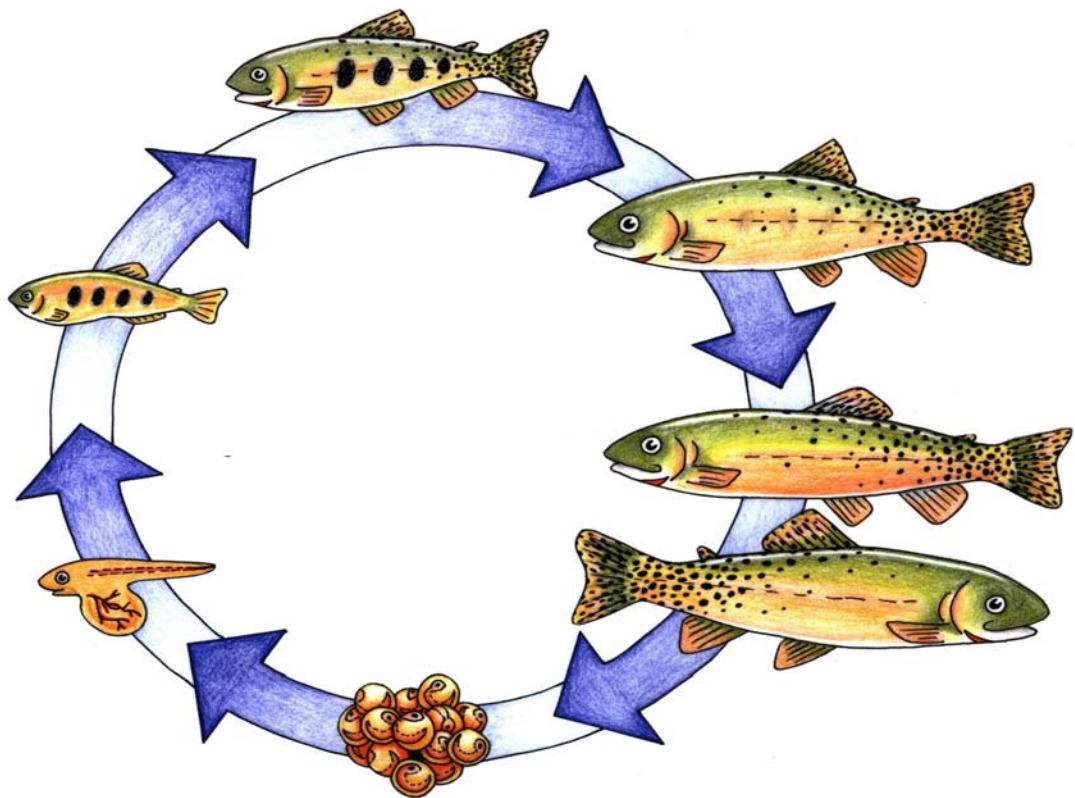


RIO GRANDE CUTTHROAT TROUT CURRICULUM



**Santa Fe National Forest
Southwestern Region
USDA Forest Service**



Acknowledgements

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Introduction

Since 2002, the fisheries program on the Santa Fe National Forest has focused on building relationships between education and conservation efforts. Education empowers local communities and forest users to participate in recovering our native fish through watershed restoration and re-introductions.

In 2002, the Rio Grande Cutthroat Trout Life Cycle Game was created, and has traveled the state making appearances at local water festivals. We never realized just how successful it would be. It began with the creative design of Katrina Lund and grew with the financial support of New Mexico Trout, New Mexico Environment Department, and Environmental Protection Agency.

In 2006, we received a USDA Forest Service Centennial of Service Challenge grant to translate the game board into Spanish and to create a curriculum supporting the game and correlated to standards set by New Mexico State Department of Education. Through the grant, we are able to distribute copies of the curriculum, game board, and life cycle poster to teachers throughout the state.

If you would like to learn more about the fisheries and education program on the Santa Fe National Forest, please visit our Web site at www.fs.fed.us/r3/sfe/fish/index.htm.

¡Viva las truchas nativas!

Kimberly A. Kelly
Education Coordinator
Santa Fe National Forest

Rio Grande Cutthroat Trout Curriculum Teacher Evaluation

1. Name: _____

School: _____

E-mail: _____ Phone: (____) _____

2. Grade(s) Taught: _____

3. Did this program help meet any of the required statewide curriculum standards?

_____ Yes _____ No

4. How close were this program and its associated materials to the appropriate reading and comprehension level for your students?

_____ Very Close _____ Somewhat Close _____ Not Close

If the program was “somewhat close” or “not close” to the appropriate reading and comprehension level, is it:

_____ Too Hard? _____ Too Easy?

5. Would you use this program again in your classroom?

_____ Yes _____ No

Why or why not? _____

6. Please rate the program on a scale of 1 to 5:

	Poor		Average		Excellent
Interactivity	1	2	3	4	5
Visual Materials	1	2	3	4	5
Written Materials	1	2	3	4	5
Activities	1	2	3	4	5

7. Would you recommend the Rio Grande Cutthroat Trout Curriculum to other teachers?

_____ Yes _____ No

Why or why not? (please note any changes you would make) _____

8. What would you like to have added or deleted from the Rio Grande Cutthroat Trout Curriculum?

Please send this evaluation form to:

Santa Fe National Forest
Jemez Ranger District
Education Coordinator
P.O. Box 150
Jemez Springs, NM 87025

Rio Grande Cutthroat Trout

There are 14 distinct cutthroat trout (*Onchorhynchus clarkii*) in western North America. The Rio Grande cutthroat trout (*Onchorhynchus clarkii virginalis*) was first reported in the upper Pecos River by Coronado's expedition in 1541 and was formally described for science in 1857. It lives further south than any of the other cutthroat trout and is native to the Rio Grande, Pecos, and Canadian river drainages. Currently this fish lives in only 7-10 percent of its original occupied habitat.



Figure 1. An adult Rio Grande cutthroat trout.

Rio Grande cutthroat trout are closely related to Yellowstone, Bonneville, Colorado, and greenback cutthroat trout. It evolved as a member of a native fish assemblage that included longnose dace, flathead chub, Rio Grande sucker, and Rio Grande chub. The last two fishes have also suffered greatly from reductions in numbers and occupied habitat.

The Rio Grande cutthroat trout has a distinctive red or orange cutthroat mark beneath the lower jaw (Figure 1). It has light rose to red-orange hues on the sides and pink or yellow-orange colorations ventrally. This trout species also has dark circular spots heavily concentrated on the tail and more sparsely concentrated dorsally. The average size for these fish in their remaining habitat is 6-10 inches, but they can grow much larger if they live in lakes or larger streams. The Rio Grande cutthroat trout diet consists primarily of aquatic invertebrates and terrestrial insects that fall into the water.



Figure 2. Rio Grande cutthroat trout eggs. The white eggs are unfertilized eggs. The dark spots within some of the eggs are the eyes of the developing fish.



Figure 3. Rio Grande cutthroat trout in the alevin stage.

The Rio Grande cutthroat trout requires four types of habitat for survival. For spawning, it needs clean gravel with little or fine sediment present. For rearing, it needs lower water velocity and slightly warmer water temperatures. The adults prefer clear, cold streams and lakes with water temperatures below 60 degrees Fahrenheit. The last habitat required is for overwintering and must include large deep pools that do not freeze in the winter.

