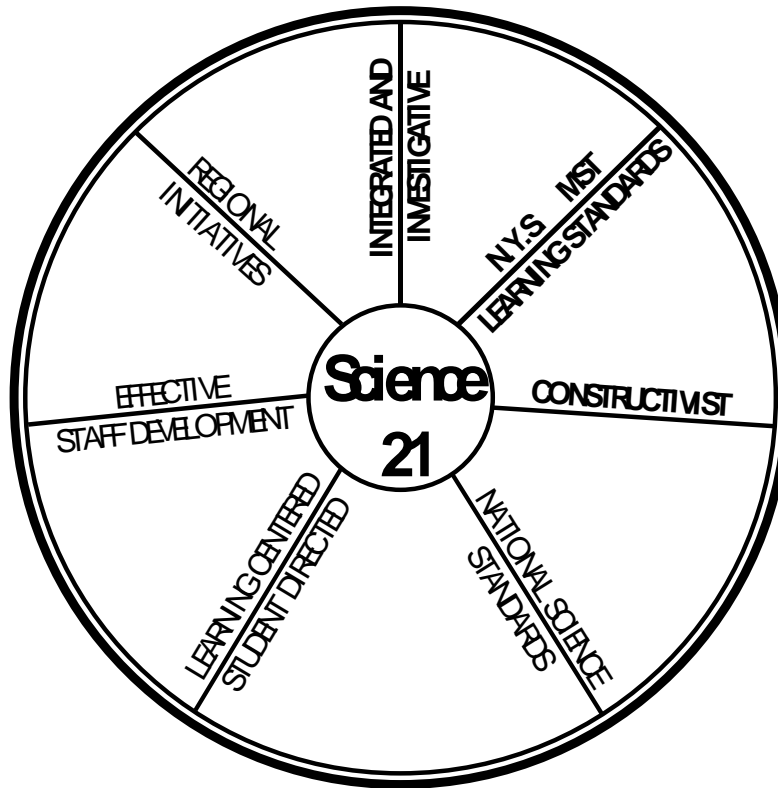


UNIT 3 ~ Triops



Grade 2

Science 21

Science for the 21st Century

A new elementary science curriculum
and staff development service of the future

SCIENCE 21

Science for the 21st Century

*A K-6 INTEGRATED SCIENCE CURRICULUM
BASED ON THE NYS LEARNING STANDARDS FOR
MATH, SCIENCE, AND TECHNOLOGY*

DEVELOPED AT

**PUTNAM/ NORTHERN WESTCHESTER BOCES
CURRICULUM & INSTRUCTIONAL SERVICES**

**Marla Gardner
Director**

**Kent T. Leo
Regional Science Coordinator**

**Helen Pashley
Grade 2 Science Consultant**

For further information regarding this curriculum and staff development program, please contact Kent Leo (914) 248-2336.

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SCIENCE 21: Science For The 21st Century

Forward

What is Science 21?

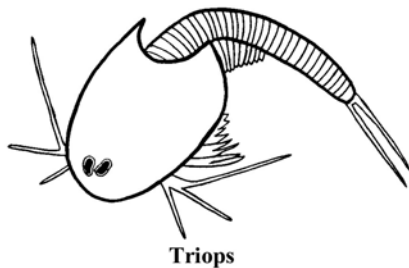
Science 21 is an integrated K-6 science curriculum developed at the Putnam/Northern Westchester BOCES. It was originally conceived by a Steering Committee and the BOCES curriculum staff. This planning committee provided the future direction and **vision** of elementary science education for the local school districts as a means to meet the needs of *the New York State Learning Standards for Mathematics, Science and Technology*. The program's major emphasis is on investigations that are **student directed** and relevant to students' everyday lives. The program's main focus is on **hands-on, inquiry-based** science, and that math, language arts and technology are integrated at points where they fit naturally. Science 21 is based on the "Big Ideas" in Science Education today.

Acknowledgements and Credits

Science 21 has been a highly effective curriculum program due to the efforts and dedication of teachers who serves as curriculum developers on grade level design teams. Using feedback based on classroom teacher experiences, the Grade 2 Design Team continually develops, pilots and revises the Science 21 curriculum for second grade.

