhance reading in all curriculum areas by:

- b. Building vocabulary knowledge
 - Use content knowledge vocabulary in writing and speaking.

SS6G10. The student will discuss the impact of government policies and individual behaviors on the environments of Australia and Oceania.

- a. Explain major environmental concerns Australians have regarding issues such as protection of The Great Barrier Reef, Ozone depletion, and global warming and actions taken by the government and/or citizens regarding these concerns.

SS6G11. The student will explain the impact of location, climate, physical characteristics, natural resources and population size on Australia and Oceania.

- a. Describe how Australia's location, climate, and natural resources have affected where people live, where agricultural and industrial regions are located, and on trade, especially the importance of deserts, the river system and the many good harbors.

Understandings:**Students will understand that...**

- drought and water use impact the availability of water resources
- the water cycle is a cycle of evaporation, condensation and precipitation that controls the distribution of Earth's water
- drought is caused by a lack of precipitation at critical growing periods or may last long enough to affect hydrology
- water is not distributed evenly throughout the world.
- droughts can have different severity levels
- drought has effects on agriculture, streamflow and lake levels, plants, animals, and the economy
- drought affects different users, geographic regions and cultures differently.

Essential Questions:

- How does water move through the water cycle?
- What causes a drought?
- How evenly is water distributed throughout the world?
- How can you determine the severity level of drought?
- What are the effects of drought?
- How does drought in Georgia compare to drought in Australia?

Students will know...

- how water moves through the water cycle
- that drought is caused by a lack of precipitation over time that can affect crop losses, or be severe enough to affect streamflow, lake levels and water supply
- that water is not distributed evenly throughout the world
- that there are different severity levels of drought that states experience
- that Georgia crops, livestock, plants, streamflow and lake levels, economy, and wildlife are affected during Georgia drought
- that drought in Australia has similarities and differences compared to drought in Georgia.

Students will be able to...

- write what they know about drought and the causes and effects before they do their research using *The Anticipation Guide*
- draw and articulate the water cycle
- research the cause of drought
- use the Georgia Annual Rainfall Map to determine annual rainfall for major cities in Georgia
- use the U.S. Drought Monitor Map to determine drought severity in Georgia and in other states
- research Web sites to discover the causes and effects of drought in Georgia and drought in New South Wales, Australia
- map their research data by filling in the information found on their U.S. map, Georgia map and their New South Wales map

- Write out causes and effects of Georgia drought in their *Anticipation Guide* using their research.
- Apply knowledge gained from research through the creation of an invention to solve a drought related problem.

Lesson Hook: Students will receive *The Anticipation Guide* to express what they know about the causes and effects of drought. Students will draw a picture of drought and state causes and effects prior to doing their research.

Assessment

Performance Tasks:

- “The Water Cycle and Cause of Drought” Student Activity Worksheet #1
Guided by a checklist, students will 1) research the water cycle, discuss it as a team, draw it and label it using eight water cycle terms; and 2) research the cause of drought providing a written definition.
- “Rainfall and Distribution of Water” Student Activity Worksheet #2
Guided by a checklist, students will read National Weather Service and U.S. Drought Monitor Maps locating the annual rainfall for seven Georgia cities and determining drought severity for various states.
- “Looking at the Effects of Drought in Georgia and Australia” Student Activity Worksheet #3
Guided by a checklist, students will identify the effects of drought in Georgia and Australia on agriculture, livestock, plants, streamflows and wildlife and record those effects on maps.
- “Creating an Invention to Solve a Drought-Related Problem”
Guided by a rubric, students will create a drawing or a model that represents an invention to solve a drought-related problem.

Other Evidence:

Anticipation Guide

Students will complete an *Anticipation Guide* at the beginning and end of the activity to determine what they know about the cause and effects of drought.

Plan of Action

Tasks:

Part A: The Anticipation Guide – What do you know?: 15 minutes

Hand out *The Anticipation Guide* and ask students to fill it out. Point out to the students that they are to draw a picture of drought in the center of the guide and fill in as many causes and effects of drought as they can name in the appropriate places. This is not a test but rather a way for students to see what they know and then what they learn after research on drought. Students will refer back to their *Anticipation Guide* at the end of the activity and fill it out again to realize what they have learned about the and effects of drought.