The Life Cycle

Rio Grande cutthroat trout have a lifespan of 5-8 years. Males generally mature at 2-3 years of age and females at 3 years of age. Spawning (reproduction) takes place at 4 years of age when the fish are 4-10 inches long. Spawning can occur anytime between March and July, but usually happens from mid-May to mid-June in New Mexico. Spawning depends on factors such as water temperature (optimal temperatures ranging from 42-48 degrees Fahrenheit), runoff from snowmelt (when the stream flow is decreasing during spring runoff), elevation, and latitude.



Figure 4. Rio Grande cutthroat trout in the fry stage, notice the large parr spots on the sides of the fish.

Females build gravel nests in flowing water with high dissolved oxygen levels and lay between 200 and 4,500 eggs (Figure 2) in these nests. The males then fertilize the eggs. The high level of dissolved oxygen flows through the semi-permeable membrane of the egg to the inside of the egg. The yolk sac within the egg provides nutrients to the growing embryo.

Hatching of the eggs takes place within 3-7 weeks with the timing dependent on temperature (colder temperatures resulting in a longer period to hatching). For example, the eggs will hatch after 21 days in 52 degrees Fahrenheit water. Once the egg has hatched, it retains a significant part of the yolk sac attached to the throat region. A fish in this stage is called an alevin (Figure 3), which allows the fish to grow without having to search for food. The fish still lives in the gravels where the eggs were laid. The yolk is fully absorbed after 40 days, at which time the fish becomes a fry.



Figure 5. Photo of a Rio Grande cutthroat trout fingerling.

Once the fish is a fry (Figure 4), it leaves the gravels where it was born and searches for food, usually small aquatic insects, in the streams. Once the fish grows, it becomes a sub-adult, or fingerling (Figure 5), at 4-6 inches long. The fish is considered an adult when it reaches 4-5 inches and the parr marks, which are the larger spots on its sides, begin to fade and the smaller spots are visible.

Threats to Its Survival

Rio Grande cutthroat trout are threatened by habitat destruction, nonnative species, pollution, disruption of water flow in streams, increasing water temperatures, and other factors. In New Mexico, competition with nonnative species like the German brown trout and the rainbow trout affects Rio Grande cutthroat trout populations. The brown trout is very aggressive and out-competes the cutthroat trout for food, habitat, and other resources. Brown trout will also eat smaller Rio Grande cutthroat trout. Brown trout can survive in warmer water temperatures, so when stream water temperatures rise, the brown trout is more adapted to these temperatures than the cutthroat. The rainbow trout, originally from western U.S. coastal streams, is not as aggressive as the brown trout but still causes more competition for food and space, and easily interbreeds with the Rio Grande cutthroat trout.

The Rio Grande cutthroat trout is part of a native fish assemblage for coldwater streams in Northern New Mexico. This assemblage also includes Rio Grande sucker (*Catostomus plebeius*), Rio Grande chub (*Gila pandora*), and longnose dace (*Rhinichthys cataractae*).

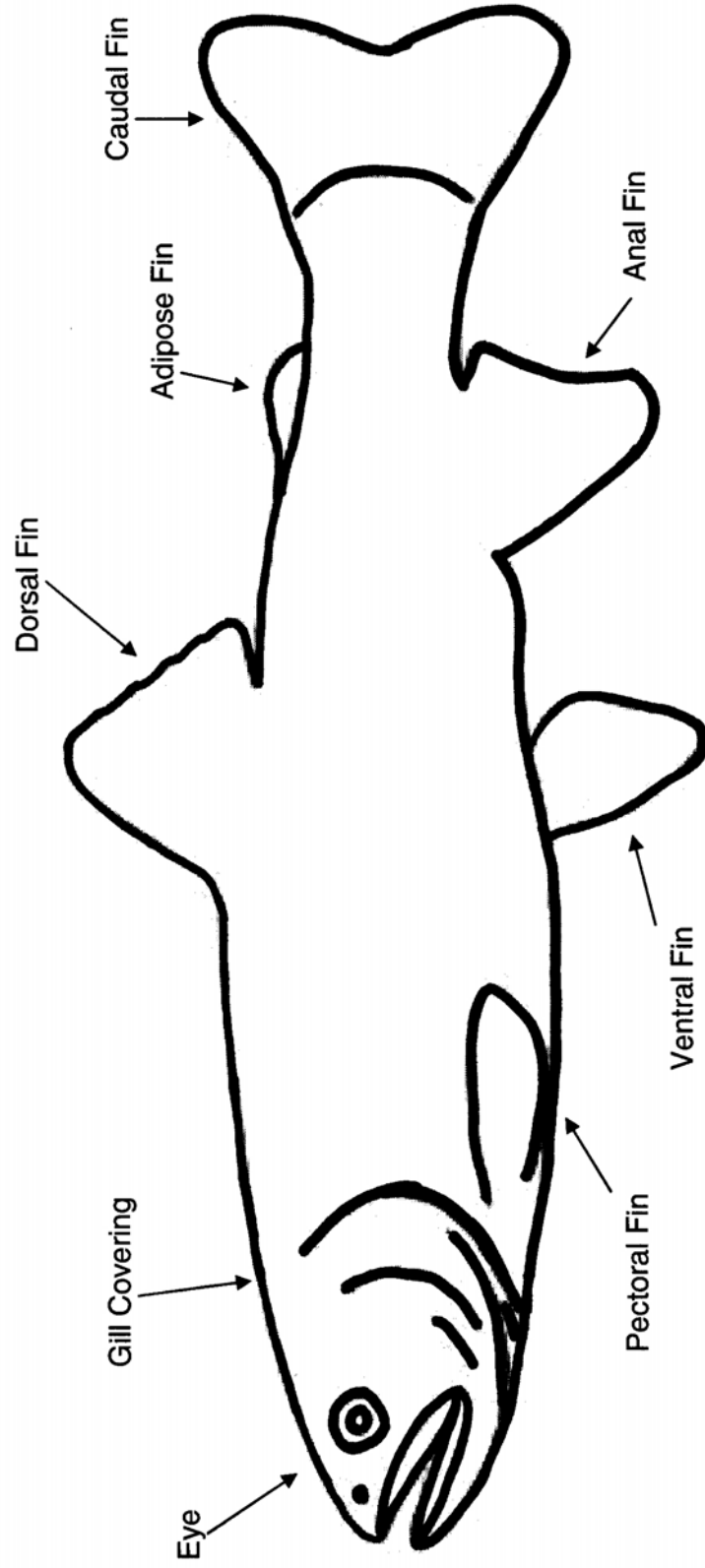
The Rio Grande cutthroat trout and Rio Grande chub are listed as a sensitive species by the U.S. Forest Service Southwestern Region. The Rio Grande sucker is proposed for listing as sensitive species by the USFS Southwestern Region.