In addition to acknowledging all our grade 2 teachers who use Science 21, we especially would like to thank the following grade 2 Designers who contributed their ideas towards the writing of this unit on the Triops: Nina Chase, Laurie Colantuono, Beverly Eisenberg, Jan Jesse and Jan Tovar.

Finally, Helen Pashley, who heads the Grade 2 Design Team, should be commended for her writing of this excellent unit on the Triops, along with several artwork that she drew for this unit of study.



SCIENCE 21: Science For The 21st Century

Unit Objectives

Students will be able to:

- State the requirements of animals to grow, stay healthy and thrive.
- Define life span.
- Describe the life span and life cycle of Triops.
- Design and carry out experiments to answer questions that they have generated themselves.
- Work cooperatively with others in a scientific environment.
- Record and communicate their results to others.

Unit Focus

How can we observe and measure changes in living things?

General Overview

Students have a natural curiosity about other living creatures that share our world. In this unit students discover what animals need in order to survive, and how they behave by an extended study of an unusual crustacean called the Triops.

Throughout the unit, students are encouraged to generate investigations, observe, measure and record their results. They communicate what they discover on the pages of their journals and in class discussion. By doing so, they fulfill many requirements of the English Language Arts standards. At this time, teachers will review concepts and content for understanding.

MST Learning Standards are reinforced when students:

STANDARD 1 Analysis, Inquiry, Design.

- Explore and solve problems generated from school and home situations, using concrete objects and materials.
- Ask “why” questions in an attempt to seek greater understanding concerning objects and events that they have observed and heard about.
- Question the explanations they hear from others and compare them with their own observations and findings.

Introduction

MST Learning
Standards

- Develop relationships among observations to construct descriptions of objects and events, and to form their own tentative explanations of what they have observed.
- Organize observations and measurements of objects and events through classification and the preparation of simple charts and tables.
- Share their findings with others and actively seek their interpretations and ideas.
- Adjust their explanations and understandings of objects and events based on their findings and new ideas.

**STANDARD 3
Mathematical
Reasoning**

- Construct tables, charts and graphs to display and analyze real-world data.
- Collect and display data.
- Use statistical methods such as graphs, tables and charts to interpret data.

**STANDARD 4
Scientific
Concepts**

- Describe the life processes common to all living things.
- Describe the major stages in the life cycles of selected plants and animals.
- Describe evidence of growth, repair and maintenance.
- Describe basic life functions of common living specimens.
- Describe some survival behaviors of common living specimens.

**STANDARD 6
Themes of MST**

- Use different types of models such as graphs, sketches and diagrams to represent various aspects of the real world.
- Use simple instruments to measure such quantities as distance, size and weight, and look for patterns in data.

**STANDARD 7
Apply MST
Skills**

- Design solutions to problems involving a familiar and real context.
- Observe phenomena and evaluate them scientifically by collecting and analyzing data.
- Solving problems by working effectively as an individual and as a group, gathering and processing information, generating and analyzing ideas, constructing models and evaluating the results, and presenting the

Curriculum Correlations

Overall, this unit develops critical thinking skills. Observing, measuring using the appropriate tools, classifying, graphing and charting data are used. Students develop vocabulary and science vocabulary. Writing skills are used to record data and analyze results. Individual lessons correlate with language arts, math, environmental science and health education (see Integration With Other Subjects in particular lesson plan).

Management And Planning

This unit will provide your class with approximately 4 weeks of instructional material, depending on the allocation of time.

Triops are crustaceans that have remained unchanged in appearance from the Triassic times (240 million years ago). They are adapted to life in temporary desert ponds, with a very short life span of less than 90 days.

It is extremely important for the teacher to read the background information about Triops before beginning this section of the unit, especially on tips about the care of Triops. Lessons are introduced with whole group, brainstorming sessions. Using inquiry-based activities, students explore the structure, movement, feeding and survival strategies of the animals. Individual, center, group, and class activities are also included, culminating in the design and completion of a group investigation of a topic of interest. Content and understanding are reinforced during informal discussion and when students are performing experiments. Content and understanding are summarized after the class has presented and compared their results. Additionally, students record their work in a science journal.

Suggested assessment/extension activities that may be used at the teacher's discretion.