Part B: The Water Cycle and Cause of Drought: 30 minutes

1. Organize students in research groups according to computer availability.
2. Each student should complete his/her own maps and worksheets with recorded data.
3. Give students Student Activity Worksheet #1. Research teams will review the water cycle using the Web sites provided. As a group they will discuss the water cycle. Students will individually draw a diagram of the water cycle on their worksheets.
4. Students will also research the cause of drought as review and write the cause of drought on Student Activity Worksheet #1.

Part C: Rainfall and Distribution of Water: 60 minutes

1. Give students Student Activity Worksheet #2. Students will determine the annual rainfall for 7 major Georgia cities using the Georgia Average Annual Rainfall Map from the National Weather Service (Use the Web site given). The map has a legend with color coding that relates to the annual number of inches for that area. Remind students that it will be necessary for them to locate the 7 cities on their Georgia map. They will need to look at a political map of Georgia to see where these cities should be located. Students will need to record the cities and the annual rainfall on their Georgia map.
2. Now students will have the opportunity to investigate the severity of drought across the country and learn whether a drought is mild, moderate, severe or exceptional. They will also learn whether a drought is considered agricultural or hydrological. This activity will require crayons or markers so that students can color in the correct colors that represent drought intensity. Students will use the U.S. Drought Monitor from the National Drought Mitigation Center and record drought severity. There is a color legend that relates to drought severity and students will use it to answer questions and record the colors on their U.S. map.

**Part D. Looking at the Effects of Drought in Georgia and Australia:
120 minutes**

1. Students will research the cause and effects of drought in Georgia and Australia using available research articles from Web sites provided and any they find on their own using the Student Activity Worksheet #3. Questions 1-5 are to be recorded on the Georgia map provided. Students should be able to record answers from at least 2 different Web sites per question.
2. Questions 6-8 compare and contrast current drought in Georgia to drought in Australia. Students will learn about Georgia as a state compared to New South Wales as a state in terms of land size, longitude and latitude, and population size. They will record this information on their Georgia and New South Wales maps. They will research Web sites that will give them an idea about drought in Australia and they must record information from at least 3 sites on their New South Wales map.
3. Students will be asked to write a paragraph comparing drought in Georgia, a state on the continent of North America, and New South Wales, a state on the continent of Australia. Students will present their research through their created maps. They will need to write similarities and two differences.

**Part E. Creating an Invention to Solve a Drought-Related Problem:
60 minutes**

1. After students have completed the research they will synthesize their knowledge by providing a solution to one of the effects of drought they have learned about. They might find a solution for a farmer, wildlife manager, hydrologist, or homeowner. They might want to refer to their Web site article on the Bass in Lake Blackshear and see if they can come up with a solution that would save the fish or focus on the farmer and come up with a solution that would help save crops or livestock in drought conditions. Homeowners need to use less outdoor water in drought conditions. (see back of the poster) and students could focus on a water saving device for the homeowner.
2. Students will need to create a drawing or a model that demonstrates a solution to an effect of drought. Students will make a presentation to the class that answers these questions:
 - What is the name of the invention?
 - How will this invention help solve a drought related problem?
 - How was the model created step by step?
 - What group of people/animals will the invention help?
 - How does the invention function to solve a drought related problem?
3. Students can research the following information on a meteorologist who invented an index to help understand more about drought and about an inventor in Australia who invented a windmill that traps water from air and uses wind energy and condensation to provide water.
 - Wayne Palmer, a meteorologist, invented an index to help us understand more about drought. Wayne Palmer, a meteorologist, invented *The Palmer Drought Severity Index* in the 1960s. The great thing about it is that it is standardized to the local climate and can be

used in any state. The index looks at temperature and rainfall in a formula to determine dryness and has now become the “semi-official drought index” (NOAA Drought Information). For more information see this Web site: <http://www.drought.noaa.gov/palmer.html>

- Max Whisson is the inventor of the Whisson windmill in Australia. He is trying to sell his invention to investors and convince government officials that it will solve drought problems. Max Whisson has created a system that uses the windmill to blow wind into a refrigerator type unit that causes the water to condense. His invention takes water out of the air using energy and wind. Mr. Whisson hopes to provide water to drought-stricken farmers. Learn more about this invention by going to the Web site below:

<http://www.abc.net.au/canberra/stories/s1837203.htm>

Part F. Anticipation Guide – What have you learned?: 15 minutes

Students will discover what they learned about the cause and effects of drought by filling out their *Anticipation Guide* again after their research.