Rio Grande Cutthroat Trout Art

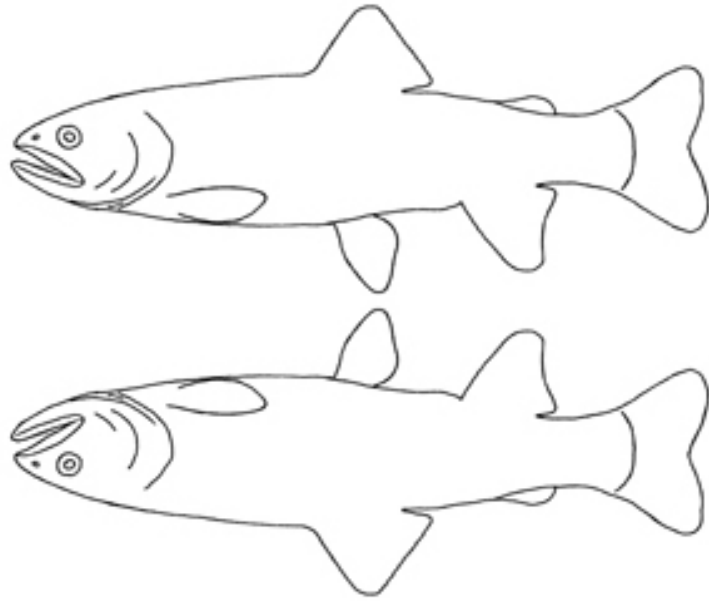
Grade Level	Grades 4-6
Goal	Students will learn the basic parts of a fish and what the State Fish of New Mexico looks like.
Strand Benchmark Performance Standards	<p><u>Grade 4 - Arts</u> Content Standard I: Learn and develop the essential skills and technical demands unique to dance, music, theatre/drama, and visual arts. K-4 Benchmark: Visual Arts, A. Participate in the process of making art to understand the elements of art: line, shape, form, color, and texture. 1. Identify and/or make art using different materials (such as watercolor, tempera, clay, etc.).</p> <p><u>Grade 5-6 - Arts</u> Content Standard I: Learn and develop the essential skills and technical demands unique to dance, music, theatre/drama, and visual arts. 5-8 Benchmark: Visual Arts, A. Explore art materials, techniques, qualities, characteristics, and processes; understand what makes them effective in solving specific art problems and how they are used to enhance life experiences and ideas. 1. Engage in problem-solving activities that apply the principles of art to the elements of art.</p>
Suggested Materials	<ul style="list-style-type: none"> ○ Copies of “External Anatomy of a Rio Grande Cutthroat Trout” (one for each student) ○ Copies of “Rio Grande Cutthroat Trout Art” (cut sheet in half, give each student half a sheet) ○ Crayons, markers, or colored pencils ○ Scissors ○ Glue
Teacher/Student Preparation Required	Print copies of “External Anatomy of a Rio Grande Cutthroat Trout” and “Rio Grande Cutthroat Trout Art.”
Length of Lesson	20-30 minutes
Activity	<ol style="list-style-type: none"> 1. Have students look up photos of Rio Grande cutthroat trout or use the photos provided in this curriculum. 2. Hand out copies of “External Anatomy of a Rio Grande Cutthroat Trout” and “Rio Grande Cutthroat Trout Art.” 3. Have students decorate the fish on both sheets with crayons,

	<p>markers, or colored pencils.</p> <p>4. Have students cut out both halves of the Rio Grande cutthroat trout from the “Rio Grande Cutthroat Trout Art” (the half sheet of paper).</p> <p>5. The students will then glue the bodies of the halves together (do not glue the ventral fins together).</p> <p>6. The students can bend the ventral fins out to allow their fish to “stand” upright.</p>
Resources	<p>Rio Grande cutthroat trout</p> <p>http://www.fs.fed.us/r3/sfe/fish/rgcutthroat.htm</p> <p>http://www.wildlife.state.nm.us/recreation/fishing/cold_water_fish.htm</p>
Alternatives/Extensions	<p>1. Students can use the “Rio Grande Cutthroat Trout Art” as their game piece for the Rio Grande Cutthroat Trout Life Cycle Game.</p>

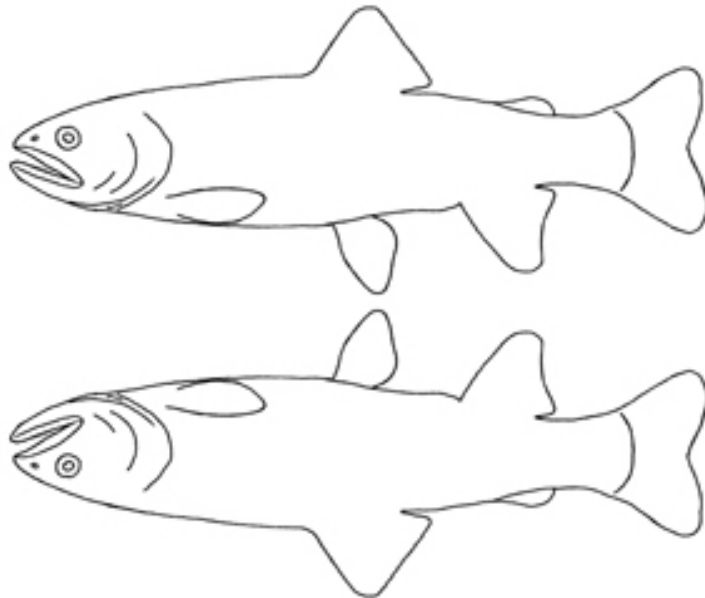
External Anatomy of a Rio Grande Cutthroat Trout



Rio Grande Cutthroat Trout Art



Rio Grande Cutthroat Trout Art



Rio Grande Cutthroat Trout Zip Game

Grade Level	Grades 4-5
Goal	Students will learn about New Mexico's State Fish: the Rio Grande cutthroat trout. They will learn about its life cycle, where it lives, and what its threats are.
Strand Benchmark Performance Standards	<p><u>Grade 4 - Science</u> Strand II Content of Science, Standard II (Life Science): Understand the properties, structures, and processes of living things and the interdependence of living things and their environments. K-4 Benchmark II: Know that living things have similarities and differences and that living things change over time. Performance Standard 1: Know that in any particular environment some kinds of plants and animals survive well, some survive less well, and others cannot survive at all.</p> <p><u>Grade 5 - Science</u> Strand II Content of Science, Standard II (Life Science): Understand the properties, structures, and processes of living things and the interdependence of living things and their environments. 5-8 Benchmark I: Explain the diverse structures and functions of living things and the complex relationships between living things and their environments. Performance Standard 4: Describe how human activity impacts the environment. 5-8 Benchmark II: Understand how traits are passed from one generation to the next and how species evolve. Performance Standard 1: Know that plants and animals have life cycles that include birth, growth and development, reproduction, and death and that these cycles differ for different organisms.</p>
Suggested Materials	<ul style="list-style-type: none"> ○ Cheat Sheet for Rio Grande Cutthroat Trout Zip Game ○ Question and Answer Slips for Rio Grande Cutthroat Trout Zip Game
Teacher Preparation Required	Print slips for Rio Grande Cutthroat Trout Zip Game double-sided. Cut questions/answers apart.
Length of Lesson	20-30 minutes

Activity	<ol style="list-style-type: none"> 1. Keep the slip of paper with the first question for yourself. (This is marked by “FIRST QUESTION: ____”) 2. Pass the rest of the slips of questions and answers out to each student. If you have extra slips, keep passing them out until they are gone. If you have more students than slips, pair up students with a slip. 3. Have the students flip their slips of paper over to the white side with the answers on them. (This is marked by “ANSWER: _____”) 4. Read the first question. 5. Ask the students to look at their answers and have the student whose answer matches the question read it out loud. 6. That student then flips his/her slip over to read the question on the other side. 7. Repeat steps 5 and 6 until it ends with you giving the final answer. <p>HINT: You may use the cheat sheet to help the students figure out the answers if they are having problems.</p>
Resources	<p>Whirling Disease http://www.wildlife.state.nm.us/conservation/disease/index.htm http://www.whirling-disease.org http://whirlingdisease.montana.edu</p>
Alternatives/Extensions	None

Cheat Sheet for Rio Grande Cutthroat Trout Zip Game

What is New Mexico's official State Fish?