Most lessons are planned to take one activity period of approximately 30-40 minutes.

Advanced preparations that are needed for upcoming lessons are denoted by this symbol:

Any safety issues associated with a lesson are highlighted by this symbol:



Any special notations and/or reminders are designated with this symbol:



A Note About Journal Pages

All journal pages that are part of this curriculum unit should be considered as recommendations. Teachers should feel free to use them as is, modify or personalize them, or create your own from scratch with these as a model.




A Note About Blackline Masters

Throughout the curriculum unit, a small version of a blackline master is usually depicted to help you quickly reference a teacher blackline master or an activity sheet from the student journal pages. Teacher blackline masters are found at the end of a lesson. Student activity sheets are found in the *Student Journal Pages* section located at the end of the unit.

Home Connection Letter

The Home Connection Letter should be sent to the parents prior to the beginning of the new science unit.

**Advanced
Preparation!**



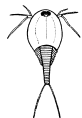
Dear Family,

In the Science 21 program, your child is studying a live animal called the Triops. Triops are small crustaceans that look like miniature horseshoe crabs.

In this unit, the students will observe the basic parts of the Triops and compare it to other animals. As they care for the Triops, they will note their behavior and responses to various stimuli. Students will develop a positive attitude towards this organism by learning how to care for it, determining its needs for survival and by setting up a habitat.

We look forward to some exciting experiences in school and hope you will encourage your child to share them with you at home.

Sincerely,



Triops And The Environment

Triops, like many animals, are important and beneficial to the local fauna where they are found. Previously, Triops egg were harvested from these areas, but at a cost to the environment. Since the Triops were being depleted, this was causing harm and degradation to the environment.

As a result, Triops Inc., the company from which we obtain our Triops, began raising them on special aquatic farms. This was done as a commitment to preserve the local fauna and habitat. This is one of many reasons why Science 21 selected Triops Inc. to supply our Triops.



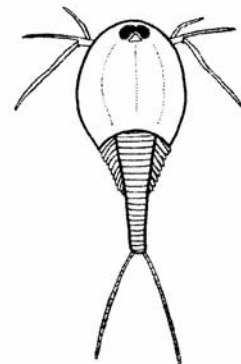
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We look forward to some exciting experiences in school and hope you will encourage your child to share them with you at home.

Sincerely,



SCIENCE 21: Science For The 21st Century

Materials List

This list is provided to help you organize the materials you will need for this unit. Journal pages are listed since they will need to be photocopied before the lesson. Journal pages can be found at the end of each lesson. Materials listed here are sufficient for a class of 30 students.

Lesson 1: Setting Up The Habitat For Triops

For class:

- Chart pad and markers
- Triops kit
- Extra packet of Triops' eggs
- Sand
- Scissors
- Overhead transparency of map showing where Triops are found (optional)
- 1 gallon distilled water
- 1 gallon spring water
- Desk lamp (if needed)

For groups of 4-5 students:

- Clear plastic salad container (approx. 6"x7")
- Lid with 2 inch "V" cut into it
- 3 Hand lenses
- 2 plastic spoons
- Journal page (optional)
- Pencil (optional)
- Aquarium plants (optional)
- Other natural objects rinsed in spring water e.g., stones, twigs, etc. (optional)
- Small quantity freeze dried shrimp or worms (optional)

For each student:

- Student Journal Page(s), *Triops Journal Page*

Lesson 2: How Can We Measure How The Triops Grow?

For pairs or each group 3-4 students

- Triops in habitat
- Dot strips (Blackline Master)
- Ruler
- Student Journal Page, *Measuring the Triops*
- Pencil
- Graph paper

Lesson 3: Observing Our Animals

For class:

- Chart and marker or board and chalk

For groups of 3-4 students:

- The Triops in its plastic container
- Hand lenses

For each student:

- Student Journal Page, *A Triops*
- Student Journal Page, *Observation of Triops* (optional)
- Friendly letter outline (optional)
- Sharpened pencil
- Eraser

Lesson 4: Body Parts

For class:

- Overhead transparency of parts of body (prepared from Blackline master)

For groups of 3-4 students:

- Triops in container
- Hand lenses
- Triops food to feed animal
- Plastic teaspoon

For each student:

- Student Journal page, *Triops Upperside*
- Journal page, *Triops Underside*
- Pencil

Lesson 5: Feeding, Movement And Behavior Of Triops

For class:

- Chart and marker or board and chalk
- Sand, if not already in containers
- Plastic teaspoons
- Triops food

For groups of 3-4 students:

- Triops in container

- Hand lenses

For each student:

- Pencil
- Student Journal Page, *Answering Questions About Triops* (can be done as a group also)
- Scrap paper/Journal for making notes

SCIENCE 21: Science For The 21st Century

Unit Vocabulary/Wordbank

accurate
acrobatic
Ammonite
appendage
arid
backwards
brush
carapace
cast skin
centimeter (cm)
container
crustacean
data interpretation
distilled water
egg pouch
estimate
exoskeleton
eye
food groove
food pellet
forward
gills
habitat
head
inch (in)
life span

Vocabulary
~
Wordbank

measure/measurement

molt/ molting

mouth

movement

nutrient pack

nymph

omnivore

ruler

segment

senses

spring water

stimulus

tail

temperature

temporary

thermometer

Triassic

Triops

trunk appendage

unique

vibration

SCIENCE 21: Science For The 21st Century

Lesson 1

Setting Up The Habitat For Triops.

Focus Question

How Can We Set Up A Habitat For The Triops?

Overview

Students are introduced to their animal of study, the Triops. Students brainstorm what they know about the desert habitat that Triops come from. Students also determine the needs of any animal, including the Triops. They review the instructions that come with the Triops kit. They assemble the equipment and set up the habitat for the Triops. Finally, students are reminded of the need to develop a respect in their treatment of animals. Materials listed are sufficient for a class of 30 students.

Students Will Know And Be Able To:

1. Describe the needs of any animal (i.e., food, water, temperature, etc.)
2. Describe the habitat that Triops need to grow and thrive.
3. Read simple kit instructions from the Triops supplier and interpret what they need to do.
4. Set up a habitat for Triops.
5. Appreciate that scientists need to have ethical standards in their treatment of animals.

Background Information For Teachers

Read the information given in the Triops kit and the *Triops Guide* found at the end of this lesson. This will give you information about the natural habitat of Triops. There is a site with a picture of the Triops habitat at www.uakron.edu/biology/triops.html. There are also web sites devoted to the care of Triops. You may wish to read some of the information provided there. A list of sites can be found in the *Triops Guide*.

Vocabulary

Arid - dry, desert-like.

Cast skin - skin that has been molted.

Container - something that you can put things in.

Lesson 1



Distilled water - water that has been purified and collected by boiling it into steam and then cooling the steam back to a liquid.

Food pellet - a small round piece of food.

Habitat - the place where an animal or plant lives.

Molt/molting - to shed or get rid of the outside covering of an animal.

Nutrient pack - bag containing plant parts and minerals needed for growth.

Sand - tiny bits of rock, shell and crystals.

Spring water - water that comes from the ground.

Temperature - a measure of how hot or cold something is in °F or °C.

Temporary - something that does not last long.

Thermometer - scientific tool used to measure temperature.

Triassic - period of earth's history 248-206 million years ago.

Triops - the scientific name of our animal of study, also called a tadpole shrimp.

Materials

For class:

- Chart pad and markers
- Triops kit
- Extra packet of Triops eggs, food and nutrient pack
- Play sand (about one pound)
- Scissors
- Clear plastic salad container (approx. 6" or 7")
- Lid for salad container, with 2-inch, V-shape cut out
- Overhead transparency of map showing where Triops are found (optional)
- 1 gallon distilled water
- 1 gallon spring water
- Desk lamp (if needed)

For each group of 4-5 students:

- Clear plastic salad container (approx. 6"x7")
- Lid with 2-inch "V" cut into it
- 3 hand lenses
- Thermometer
- 2 plastic spoons

- Journal Page (optional)
- Pencil (optional)
- Aquarium plants (optional)
- Other natural objects (e.g., stones, twigs etc.) (optional)
- Small quantity of freeze dried shrimp or worms (optional)

For each student:

- Student Journal Page(s), *Triops Journal Page*

Management

- It is suggested that you start this lesson on a Friday.
- The desk lamp is needed if the temperature in your classroom drops below 72°F during the night. Check the temperature when you first come into the classroom in the morning. After 7 days, Triops can tolerate cooler temperatures down to 65°F. Do not place the containers in direct sunlight, as they may overheat. Please see the guide in the Triops kits.
- 1 lesson of approximately 30-40 minutes with the whole class to set up the water.
- Three days later, allow 15-20 minutes to add eggs.
- After four days, 10 minutes minimum to feed as required or instructed.
- Begin observations for growth of Triops shortly after eggs are added (see lesson 2).
- Distilled water is available in the laundry detergent aisle of supermarkets.
- You may want to obtain extra spring water.
- *Students should wash hands after each lesson. The nutrient pack contains natural dried plant materials. Care should be taken to wash hands with soap after handling and not to place the pack near other foods that may be eaten by students.*
- Before the lesson, you may wish to cut in advance for the students, a two inches “V” shape in each container lid.



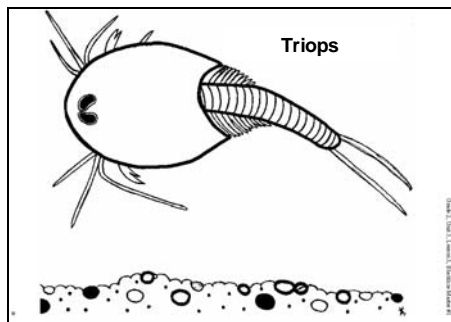
**Please
Note!**



**Safety
Note!**

Teaching Procedures

1. Introduce the students to the animal. You can do this by showing students the pictures on the Triops kit box and/or an overhead transparency of Blackline Master #1. Ask: *What does the animal look like? What other animal can you think of that might look like the Triops?* (See example of Blackline Master #1 on page 16)



2. The Triops kit lets you grow Triops from eggs. Triops have remained unchanged in appearance since the beginning of the age of the Dinosaurs. Triops first appeared on the Earth during the Triassic Period (248-202 million years ago). The continents were all in one land mass (Pangaea), and it was warmer and drier than it is now. The Pangaea land mass later divided into the continents we now see on the map of the World. Triops still live in temporary ponds in many places. *What countries do Triops live in?*
3. Using a world map and an overhead transparency of Blackline Master #2, show students where Triops live. Triops live in Japan, Russia, western North America, Africa and Australia. They are sometimes found in India, Central and South America, the West Indies, Hawaii, New Caledonia and the Galapagos islands.



4. *What do you think the climate is like in all these places?* All these places are dry and warm (arid). Sudden thunderstorms can create temporary pools, which dry up in a month or so. Rain may not come again for several years!
5. Along with the students, review the set of instructions outlined on the next page for growing the Triops. If it is not possible to set up the kit on a Friday, follow the instructions given in the Triops Kit.

Day 1 (Friday), Preparing The Water.

- Open the gallon container of distilled water.
- Write down the time.
- Place the container of distilled water in natural light, artificial light or both.
- Peel off backing from the thermometer and stick it on the outside of the plastic tank. *What is the temperature of the water?* (It should be between 74 -84°F.)
- If you have not already done so, cut a V-shape in the round lid of the tank as well as in the lid of the salad container.
- Rinse the tank and salad container with a little distilled water, and pour this water away.
- Pour more distilled water into the tank and salad container until it is about 2 inches deep.
- Open the packets labeled Triops and take out only the nutrient packs (they look like teabags).
- Add one nutrient pack to the water in the tank. Add another nutrient pack to the water in the salad container. Put on the lids for both containers.
- Place the spring water container next to the tank and salad container.

Day 4 (Monday), Adding the eggs.

- Check the temperature of the distilled water. *What is it?* (It should be between 74 -84°F.)
- Check the time. *How long has the nutrient pack been in the water?* (It should have been in the water for more than 30 hours.)
- Now comes the hardest part. Don't sneeze and watch out for drafts. Tap the packet of eggs gently so the eggs fall to the bottom of the packet. Open the packets of eggs one at a time by removing *all* the tape. Remove the lid from the tank. Tap the packet to add the eggs to the water in the tank. Try not to get the eggs on the side of the tank or onto the nutrient bag. The eggs look like poppy seeds, but they are about half the size! Each pack contains about 15-20 eggs. (not all of them will hatch) Repeat the same procedures with the second packet of eggs for the salad container.
- Replace the lids. Place the tank and salad container in an area where they will stay between 74 -84°F.
- Use the thermometer that you placed on the tank to monitor the temperature.
- Write down the time you added the eggs.