Additional Resources:

<http://ga.water.usgs.gov/news/drought99/photos/index.html>

<http://drought.unl.edu/kids/reduce/awareness.htm>

www.drought.noaa.gov/

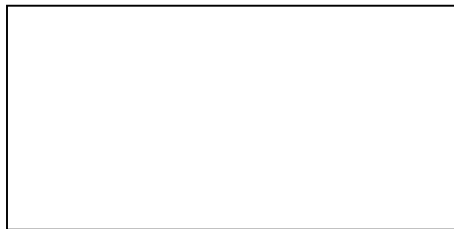

<http://gpc.edu/~pgore/Earth&Space/GPS/GPScontents.html>

Lesson Plan Template

Wiggins, G., & McTighe, J. (2004). *Understanding by design professional development workbook*. Alexandria, VA: Association for Supervision and Curriculum Development.

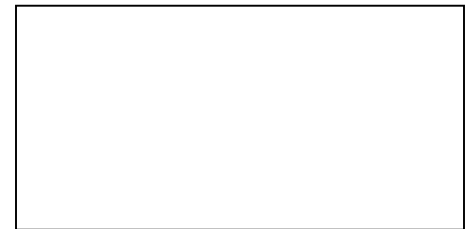
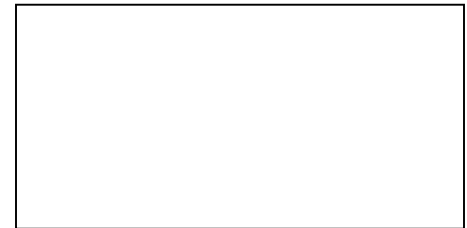


Anticipation Guide

Causes



Draw a picture of drought here.

Effects



TEACHER – Copy and Distribute to Students

**The Water Cycle and Cause of Drought
Student Activity Worksheet #1**

1. Review the *water cycle* through research.

In your research team look at the Web site below and review the diagram of the water cycle and the water cycle words. Discuss the meaning of the words as a group. In the space below draw your own water cycle using as many water cycle words as possible. You should use at least 8 water cycle words in your diagram.

Draw your water cycle diagram here:

Water Science for Schools: The Water Cycle
<http://ga.water.usgs.gov/edu/watercycle.html>

2. What causes a drought?

In your research team, look at the Web sites given below and read the information on the causes of drought. Decide as a group what it is that causes a drought. Take notes and then write an explanation of the cause/s of drought in the space provided on this worksheet.

DRBC – Drought Information for Kids
http://www.state.nj.us/drbc/drought/kids_droughtinfo.htm

Drought: A Paleo Perspective – What is drought?
http://www.ncdc.noaa.gov/paleo/drought/drght_what.html

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Rainfall and Distribution of Water Student Activity Sheet #2

1. What is Georgia's average annual rainfall?

Record the information below on the map of Georgia.

Annual rainfall is the measured amount of rain that falls in an area in a year (see your vocabulary definition). You are going to determine what the annual rainfall is for some of Georgia's cities.

- a. Locate these cities on your Georgia map and write them down. The cities are: **Albany, Augusta, Columbus, Dalton, Macon, Marietta and Savannah.** You may need to find a political map of Georgia to locate these cities.
- b. Once the cities are on your Georgia map in the proper location your research team will need to go to the National Weather Service site below and it will open to Georgia's Average Annual Rainfall Map. You will notice that the map is full of color and the colors have a meaning. Different colors designate different rainfall amounts and you will be able to get those amounts by looking at the legend provided.
- c. You will want to look at the area on the annual rainfall map where the city is located and see what color is in that area. The color will let you know the annual rainfall inches.
- d. Record the annual rainfall inches next to the city and write down AR for annual rainfall next to the number on your Georgia map. For example, if the color is dark brown where your city is located, the average annual rainfall is under 46 inches. You write down *under 46 inches AR* next to the city name.

National Weather Service Forecast

<http://www.srh.noaa.gov/ffc/images/gapcph7.gif>

Open the section – Georgia's Average Annual Rainfall Map

2. What is the drought severity?

Record the information on the next page on the map of the United States.

Investigate the most up-to-date U.S. Drought Monitor Map using the Web site on the next page. This map gives you a way to look at the intensity or the severity of a drought in a particular part of the country. The Drought Monitor Map is accurate for this date in time. You will also notice by the color-coded legend that droughts can be more or less intense depending on where and when they occur and their duration.

Find Georgia on your United States map.

Does Georgia have any color on the U.S. Drought Monitor Map?

Follow the instructions to color in one or more areas on your U.S. map, label the drought intensity and date your work.