The Rio Grande cutthroat trout was adopted in 1955 as New Mexico's State Fish.

What is a common characteristic of all cutthroat trout?

Cutthroat trout have characteristic reddish-orange slashes in folds on either side of its lower jaw.

Where do Rio Grande cutthroat trout live?

Rio Grande cutthroat trout live in streams with gravel bottoms and cold, clear, flowing water on the Santa Fe and Carson National Forests. They can also live in high mountain cold water lakes. Some streams would include Rio Cebolla, Chama River, and Rio Costilla.

The current range of Rio Grande cutthroat trout is what percent of its historical range?

The current range of Rio Grande cutthroat trout is less than 7 – 10 percent of its historical range.

What are some reasons for the decline of Rio Grande cutthroat trout?

Rio Grande cutthroat trout are declining because of introduction of nonnatives and habitat loss.

What does nonnative mean?

Nonnative means that an organism did not historically occur here. It was brought here by people.

What are the only two trout native to New Mexico?

The Rio Grande cutthroat trout and the Gila trout are the only two trout native to New Mexico.

What are two popular nonnative trout that threaten current Rio Grande cutthroat trout populations?

Brown trout and rainbow trout are two nonnative trout that threaten Rio Grande cutthroat trout populations. Brown trout, which were brought to the U.S. from northern Europe and the British Isles, eats and out-competes Rio Grande cutthroat trout for food and habitat. The rainbow trout came from western U.S. coastal streams and competes for food and hybridizes with cutthroat.

What are a few things that cause habitat loss for the Rio Grande cutthroat trout?

Rio Grande cutthroat trout lose habitat from poor logging methods, overgrazing by livestock, loss of vegetation along streams, increased water temperatures, trampled streambanks, poor location of roads, and poor recreation behavior of people, such as driving through streams and camping too close to the streams.

What do Rio Grande cutthroat trout eat?

Terrestrial insects and immature aquatic insects account for most of Rio Grande cutthroat trout's summer diet, until the caddis flies hatch (their favorite food). They also eat mayflies, stoneflies, zooplankton, and crustaceans.

How do fish start out their lives?

Fish start their lives as eggs.

How are fish eggs different than bird eggs?

Fish eggs are soft and squishy, not hard like bird eggs. Fish eggs must remain in water.

How many eggs can a female Rio Grande cutthroat trout produce?

A female Rio Grande cutthroat trout can produce 200 to 4,500 eggs. Each egg is about the size of a green pea.

Where do female Rio Grande cutthroat trout lay their eggs?

Rio Grande cutthroat trout lay their eggs on a gravel nest, called a redd, in flowing water where high levels of dissolved oxygen exist – a requirement of developing embryos. The spaces in between the gravel offer shelter.

After hatching from the egg, what life cycle stage is the Rio Grande cutthroat trout in?

When Rio Grande cutthroat trout hatch from the egg, they are called alevins (al-uh-vins). This funny looking stage is about the size of a paperclip.

What is the bubble or bulge attached to the alevin's throat region?

The weird bulge attached to the alevin's throat region is actually the yolk sac – it's like a feed bag. As it develops, the alevin absorbs nutrients from the yolk sac.

Once the alevin absorbs the yolk sac, what life cycle stage is next?

After the alevin life stage (about 30-35 days), a Rio Grande cutthroat trout becomes a fry. It has absorbed the yolk sac and looks like a fish about the length of a crayon. Fry have large vertical spots, called parr marks, on their sides.

A Rio Grande cutthroat trout fry becomes what life cycle stage?

As the fry continues to grow it becomes a sub-adult (fingerling), which is the length of a pencil. It also starts to show spotting on the dorsal and tail region, which is more typical of an adult fish.

At what life cycle stage do Rio Grande cutthroat trout start to lose their large parr marks on their sides?

Rio Grande cutthroat trout start to lose their large parr marks when they reach the adult stage. The fish are about 4-5 inches in length.

What is the last life cycle stage of Rio Grande cutthroat trout?

A spawning adult is the last life cycle stage of Rio Grande cutthroat trout.

What does spawning mean?

Spawning means that Rio Grande cutthroat trout are mature enough to mate and produce young.

How many years does it take for a Rio Grande cutthroat trout to mature enough to spawn?

It takes 3-4 years for a female Rio Grande cutthroat trout to mature enough to spawn. It takes 2 years for a male Rio Grande cutthroat trout to mature.

What months of the year do Rio Grande cutthroat trout typically spawn?

Rio Grande cutthroat trout typically spawn between March and July.

What triggers spawning?

Spawning is believed to be triggered as flows peak from snowmelt. These types of flows along with the cold melt water trigger Rio Grande cutthroat trout to spawn.

How large can Rio Grande cutthroat trout grow?

Rio Grande cutthroat trout can grow to 16 inches, sometimes over 20 inches.

What is whirling disease?

Whirling disease is caused by a parasite that attacks the spinal cartilage of trout and salmon.

How does whirling disease affect Rio Grande cutthroat trout?

In developing young fish, the whirling disease parasite affects their ability to swim as their equilibrium or balance goes wrong. This is where the whirling disease comes into play as young fish will swim in circles, unable to eat. Eventually this cycle starves the fish and causes death.

Is whirling disease found in the Santa Fe National Forest?

On the Santa Fe National Forest, whirling disease has been found in Rio Cebolla, Jack's Creek, and Pecos River.

How can people prevent the spread of whirling disease?

Visitors can prevent the spread of whirling disease by cleaning and drying all gear before entering a new stream. After leaving a stream, clean gear with biodegradable detergent 300 feet from water's edge. Moving live infected fish, or parts of dead infected fish, is probably the biggest source of contamination. Anglers should never move live fish and properly dispose of fish entrails and skeletons in trash receptacles on land rather than throwing fish parts into the water.

What are some things we can do to help Rio Grande cutthroat trout?

Some things we can do to help Rio Grande cutthroat trout include protecting their habitat by not driving vehicles or ATVs through streams, observing fishing regulations, not building rock dams or other barriers in streams, conserving water, and respecting the rio.

FIRST QUESTION: What is New Mexico's official State Fish?

QUESTION: What is a common characteristic of all cutthroat trout?