Day 5 (Tuesday)

- Use the hand lenses. Check the containers for Triops. They are very tiny. You sometimes see little white dots if you place the container on black construction paper.

- Write down the time you saw your first Triops.
- *What is the temperature? What color are the Triops? How many Triops have hatched in the class?*

Day 6 (Wednesday)

- Crush one brown food pellet and one green food pellet between 2 plastic spoons. Add *half* of the powder mix to the round tank. Feed the other half to the Triops in the salad container.
- *What is the water temperature?*
- Now you should start Lesson 2. *How can we measure how big the Triops grow?*

Day 7 (Thursday)

- ***Do not feed today.***
- *What is the temperature of the water?*
- Triops grow by molting their outer covering (exoskeleton). While their new exoskeleton is still soft, they can stretch it bigger. Look out for molted skins on the bottom of the container. Count the number of skins the Triops sheds as it grows bigger.
- *Where do you see Triops?* (i.e., on the surface, at the bottom, etc.)

Please
Note!



Please
Note!



Day 8 (Friday)

- Crush one green food pellet and one brown food pellet for each container. Add the entire amount to the container to keep them going for the weekend. Over the weekend you can feed a tiny piece of carrot as well. This should be a baby carrot thinly sliced, with the slices cut into semi-circles at first. Bigger pieces can be given over weekends as the Triops get larger.

Day 10 (Monday), Setting up more habitats

- Remove the nutrient bags from the tank and salad container.
- Now take the other salad containers and rinse with *Spring* water.
- Pour enough Spring water into each container so that it is about 2 inches deep.
- Transfer the Triops to these new containers with a plastic spoon. If you have more Triops than containers, make sure the little ones are put together. Do not place the smaller Triops with the larger ones, otherwise, they might get eaten. Put on the lids with a V-shape cut out of them.
- Feed each Triops one whole pellet of food per day. Alternate green and brown. Add more food only when it has been completely eaten. As the Triops grow, increase the amount they are given. A 2-inch Triops will eat 4-5 pellets twice a day. You can also try feeding very small quantities of dried shrimp or worms. Remember to add carrot for the weekend.
- Check the water temperature. It can be lower now, but not lower than 65°F.

- Add more spring water as needed. Change the water as needed.
 - Rinse and add play sand to the containers in piles. Watch what the Triops do.
 - When Triops are 1” long, start looking for their egg pouches.
6. As students are caring for their Triops, ask them: *What do the Triops need to keep them thriving and growing? What are some ways that the Triops are the same as other animals/pets? What are some differences?* Summarize with students that many of the needs of Triops are the same needs for all animals (i.e., food, water, certain temperature, etc.)
- 7 Discuss the routine caring and maintenance such as feeding, topping off with water and replacing of water when needed.
- 8 Ask students: *What other questions do you have about Triops? Which of these questions could be answered by research on the internet or with books? by doing an experiment? Of those questions that would be answered by doing experiments, what would **not** be appropriate to do with animals?* (anything that would be cruel and harm the animals). Students may be aware of some animal rights issues and issues dealing with humane treatment of animals. Use discretion when dealing with this. However, they should know that scientists have to get approval for their experiments from supervisors or funding committees to justify what they are planning to do.

Assessment Procedures/Suggested Rubrics

1. Student can describe the needs of the Triops and how they can be met.
2. Student can follow directions to set up and look after Triops.
3. Student can work cooperatively in a group to care for the Triops.

Integration With Other Subject Areas

Social studies

- Identify countries on a world map.
- Describe conditions found in a desert.

Extensions And Applications

- Look at a Triops egg under a microscope. *What color is an egg? What do the eggs look like?*
- Look at a cast skin under the microscope.
- Keep a student journal/class journal to record day to day observations and care of the Triops.