- a. Using markers, copy the same colors in the same locations on your United States map in the state of Georgia. Label the colors with the intensity designated by the color legend. For example, if you colored an area of Georgia yellow, it means abnormally dry. You would write in “abnormally dry” by that area and write the date of your research.
- b. What colors do you see in the states that border Georgia? Use crayons or markers and copy the colors on your U.S. map in the states that border Georgia. Label the intensity of drought for each colored area in the states. Be sure to date your research.
- c. Look at the U.S. Drought Monitor Map and see if you can find a state or part of a state that has a **moderate** drought at present. Color that state and area with the appropriate color and label the type of drought **moderate**. Add the current date on the map next to each researched drought.
- d. Looking at the U.S. Drought Monitor Map, can you see a state or part of a state experiencing a **severe** drought at this time? If so, color that state and area in on your U.S. map with the appropriate color. Label the intensity of the drought and date your research.
- e. According to the U.S. Drought Monitor Map, is any state experiencing an **exceptional** drought at present? Color in an area of a state experiencing **exceptional** drought if you were able to locate one and label the type of drought **exceptional** on your U.S. map. Date your research.
- f. How would you know if a state has an **agricultural** drought occurring? On your U.S. Drought Monitor Map, can you find a state that has **agricultural** drought occurring? Put the appropriate symbol in that state on your U.S. map to designate agricultural drought. Check your map legend.
- g. Check your U.S. Drought Monitor Map again to see if a state has **hydrological** drought occurring. If so, put an **H** on your U.S. map in the state that is experiencing **hydrological** drought.

U.S. Drought Monitor

<http://www.drought.unl.edu/dm/monitor.html>

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Looking at the Effects of Drought in Georgia and Australia Student Activity Sheet #3

1. How have droughts affected crops in Georgia?

Record the information below on the map of Georgia.

Working in research teams use the Web sites below to learn how drought affects crops in Georgia. If you have time and your teacher approves, you can look at other sites to find additional information.

You will use your Georgia map and record your notes there. If the article provides a geographic location, you will put your notes in the appropriate place on your Georgia map. For example, if you discover that pecan production was affected in southwest Georgia and that only one third of the crops were saved, you would write southwest Georgia on the Georgia map. Your notes would say that pecan crops are affected and one-third crop losses occurred. Include the date of the article on your map. You will need to find 2 sources of information to include on your Georgia map for each question.

Dry conditions have an effect on GA's number one industry

http://agr.georgia.gov/00/article/0,2086,38902732_39653527_57253823,00.html

Go to the Press Releases. List title of the article in the search box.

Georgia Economic Losses due to the drought of 2006

<http://www.caed.uga.edu/publications/2006/pdf/CR-06-06A.pdf>

Drought Hits Farmer's Wallets Hard

<http://georgiafaces.caes.uga.edu/getstory.cfm?storyid=985>

Drought Reduces Georgia's 2006 Pecan Production

<http://www.geocities.com/CollegePark/Campus/3370/DroughtReducesGa06PecanProduction.htm>

2. How has livestock been impacted by droughts in Georgia?

Record the information below on the map of Georgia.

In your research group, look at the Web sites below and find information that will tell you how livestock is affected during a drought. You will need to find at least 2 sources. If the articles give you a geographic location please put your notes in that location on your Georgia map.

Caring for Dairy Cows in Hot Weather

<http://interests.caes.uga.edu/drought/content/dairydry.htm>

Livestock Assistance Grant Program/Frequently Asked Questions

http://agr.georgia.gov/vqn/images/portal/cit_1210/26/4/73085159Q%20&%20A%20LAG%20sheet.doc

3. How does drought affect plants and trees in Georgia?

Record the information below on the map of Georgia.

Your research team can use the following Web sites to find information on how trees and plants are affected by drought. You will need to find 2 sources and put the information in note form on your Georgia map and date it.

Drought Information for Kids

http://www.state.nj.us/drbc/drought/kids_droughtinfo.htm

Drought and Flooding

<http://www.forestpests.org/gfcbook/droughtflooding.html>

Effects on Trees – Thirsty Trees

http://www.georgiamagazine.org/archives_view.asp?mon=11&yr=2006&ID=1450

4. Have there been any impacts on streamflows or lake levels during recent droughts in Georgia?

Record the information below on the map of Georgia.

Your research team will look for information about hydrological drought because that affects streamflows and lake levels. Record your notes on your Georgia map with the date. You will need to find at least 2 sources.