QUESTION: Where do Rio Grande cutthroat trout live?

QUESTION: The current range of Rio Grande cutthroat trout is what percent of its historical range?

QUESTION: What are some reasons for the decline of Rio Grande cutthroat trout?

ANSWER: Some things we can do to help Rio Grande cutthroat trout include protecting their habitat by not driving vehicles or ATVs through streams, observing fishing regulations, not building rock dams or other barriers in streams, conserving water, and respecting the rio.

ANSWER: The Rio Grande cutthroat trout was adopted in 1955 as New Mexico's State Fish.

ANSWER: Cutthroat trout have characteristic reddish-orange slashes in folds on either side of its lower jaw.

ANSWER: Rio Grande cutthroat trout live in streams with gravel bottoms and cold, clear, flowing water on the Santa Fe and Carson National Forests. They can also live in high mountain cold water lakes. Some streams would include Rio Cebolla, Chama River, and Rio Costilla.

ANSWER: Rio Grande cutthroat trout currently reside in less than 7 – 10 percent of its historical range.

QUESTION: What does nonnative mean?

QUESTION: What are the only two trout native to New Mexico?

QUESTION: What are two popular nonnative trout that threaten current Rio Grande cutthroat trout populations?

QUESTION: What are a few things that cause habitat loss for the Rio Grande cutthroat trout?

QUESTION: What do Rio Grande cutthroat trout eat?

ANSWER: Rio Grande cutthroat trout are declining because of introduction of nonnatives and habitat loss.

ANSWER: Nonnative means that an organism did not historically occur here. It was brought here by people.

ANSWER: The Rio Grande cutthroat trout and the Gila trout are the only two trout native to New Mexico.

ANSWER: Brown trout and rainbow trout are two nonnative trout that threaten Rio Grande cutthroat trout populations. Brown trout, which were brought to the U.S. from northern Europe and the British Isles but, eats and out-competes Rio Grande cutthroat trout for food and habitat. The rainbow trout came from western U.S. coastal streams and competes for food and hybridizes with cutthroat.

ANSWER: Rio Grande cutthroat trout lose habitat from poor logging methods, overgrazing by livestock, loss of vegetation along streams, increased water temperatures, trampled streambanks, poor locations of roads, and poor recreation behavior of people, such as driving through streams and camping too close to the streams.

QUESTION: How do fish start out their lives?

QUESTION: How are fish eggs different than bird eggs?

QUESTION: How many eggs can a female Rio Grande cutthroat trout produce?

QUESTION: Where do female Rio Grande cutthroat trout lay their eggs?

QUESTION: After hatching from the egg, what life cycle stage is the Rio Grande cutthroat trout in?

ANSWER: Terrestrial insects and immature aquatic insects account for most of Rio Grande cutthroat trout's summer diet, until the caddis flies hatch (their favorite food). They also eat mayflies, stoneflies, zooplankton, and crustaceans.

ANSWER: Fish start their lives as eggs.

ANSWER: Fish eggs are soft and squishy, not hard like bird eggs. Fish eggs must remain in water.

ANSWER: A female Rio Grande cutthroat trout can produce 200 to 4,500 eggs. Each egg is about the size of a green pea.

ANSWER: Rio Grande cutthroat trout lay their eggs on a gravel nest, called a redd, in flowing water where high levels of dissolved oxygen exist – a requirement of developing embryos. The spaces in between the gravel offer shelter.

QUESTION: What is the bubble or bulge attached to the alevin's throat region?

QUESTION: Once the alevin absorbs the yolk sac, what life cycle stage is next?

QUESTION: A Rio Grande cutthroat trout fry becomes what life cycle stage?

QUESTION: At what life cycle stage do Rio Grande cutthroat trout start to lose their large parr marks on their sides?

QUESTION: What is the last life cycle stage of Rio Grande cutthroat trout?

ANSWER: When Rio Grande cutthroat trout hatch from the egg, they are called alevins (al-uh-vins). This funny looking stage is about the size of a paperclip.

ANSWER: The weird bulge attached to the alevin's (al-uh-vins) throat region is actually the yolk sac – it's like a feed bag. As it develops, the alevin absorbs nutrients from the yolk sac.

ANSWER: After the alevin (al-uh-vin) life stage (about 40 days), a Rio Grande cutthroat trout becomes a fry. It has absorbed the yolk sac and looks like a fish about the length of a crayon. Fry have large vertical spots, called parr marks, on their sides.

ANSWER: As the fry continues to grow it becomes a sub-adult (fingerling), which is the length of a pencil.

ANSWER: Rio Grande cutthroat trout start to lose their large parr marks when they reach the adult stage. The fish are about 4-5 inches in length.

QUESTION: What does spawning mean?

QUESTION: How many years does it take for a Rio Grande cutthroat trout to mature enough to spawn?

QUESTION: What months of the year do Rio Grande cutthroat trout typically spawn?

QUESTION: What triggers spawning?

QUESTION: How large can Rio Grande cutthroat trout grow?

ANSWER: A spawning adult is the last life cycle stage of Rio Grande cutthroat trout.

ANSWER: Spawning means that Rio Grande cutthroat trout are mature enough to mate and produce young.

ANSWER: It takes 3-4 years for a female Rio Grande cutthroat trout to mature enough to spawn. It takes 2 years for a male Rio Grande cutthroat trout to mature.

ANSWER: Rio Grande cutthroat trout typically spawn between March and July.

ANSWER: Spawning is believed to be triggered as flows peak from snowmelt. These types of flows along with the cold melt water trigger Rio Grande cutthroat trout to spawn.

QUESTION: What is whirling disease?

QUESTION: How does whirling disease affect Rio Grande cutthroat trout?

QUESTION: Is whirling disease found in the Santa Fe National Forest?

QUESTION: How can people prevent the spread of whirling disease?

QUESTION: What are some things we can do to help Rio Grande cutthroat trout?

ANSWER: Rio Grande cutthroat trout can grow to 16 inches, sometimes over 20 inches.

ANSWER: Whirling disease is caused by a parasite that attacks the spinal cartilage of trout and salmon.

ANSWER: In developing young fish, the whirling disease parasite affects their ability to swim as their equilibrium or balance goes wrong. This is where the whirling disease comes into play as young fish will swim in circles, unable to eat. Eventually this cycle starves the fish and causes death.

ANSWER: On the Santa Fe National Forest, whirling disease has been found in Rio Cebolla, Jack's Creek, and Pecos River.

ANSWER: Visitors can prevent the spread of whirling disease by cleaning and drying all gear before entering a new stream. Moving live infected fish, or parts of dead infected fish, is probably the biggest source of contamination. Anglers properly dispose of fish entrails and skeletons in trash receptacles on land rather than throwing fish parts into the water.