Over 2, One 1, Lesson 1

Name _____ Date _____

Triops Journal Page

Today is day _____

This is what I observed:

Draw

Notes: _____

We noticed: _____

11

- Plot the water temperature on a graph. Does it stay the same?
- Start looking for information about Triops on the Internet.

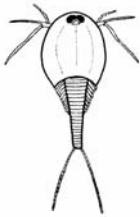
Teacher Resources

- Journal Page, *Triops Journal Page* (Optional)
- Map showing where Triops are found

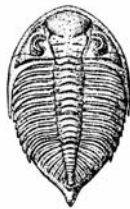
Triops Guide

The Body

Triops (or Tadpole shrimps) are small, primitive, freshwater crustaceans, of the Branchiopod (gillfoot) family. They are related to the more familiar crabs, lobsters and crayfish. Triops look a lot like Horseshoe crabs. Both have a large carapace over the head and thorax, covering many appendages underneath, and a tapered trunk or tail. Scientists suggest they possibly both had trilobites as ancestors because they have similar looking larvae.



Triops



Trilobite



Horseshoe crab

In the wild the 15 species of Triops are found in western North America, Africa, Australia, Japan, and Russia. They have also been found in Central and South America, the West Indies, Hawaii, New Caledonia, the Galapagos Islands and India.

Triops may be colored brownish, greenish or reddish. The carapace is darker when they are mature. Generally they grow to 1-3" long (2.5-7.5 cm), but some larger specimens exist in Africa. The body has 2 long "tails" or filaments. Triops show an incredibly rapid life cycle. Unlike water fleas, usually there is only one generation of animals before they lay their eggs and die.

The development from egg to adult to next generation is characterized by *diapause* (the ability to remain dormant or resting through extreme conditions until favorable conditions occur again). This is an adaptation for surviving in temporary pools (see below).

Like other crustaceans, they breathe using gills that are located at the upper end of the legs. Swimming increases the water flow over gills. Tail filaments are used as rudders when they move, and may act as posterior antenna, warning of attacks from behind.

This animal was first described in 1732. Its scientific name was changed from Apus to Triops in 1958. Triops means 3 eyes. It actually has 2 compound eyes and a dorsal organ that was mistaken for a third eye.

Appendages

Triops have 34-44 body segments, but are unique in that they may have many more pairs of limbs than segments, with 35-70 pairs of trunk appendages. They gain more appendages with each molt, and different animals of the same species may have different numbers of appendages. The first appendages have the sensory function of antennae. Triops have 2 large mandibles (mouth parts) for grinding up food (but they are too small to bite us!).

Feeding

Triops feed on algae, bacteria, single-celled animals (protozoa) and other small organisms by filtering and burrowing through the substrate. In the wild they may also feed on other inhabitants of the pond, such as fairy shrimp and daphnia (water fleas), and even on each other if they are crowded. They may also scavenge earthworms, detritus and mollusks as well as microscopic organisms. Filtered food is directed to the mouth along the food groove, and is chewed by the mouth (mandibles). The size they reach depends on the amount and kind of food they are given, and by the temperature of the water. They may double in size daily.

The food provided in the kit is a mixture of 2 high-grade fish foods. The green food pellets are rich in algae, while the brown food pellets are rich in protein.

Breathing

Triops breathe using gills. These are found on the underside of the body at the top of the trunk appendages. If the oxygen levels get low in the water, Triops swim upside down at the surface more frequently. This

behavior helps them absorb the oxygen they need. Their bodies also contain hemoglobin, the chemical that makes blood red. This is also an adaptation to possible low oxygen levels.

Habitat

Their habitat is usually still, muddy, fresh water, or temporary ponds. Triops are not found in running water. Species are not found in marine habitats, but Triops can tolerate some salt in the water. These temporary ponds are usually small and located in arid areas. In the South they may be common in rice fields. Here, Triops may be considered pests, as they harm the growth of rice seedlings by eating them and/or uprooting them. The pools are normally formed by flash floods after a thunderstorm. In the arid, desert conditions, the temperatures are warm, and the pools do not last long. The pools eventually dry out over a few days. The Triops grow fast, reproduce, and die very quickly. Pools that contain Triops do not have any fish, or frogs. Other predators of Triops include aquatic larvae such as dragonflies and beetles. Since Triops are an important food source for migrating wading birds, the Triops eggs may be transported from pool to pool by the mud on bird's feet, or possibly in their droppings.