Droughts in Georgia

<http://ga.water.usgs.gov/publications/ofr00-380.pdf>

Protecting Georgia's Surface Water

UGA College of Agriculture and Environmental Sciences

<http://pubs.caes.uga.edu/caespubs/pubcd/B1217.htm>

5. What evidence is there of wildlife being affected by Georgia droughts?

Record the information below on the map of Georgia.

Research the Web sites below, and others if time allows, to discover how wildlife is affected during a drought. Record your 2 sources on your Georgia map and add the date of the articles.

Mussel and other aquatic species impacts

http://www.jonesctr.org/research/aquatics_research/final_report.pdf

<http://www.ens-newswire.com/ens/jul2002/2002-07-19-09.asp>

Striped Bass Survival in Lake Blackshear

<http://www.Springerlink.com/content/m5645n4573381g30/>

Georgia Drought Brings Alligators Together

<http://animals.about.com/b/a/256914.htm>

6. What is the population, land size, latitude and longitude of the state of Georgia in the United States compared to the state of New South Wales in Australia?

Record the information below on the map of Georgia or the map of New South Wales.

Research the Web sites below to determine the population, land size, latitude and longitude of Georgia and New South Wales.

For Georgia, New South Wales geographic information see:

<http://www.worldatlas.com/webimage/countrys/namerica/usstates/ga.htm>

7. How has drought affected New South Wales, Australia?

Record the information below on the map of New South Wales.

Research the Web sites below, and others if time allows, to discover how Drought has affected New South Wales. Provide information from at least 3 sources on your New South Wales map. Just take brief notes of the main point in the articles.

Australia drought could impact dairy prices

<http://www.dairyreporter.com/news/nq.asp?id=71475>

Australia drought could be worst in 1,000 years

<http://www.msnbc.msn.com/id/15625626/>

Drought in Australia – Nov 12

<http://www.energybulletin.net/22268.html>

Parched in Australia: Drought changes views on warming

<http://www.iht.com/articles/2006/11/07/news/drought.php>

MWC News – A Site Without Borders – Australia’s battle with drought

<http://mwcnews.net/content/view/11677&Itemid+1>

Drought hits wholesale, retails sectors

<http://www.abc.net.au/news/newsitems/200701/s1823661.htm>

Nationals highlight drought’s impact on regional education

<http://www.abc.net.au/news/newsitems/200701/s1823837.htm>

8. What are the similarities and differences between the effects of the 2006 drought in Georgia and the 2006/07 drought in New South Wales?

Write a paragraph on a separate sheet of paper.

Please list two similarities and two differences. According to your research, do you think the drought in New South Wales is more or less severe than the drought in Georgia?

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**Who Shut Off My Water?
Cause and Effects of Drought
Student/Teacher Checklist**

Student _____

	Total Points
<p>1. Anticipation Guide (At the beginning) No attempt to fill in (2 pts.) A picture of drought and a cause and effect (5 pts.) 5 points total</p>	_____
<p>2. Water cycle diagram (Student Activity Sheet #1) 8 or more water cycle words in the correct places (8 pts.) 5-7 water cycle words (6 pts.) Less than 5 (4 pts.) 8 points total</p>	_____
<p>3. Cause of drought (Student Activity Sheet #1) Student has written an accurate definition of drought (2 pts.) 2 points total</p>	_____
<p>4. Annual Rainfall (Georgia Map) Students have placed all 7 cities in the correct geographic location on the Georgia map. (7pts.) Students have researched and recorded annual rainfall for the 7 cities. (7 pts.) 14 points total</p>	_____
<p>5. Drought Severity (U.S. Map) Students have... colored in the drought severity for Georgia. (2 pts.) used the color legend and colored in the border states' drought severity information. (2 pts.) found a state with moderate drought. (2 pts.) found a state with severe drought. (2 pts.) found a state with exceptional drought. (2 pts.) found a state with agricultural drought. (2 pts.) found a state with hydrological drought. (2 pts.) 14 points total</p>	_____

6. **Drought in Georgia – Effects** (Georgia Map)

Students have researched and recorded the answers to 5 questions on how drought has affected Georgia’s crops, livestock plants and trees, streamflows and lake levels, and wildlife. Each answer included information from at least 2 sources.

Students have listed effects under each question (2 pts.)

Students have provided at least 2 sources for the answers to each question (2 pts.)

20 points total _____

7. **Comparing Georgia and New South Wales**

(Georgia and New South Wales Maps)

Students have...

compared these 2 states in population. (3 pts.)

compared these 2 states in land size. (3 pts.)

compared these 2 states in latitude and longitude. (3 pts.)