Rio Grande Cutthroat Trout Life Cycle Game

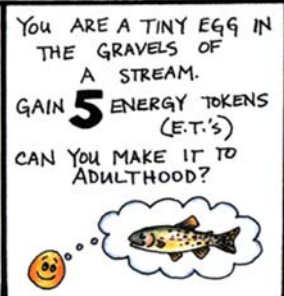

Grade Level	Grades 4-6
Goal	Students will learn about New Mexico's State Fish: the Rio Grande cutthroat trout. They will learn about its life cycle and obstacles it faces throughout its life.
Strand Benchmark Performance Standards	<p><u>Grade 4 - Science</u> Strand II Content of Science, Standard II (Life Science): Understand the properties, structures, and processes of living things and the interdependence of living things and their environments.</p> <p>K-4 Benchmark I: Know that living things have diverse forms, structures, functions, and habitats. Performance Standard 4: Describe the components of and relationships among organisms in a food chain (e.g. plants are the primary source of energy for living systems).</p> <p>K-4 Benchmark II: Know that living things have similarities and differences and that living things change over time. Performance Standard 1: Know that in any particular environment some kinds of plants and animals survive well, some survive less well, and others cannot survive at all.</p> <p>Strand III Science and Society, Standard I: Understand how scientific discoveries, inventions, practices, and knowledge influence, and are influenced by, individuals and societies. K-4 Benchmark I: Describe how science influences decisions made by individuals and societies. Performance Standard 1: Know that science has identified substances called pollutants that get into the environment and can be harmful to living things.</p> <p><u>Grade 5 - Science</u> Strand II Content of Science, Standard II (Life Science): Understand the properties, structures, and processes of living things and the interdependence of living things and their environments.</p> <p>5-8 Benchmark I: Explain the diverse structures and functions of living things and the complex relationships between living things and their environments. Performance Standard 3: Know that changes in the environment can have different effects on different</p>





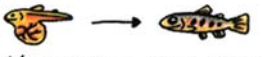
	<p>organisms (e.g., some organisms move, some survive, some reproduce, some die).</p> <p>Performance Standard 4: Describe how human activity impacts the environment.</p> <p>5-8 Benchmark II: Understand how traits are passed from one generation to the next and how species evolve.</p> <p>Performance Standard 1: Know that plants and animals have life cycles that include birth, growth and development, reproduction, and death and that these cycles differ for different organisms.</p> <p><u>Grade 6 - Science</u></p> <p>Strand II Content of Science, Standard II (Life Science): Understand the properties, structures, and processes of living things and the interdependence of living things and their environments.</p> <p>5-8 Benchmark I: Explain the diverse structures and functions of living things and the complex relationships between living things and their environments.</p> <p>Performance Standard 1: Understand how organisms interact with their physical environments to meet their needs (i.e., food, water, air) and how the water cycle is essential to most living systems.</p> <p>Performance Standard 2: Describe how weather and geologic events (e.g. volcanoes, earthquakes) affect the function of living systems.</p> <p>Performance Standard 3: Describe how organisms have adapted to various environmental conditions.</p>
Suggested Materials	<ul style="list-style-type: none"> ○ Game board ○ Dice ○ Energy tokens (about 100 per game board) ○ Game piece (one for each player, can be a piece of paper with the student’s name or a small item the student chooses to represent his/her place on the game board – OR – can use the student’s creation from the Rio Grande Cutthroat Trout Art activity) ○ Life cycle poster
Teacher Preparation Required	Read “Explanations to Squares on the Rio Grande Cutthroat Trout Life Cycle Game Board.”
Length of Lesson	30 minutes
Activity	1. The Rio Grande Cutthroat Trout Zip Game is a good introduction to the fish and its life cycle stages. If you chose not to use it, you should briefly go over the different





	<p>stages of a Rio Grande cutthroat trout’s life cycle, using the poster as a visual aid, before playing the game.</p> <ol style="list-style-type: none"> 2. Each player places his/her game piece on the square next to “start.” 3. One player rolls the dice and moves his/her game piece the number of squares indicated on the dice. 4. The player then reads the square out loud. He/she has several consequences—gains energy tokens, loses energy tokens, loses a turn, rolls again, or has to start over. (Note: if someone loses all of his/her energy tokens, he/she starts over.) 5. The person on the player’s left rolls the dice next. 6. The game can be set up to be played until someone wins or can be set up with a time limit (everyone keeps playing, winners just start over at their next turn, until time is up). 7. To wrap up the game, ask the students the following questions. <ol style="list-style-type: none"> a. Was it easy growing up as a Rio Grande cutthroat trout? b. How many of you lost all of your energy tokens at some point in the game? Were eaten by a brown trout? Were caught by a fisherman? c. What obstacles made it difficult for you? What can we do about those obstacles? d. What were some natural events that helped the Rio Grande cutthroat trout along the way? e. What can we do to help our state fish, the Rio Grande cutthroat trout?
<p>Alternatives/Extensions</p>	<ol style="list-style-type: none"> 1. Have the students hold onto their energy tokens at the end of the game. Tell them to flip the tokens over to the side that says food, water, shelter, space, or “?”. Ask the students how many of them had at least one food, one water, one shelter, AND one space. This ties back to all animals needing those four basic requirements to survive. What about the question marks? Those could be related to things like trash in the environment. Can animals live with some trash? Yes, they could. They (and us) may not like it, but they could survive depending on the type of trash (let’s say a plastic cup in a stream). But as the trash builds up (a player with lots of energy tokens with “?”s), it becomes more difficult for fish and other animals to survive.



Explanations to Squares on the Rio Grande Cutthroat Trout Life Cycle Game Board





Between May and the middle of June, the Rio Grande cutthroat trout spawn. The female chooses sections of flowing water where high levels of dissolved oxygen exist, a requirement of developing embryos, and where the gravels range from 1 to 4 inches in diameter. The female creates a redd by forming a depression in the gravels. She then lays her eggs, the male fertilizes them, and then the female covers the eggs with the gravels. This gives an extra source of protection for the fragile eggs.


 <p>YOU ARE A TINY EGG IN THE GRAVELS OF A STREAM. GAIN 5 ENERGY TOKENS (E.T.'s) CAN YOU MAKE IT TO ADULTHOOD?</p>	<p>Each player places his/her game piece on this square to start the game. At this point, everyone is an egg. Each player also starts with five energy tokens (E.T.'s). The energy tokens represent the four basic requirements all organisms need to survive: food, water, shelter, and space. Space can represent air, or in the case of fish, dissolved oxygen. Space can also represent the physical amount of space. For example, give the players the following scenario. Have them think of all of their family (aunts, uncles, cousins, etc.) and friends. Then have them imagine all those people living with them in their room, sharing their bed, their clothes, their food, etc. Then ask them how important space is. The same principle applies for animals. Some animals need lots of space to survive, while some don't need very much. During the course of the game, if a player ever loses all of their energy tokens, they "die," but to keep the game going the player may start over. Whenever a player starts over, they always start on this square with five energy tokens.</p>
 <p>WATER FLOWS THROUGH YOUR GRAVELS TO GIVE YOU FRESH AIR AND FOOD. GAIN 2 E.T.'s</p>	<p>As the water flows through the gravels, the semi-permeable membrane of the egg allows dissolved oxygen to pass through. The fish gets its nutrients from the yolk inside the egg.</p> <p>The player earns 2 energy tokens.</p>