9 points total _____

8. **Learning about drought in Australia** (New South Wales Map)

Students have listed effects of drought from at least 3 sources. (2 pts. each)

12 points total _____

9. **Written Comparison Paragraph on Drought** (separate sheet)

Students have written a paragraph comparing the drought in Georgia to the drought in New South Wales that includes 2 similarities and 2 differences.

10 points total _____

10. **Anticipation Guide** (At the end)

3 effects of drought (2 pts. each)

6 points total _____

100 points total

Total points _____

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G.R.A.S.P. Model or Drawing: Creating an Invention to Solve a Drought Related Problem

Goal:

To apply knowledge gained from research through the creation of an invention to solve a drought related problem.

Role:

Your job is to design an invention that can help farmers, wildlife managers, water managers, or homeowners solve a specific drought related problem.

Here are two examples of scientists who created inventions to help solve a drought related problem. Take a look at these websites to help you generate ideas.

Wayne Palmer, a meteorologist, invented *The Palmer Drought Severity Index* in the 1960s. The great thing about it is that it is standardized to the local climate and can be used in any state. The index looks at temperature and rainfall in a formula to determine dryness and has now become the “semi-official drought index.” (NOAA Drought Information Center)

For more information see this Web site: <http://www.drought.noaa.gov/palmer.html>

Max Whisson is the inventor of the Whisson windmill in Australia. He is trying to sell his invention to investors and convince government officials that it will solve drought problems. Max Whisson has created a system that uses the windmill to blow wind into a refrigerator type unit that causes the water to condense. His invention takes water out of the air using energy and wind. Mr. Whisson hopes to provide water to drought-stricken farmers. For more information see this Web site:

<http://www.abc.net.au/canberra/stories/s1837203.htm>

Audience:

Farmers, wildlife managers, water managers, OR homeowners, depending on which drought related problem you choose.

Situation:

Drier than normal conditions over time or at critical growing periods that result in water-related problems are the **cause** of drought. These problems produce a **variety of effects** that occur from water that is not distributed evenly throughout our world. Precipitation (rain or snow) falls in uneven patterns across the country.

The amount of rain and snow also varies with the seasons. In Georgia, for example, most of the yearly precipitation falls during winter, early spring, and in July. Even if the total amount of rainfall for a year is about average, short-term rainfall shortages can occur when moisture is critically needed for plant growth, such as in the early summer for crops like peanuts and cotton. When this happens, the **effect** is agricultural drought and can affect farmers in many ways. Farmers can be affected through crop losses, livestock reductions and, of

course, economic losses that result from reduced crop yields and business services.

When rainfall is less than normal for several weeks, months, or years the **effect** can be hydrological drought. The flow of streams and rivers declines, water levels in lakes and reservoirs fall, and the depth of water in wells decreases. If dry weather persists water supply for human consumption can then become a problem. Drought is a natural hazard that cumulatively has affected more people in North America than any other natural hazard (Riebsame et al, 1991). The cost of losses due to drought in the United States averages \$6-8 billion every year but ranges as high as \$39 billion. The three-year drought of 1987-1989, was the most costly natural disaster documented in U.S. history.

http://www.ncdc.noaa.gov/paleo/drought/drght_history.html

Droughts in Georgia have severely affected municipal and industrial water supplies, agricultural productivity, stream and water quality, recreation at major reservoirs, habitat, hydropower generation, navigation, and forest resources.

<http://ga.water.usgs.gov/edu/qadroughts.html#drought>

Product:

Design a model or drawing of an invention that will help solve a drought related problem. The model must be able to move to demonstrate how it works. The drawing must be larger than an 8 ½ x 11 sheet of paper but no larger than a typical poster board. You will share your invention through a presentation to the class that answers the following questions:

- What is the name of the invention?
- How will this invention help solve a drought related problem?
- How was the model created step by step?
- What group of people/animals will the invention help?
- Where and when will the invention be used?
- How does the invention function to solve a drought effect?