<p>EROSION! PEOPLE DRIVE RIGHT THROUGH YOUR STREAM. THE DIRT CLOGS YOUR GRAVELS AND YOU ALMOST CHOKE! LOSE 2 E.T.'S</p> 	<p>When people drive through the streams, they don't realize they are crushing the gravels, stirring up the sediments, breaking down streambanks, and contributing to soil erosion. Tires can damage or kill eggs, tiny fish, insects, and other aquatic organisms living in the stream. Forest visitors should not drive through streams and should stay on designated forest roads.</p> <p>The player loses 2 energy tokens.</p>
 <p>A BIG SNOWPACK IN THE MOUNTAINS MAKES STREAMS FLOW WITH LOTS OF WATER. GAIN 2 E.T.'S</p>	<p>Lots of snow in the winter means lots of water in the springtime. As temperatures warm during the spring, the snow melts. Some of the water ends up in a stream and some soaks into the ground to help recharge ground water and springs. In addition, this cool snowmelt helps keep stream temperatures low for aquatic organisms.</p> <p>The player earns 2 energy tokens.</p>
<p>YOU'VE HATCHED FROM YOUR EGG!</p>  <p>YOU ARE NOW A VERY SMALL ALEVIN AND YOU CARRY A YOLK SAC. GAIN 2 E.T.'S</p>	<p>When the Rio Grande cutthroat trout hatches from the egg, it retains a significant portion of the yolk attached to the throat region. This yolk sac allows the alevin to grow a fair amount without having to search for food (the nutrients come from the yolk sac). By the time the yolk is fully absorbed (about 40 days after hatching), the fish becomes a fry.</p> <p>The player earns 2 energy tokens.</p>
<p>OH NO! A 4-WHEELER DRIVES UP THE STREAM AND CRUSHES THE GRAVELS. YOU ALMOST DIE! LOSE 1 TURN</p> 	<p>When people drive 4-wheelers, motorcycles, and other vehicles through the streams, they don't realize they are crushing the gravels, stirring up the sediments, breaking down streambanks, and contributing to soil erosion. Tires can damage or kill eggs, tiny fish, insects, and other aquatic organisms living in the stream. Forest visitors should not drive through streams and should stay on designated forest roads.</p> <p>The player must sit out his/her next turn.</p>
<p>"BUTTON UP!"</p>  <p>YOU ABSORB YOUR YOLK SAC AND GROW BIGGER. YOU LEAVE YOUR GRAVELS. NOW YOU ARE A FRY. GAIN 3 E.T.'S</p>	<p>With the yolk sac absorbed, the Rio Grande cutthroat trout is now a fry. At this stage in the life cycle, the trout is now big enough to leave the gravels to search for food, typically small invertebrates (insects).</p> <p>The player earns 3 energy tokens.</p>

 <p>LIFE CAN BE SCARY IN THE STREAM. THE CURRENT IS SWIFT AND YOU GET SWEEP DOWN-STREAM. LOSE 3 E.T.'S</p>	<p>Water flow in a stream can be affected by several factors. Those factors increasing water flow include spring runoff from melting snow and rainfall. New Mexico summer monsoons can generate increased water flows in a small amount of time.</p> <p>The player loses 3 energy tokens.</p>
<p>A KID LEAVES THE FAUCET RUNNING AT HIS HOUSE. HE'S WASTING YOUR WATER!</p>  <p>LOSE 2 E.T.'S</p>	<p>Water conservation is very important in the arid southwest. We must all do our part to conserve water.</p> <p>Water from high mountain streams and other above ground sources slowly works its way down through the soil and into the ground water. Ground water is where much of New Mexico's population gets their drinking water. The process to recharge, or fill, ground water is very slow; therefore, we must conserve what we use.</p> <p>The player loses 2 energy tokens.</p>
<p>A BROWN TROUT IS HUNGRY.</p>  <p>HE EATS YOU FOR BREAKFAST. TOO BAD! - START OVER -</p>	<p>The nonnative brown trout is very aggressive compared to the Rio Grande cutthroat trout. Not only can the brown trout out-compete the cutthroat for food, habitat, and other resources, but it can also survive in warmer water temperatures and will often prey on other fish species.</p> <p>The player must return to the start and follow the direction for the first square. (Basically, any tokens over five must be turned in. If the player has less than five, he/she can acquire enough tokens to add up to five.)</p>
<p>YOU'VE GROWN SO MUCH!</p>  <p>YOU ARE NOW A SUB-ADULT FISH. - ROLL AGAIN -</p>	<p>In this next stage of the Rio Grande cutthroat trout life cycle, the trout can grow to a size of 6 inches.</p> <p>The player gets to roll the dice again.</p>

<p>A RAINBOW TROUT EATS ALL YOUR FOOD. YOU HAVE NOTHING TO EAT. LOSE 2 E.T.'S</p> 	<p>The nonnative rainbow trout originally came from western U.S. coastal streams. While the rainbow trout is not as aggressive as the brown trout, it still competes with the Rio Grande cutthroat trout for food. Additionally, it will spawn with Rio Grande cutthroat trout and wipe out its gene pool.</p> <p>The player loses 2 energy tokens.</p>
<p>LOGS CREATE FISH HABITAT. A TREE FALLS IN AND GIVES YOU A HOME.</p>  <p>GAIN 3 E.T.'S</p>	<p>When a tree falls into the stream, it creates a new habitat for fish and other aquatic organisms. In addition, the organisms that help decompose the log can also become food for the trout. As the water flows over and around the log, a pool can form, creating even more fish habitat.</p> <p>The player earns 3 energy tokens.</p>
<p>SOMEONE DUMPS THEIR CAR OIL DOWN THE GUTTER. THIS DRAINS INTO YOUR STREAM AND POLLUTES IT.</p>  <p>LOSE 3 E.T.'S</p>	<p>Improper disposal of car oil and other household wastes is pollution. We should be aware of how to properly dispose of all waste materials and recycle whenever possible. Car oil can often be recycled. Check your local recycling centers for locations.</p> <p>The player loses 3 energy tokens.</p>
<p>YOU FIND SOME YUMMY INVERTEBRATE BUGS FOR LUNCH.</p>  <p>GAIN 2 E.T.'S</p>	<p>Terrestrial insects and immature insects account for most of the Rio Grande cutthroat trout's summer diet, until the caddis flies hatch (their favorite food). They also eat mayflies, stoneflies, zooplankton, and crustaceans.</p> <p>The player earns 2 energy tokens.</p>

	<p>Water flow in a stream can be affected by several factors. Those factors decreasing water flow include diverting water for agricultural needs, industrial uses, and human consumption (for home use). As urban areas expand in the southwest, we should remember that other animals need the water as well.</p> <p>The player loses 2 energy tokens.</p>
	<p>In this next stage of the Rio Grande cutthroat trout life cycle, the trout can grow to a size of 10 inches, and the larger spots on the sides begin to fade.</p> <p>The player gets to roll the dice again.</p>
	<p>Fishermen will often use lures that mimic or look like insects to trick trout. Fly fishermen learn how to cast their lures, called flies, so that they mimic flying insects that land briefly on the water. Trout are the prized catch of fly fishermen. Be sure to follow fishing regulations set up by New Mexico Department of Game & Fish when you go fishing in New Mexico.</p> <p>The player must return to the start and follow the direction for the first square. (Basically, any tokens over five must be turned in. If the player has less than five, he/she can acquire enough tokens to add up to five.)</p>
	<p>Rio Grande cutthroat trout need places to rest. A pool is a section of a stream where the water is a little deeper and slower. In the pool, the trout doesn't have to struggle as much to stay in place, giving it a chance to rest.</p> <p>The player earns 2 energy tokens.</p>