TEACHER – Copy and Distribute to Students

**G.R.A.S.P. Model or Drawing:
Creating an Invention to Solve a Drought Related Problem**

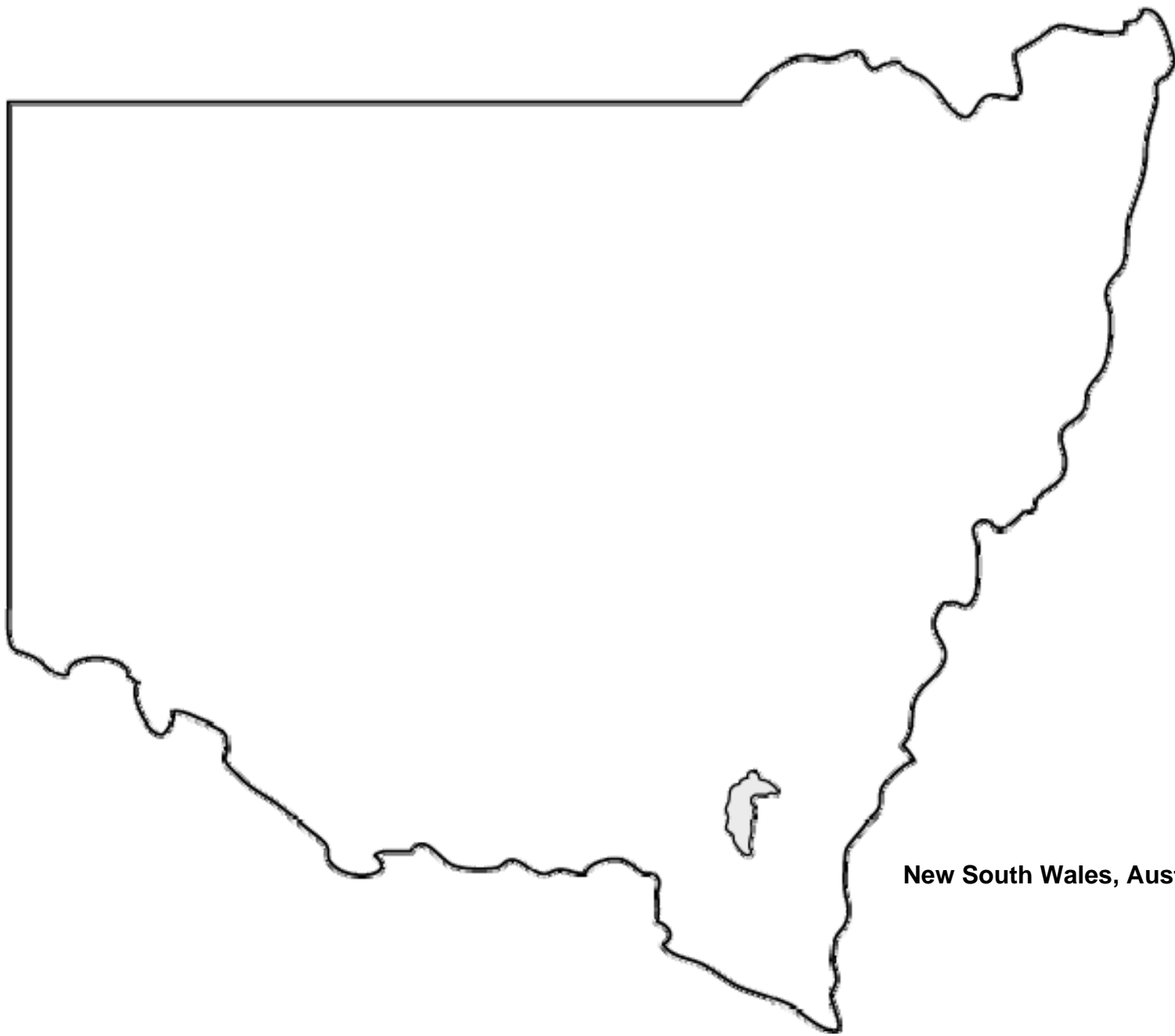
Scoring Rubric

Student Name: _____

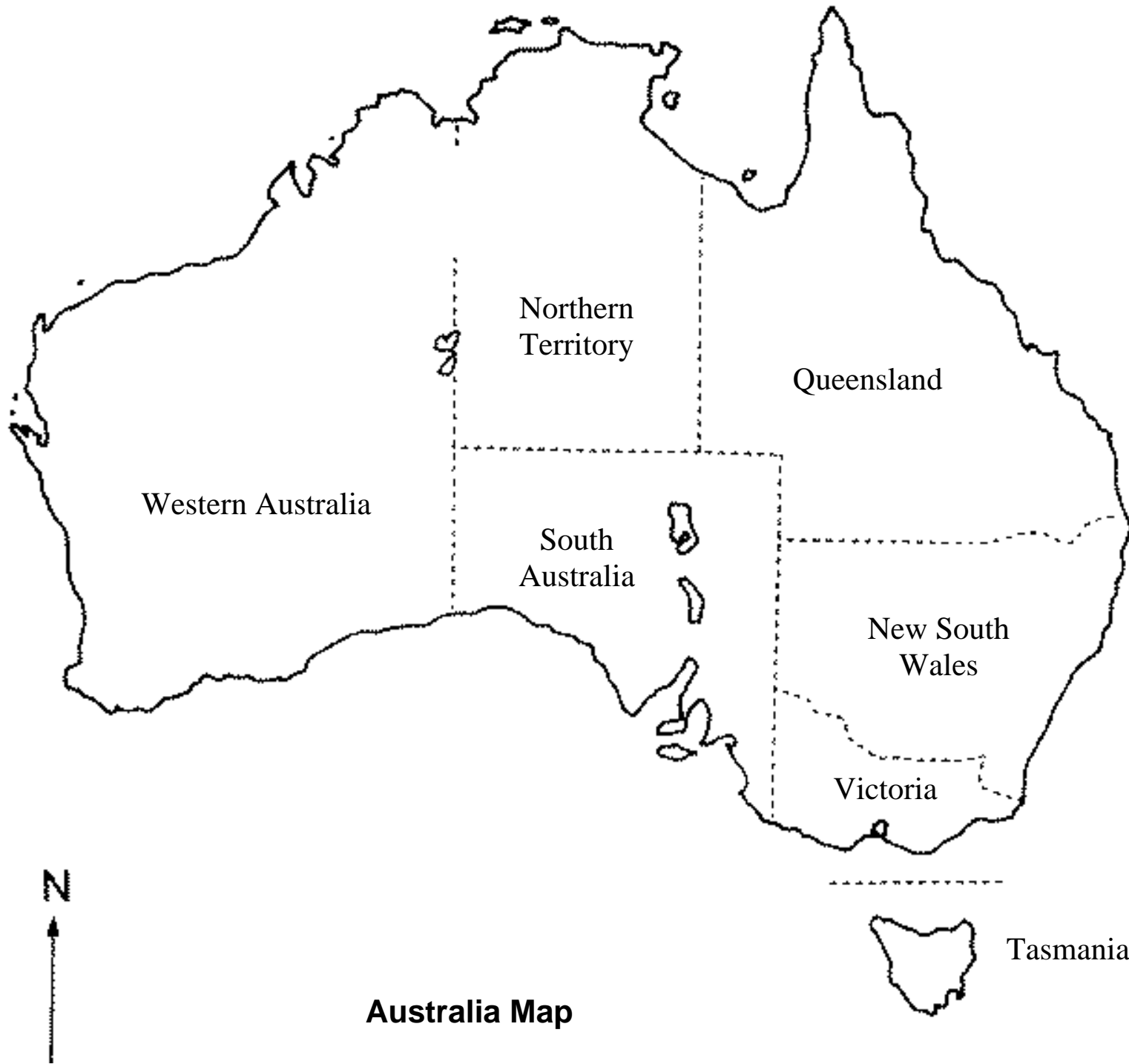
CATEGORY	4	3	2	1
Student will identify one drought related problem in a specific area through research and will create a workable invention to solve this problem using a model or a drawing.	Clearly identifies the drought related problem and has created a workable invention to solve this problem using a model or drawing. Clearly uses research to support the choice of the drought related problem and has created an invention based on research to solve the drought related problem.	Identifies the drought related problem and has created a workable invention to solve the problem using a model or drawing. Uses some research to support the choice of the drought related problem and has created an invention somewhat based on research to solve the drought related problem.	Identifies the drought related problem not based on research and has created an invention to solve the problem using a model or drawing.	Did not identify the drought related problem and the invention did not clearly solve any problem related to drought.
Student will present the invention model or drawing, explaining how this invention will solve the drought related problem, name the invention, explain how the model/drawing was created, identify who or what group of people/animals will benefit from the invention, and how the invention functions.	Presentation is clear, well organized and logical in creating an invention that works to solve a drought related problem and contains 5 out of 5 of the criteria listed.	Presentation is mostly clear, well organized and logical in creating an invention that works to solve a drought related problem and contains 4 out of the 5 criteria listed.	Presentation is somewhat clear, well organized, and logical in creating an invention that works to solve a drought related problem and contains 3 out of the 5 criteria listed.	Presentation is not clear, not well organized, and thoughts are not logical and contains less than 3 of the criteria listed.



Georgia Map



New South Wales, Australia Map



Australia Map