	<p>Poorly managed cows can be devastating to streams. As cattle eat the plants and drink from the water, they trample streambanks, causing erosion and widening of streams. The lack of streamside vegetation and widening of the streams open the streams up to more sunshine, resulting in higher water temperatures. Rio Grande cutthroat trout prefer water that is less than 64 °F. Above that temperature, the trout start stressing and could die.</p> <p>The player loses 2 energy tokens.</p>
	<p>As a spawning adult, the life cycle can begin again if the conditions are right.</p> <p>The player earns 2 energy tokens.</p>
	<p>While it may seem odd to take a Rio Grande cutthroat trout out of a stream and raise it in a hatchery, it is part of an effort by the New Mexico Department of Game & Fish to aid in recovery of the trout. Seven Springs Fish Hatchery has been devoted to raising Rio Grande cutthroat trout. As streams and their habitat are improved, the trout can be released into them.</p> <p>The player must sit out his/her next turn.</p>
	<p>It is up to us to help ensure that the Rio Grande cutthroat trout have streams that are clean, clear, and able to support them and their offspring.</p> <p>To keep the game going, the player may start over.</p>

Rio Grande Cutthroat Trout for New Mexico Streams!

Grade Level	Grades 4-6
Goal	Students will learn the difference between native and nonnative species and the effect nonnatives have on the environment.
Strand Benchmark Performance Standards	<p><u>Grade 4 – Language Arts</u> Strand: Reading and Listening for Comprehension, Content Standard I: Students will apply strategies and skills to comprehend information that is read, heard, and viewed. K-4 Benchmark I-B: Locate and use a variety of resources to acquire information across the curriculum Performance Standard 1: Use key words, indices, cross-references, and letters on volumes to find information.</p> <p>Strand: Writing & Speaking for Expression, Content Standard II: Students will communicate effectively through speaking and writing. K-4 Benchmark II-A: Demonstrate competence in speaking to convey information Performance Standard 3: Make oral presentations, using technologies when appropriate, with an awareness of audience and purpose. Performance Standard 4: Use appropriate non-verbal communication while giving presentations.</p> <p><u>Grade 5 - Language Arts</u> Strand: Reading and Listening for Comprehension, Content Standard I: Students will apply strategies and skills to comprehend information that is read, heard, and viewed. 5-8 Benchmark I-B: Gather and use information for research and other purposes Performance Standard 2: Research multiple sources to deepen understanding and integrate information and ideas across varied sources and content areas by:</p> <ul style="list-style-type: none"> • conducting research (with assistance) from a variety of sources for assigned or self-selected projects (e.g., print and non-print texts, artifacts, people, libraries, databases, Internet, computer networks) • evaluating the usefulness and quality of information and ideas based on purpose, experiences, text(s) and graphics <p>Strand: Writing & Speaking for Expression, Content</p>

Standard II: Students will communicate effectively through speaking and writing.

5-8 Benchmark II-A: Use speaking as an interpersonal communication tool

Performance Standard 2: Use language to:

- formulate hypotheses
- evaluate information and ideas
- present and support arguments
- influence the thinking of others

Performance Standard 3: Make presentations to inform or persuade, selecting vocabulary for impact.

5-8 Benchmarks II-C: Demonstrate competence in the skills and strategies of the writing process

Performance Standard 1: Produce a variety of written products that demonstrate competence in:

- persuasive writing (e.g., states a clear position, elaborates on the position with reasons, examples, information and other evidence)
- autobiographical writing
- essays that speculate on cause and effect

Grade 6 - Language Arts

Strand: Reading and Listening for Comprehension,

Content Standard I: Students will apply strategies and skills to comprehend information that is read, heard, and viewed.

5-8 Benchmark I-B: Gather and use information for research and other purposes

Performance Standard 1: Interpret and synthesize information from a variety of sources by:

- reviewing the characteristics of informational works
- restating and summarizing information
- determining the importance of information
- making connections to related topics and information
- monitoring comprehension
- drawing inferences
- generating questions

Performance Standard 2: Use multiple sources of print and non-print information in developing informational materials such as brochures, newsletters, and advertisements by:

- exploring a variety of sources that provide information (e.g., books, newspapers, Internet, electronic databases, CD-ROMs)

	<ul style="list-style-type: none"> • distinguishing between primary and secondary sources <p>Strand: Writing & Speaking for Expression, Content Standard II: Students will communicate effectively through speaking and writing.</p> <p>5-8 Benchmark II-B: Apply grammatical and language conventions to communicate</p> <p>Performance Standard 9: Support opinions expressed with detailed evidence and with visual or media displays that use appropriate technologies.</p>
Suggested Materials	<ul style="list-style-type: none"> ○ Poster board ○ Markers ○ Misc. art supplies depending on creativity of students
Teacher/Student Preparation Required	May wish to do a little research on difference between native and nonnative fish.
Length of Lesson	<ul style="list-style-type: none"> ○ 45 minutes to get students started ○ bulk of time would be determined by the parameter for the ad campaign and whether students would be working on assignment during class time or outside of class time ○ 45+ minutes for teams to present ad campaign to the class
Activity	<ol style="list-style-type: none"> 1. Have students learn the difference between native and nonnative fish. (To keep it simple you can have the students focus on one group of fish—trout. Rio Grande cutthroat trout and Gila trout are the only trout native to New Mexico. Brown trout, rainbow trout, and brook trout are all nonnative to New Mexico.) 2. Have students research the pros and cons of native and nonnative fish in New Mexico streams. 3. Divide the class into multiple teams of 2-4 students. 4. Have half of the teams pick a native fish and the other half pick a nonnative fish. 5. Each team is to design an ad campaign for their fish- “___ for New Mexico Streams!” Students should focus on why their fish should be in New Mexico’s streams. 6. The ad campaign can include a poster, fliers, bumper stickers, and/or a 60-second advertisement. You can set the parameter for the ad campaign (ex. one poster and one 30-second ad) or you can see what your students create on their own. 7. Each team presents their ad campaign to the rest of the class.

	8. The class evaluates each team's ad campaign.
Resources	<p>New Mexico Department of Game & Fish http://www.wildlife.state.nm.us/contact/index.htm</p> <p>U.S. Fish & Wildlife Service, Southwest Region 2 http://www.fws.gov/southwest/contact.html</p> <p>U.S. Forest Service, Southwestern Region http://www.fs.fed.us/r3/index.shtml (You can find the contact information for a nearby forest from the regional Web site.) http://www.fs.fed.us/r3/sfe/fish/index.htm</p>
Alternatives/Extensions	<ol style="list-style-type: none"> 1. Invite a fisheries biologist to your classroom to talk about their work restoring native fish to streams (contact information is located on the Web sites in the resource section above). 2. Have each team work on an ad campaign for different fish. Display the materials around the school and have the entire school vote on which fish they would like to see more of in New Mexico's streams.