Care

Follow the guidebook in the Triops kit. It is self explanatory and fool proof. The key things are proper temperature and light. Light influences the hatching rate. With low light, fewer eggs hatch.

Try to keep the Triops warm (over 72°F) for the first week. After that you can consider slightly lower temperatures. Lower temperatures are supposed to give you smaller animals, but will allow the Triops to live longer. When they are 8 days old, they can survive if the night temperature drops to 60°F. But temperatures over 65°F are better, if it can be arranged.

Triops can be given a bit more food on Friday, including a sliver of carrot to carry them over the weekend.

Sand in the bottom of the container, aquarium plants and a little freeze dried shrimp or worms (obtainable from pet stores) will reduce fighting if you decide to keep them together. Triops naturally have 2 types of larvae, faster growing and slower growing. Make sure you remove any smaller animals from containers that have larger animals, otherwise, they may be attacked.

Diapause

The eggs containing unhatched young (embryos) are called cysts or resting eggs. They can survive drought. Scientists have heated dried eggs to 98°C (nearly boiling) and they have still hatched! The eggs can lie dormant for more than 15 years. Drying is not absolutely necessary for eggs to hatch, but if they stay damp, it will take at least 20 days before they do hatch. Resting eggs have a thick, hard, outer shell

(chorion) which prevents them from drying out completely. When wetted by warm water, the egg shell breaks open and the young Triops emerges. At this stage, it is about 1/2mm long. The nauplius larva looks different from adult Triops, as it doesn't have a carapace. Triops molt 12 times before they are mature adults. At each molt a segment is added and the tail grows in length. They are about 10-20 mm in length when they mature

2-3 weeks later.

Behavior And Senses

Triops swim with non-stop, wavelike motion of appendages. They can swim right side up or upside down. They can also creep over the bottom and burrow in sand or gravel. They like to burrow through sediment for food.

Triops demonstrate *phototaxis*, that is, they respond to light. Nauplius larvae collect on the side of the container towards a light. Adults do not avoid light like many other crustaceans.

Triops also show *chemotaxis*. They are good at detecting the chemicals from food pellets in the water. You can see if they can "smell" food by observing their response to a food and a plastic pellet placed in the tank. They can also swim through a simple maze to get to food pellet.

Other experiments that Dr. Eugene Hull suggests are:

- Measure the effects of good diet, light or temperature on their growth rate by comparing growth with less light, a lower temperature or less food.
- *What do they do in the dark?* Do this by watching Triops swimming over the glow beads (if you have purchased the deluxe kit).
- *Do more eggs hatch in the dark or in the light at the same temperature?* Use foil to cover one container and keep it out of the light.
- *Does putting them in a bigger container increase their size?*
- Observe what they do if you put a pile of sand into the bottom of the tank. *What behaviors do you see?* They may be looking for food or to deposit eggs.
- Using a small flashlight, can you make the Triops swim the way you want? *What does this tell you about how it responds to light?*
- Experiment with density population of Triops. *Does having more than 1 Triops affect the growth rate?* Try 5, 10, 15 Triops in a 10-gallon tank. Measure their growth rate.
- Put a drop of food coloring in the water to show feeding currents.
- Time how long Triops spend digging, swimming, eating, etc.
- Watch them molt.

Breeding And Development

It was once thought there were only female Triops and that they reproduced by the development of unfertilized eggs. Now, males have been found, but they are not absolutely necessary for egg laying. Triops may be hermaphrodite (male and female). The eggs are carried on the 11th pair of appendages in egg pouches. Triops have a life cycle specialized for survival in temporary pools. They have a phenomenally rapid development, from egg to adult in 2 weeks. This is an adaptation to the rapid disappearance of their pool habitat. They lay eggs before the water finally dries up. When this happens, the adults die. It is thought they lay many eggs (up to 200) in several batches. The entire life span is only 20-90 days. Triops eggs are white to pinkish, and usually covered with dirt. They are about 1/2 mm in diameter when in water. When the eggs hatch, nauplii larvae develop. They go through several molts and then turn into the shape of the adult tadpole shrimp. At this stage, they are ¼ inch (5mm) long. They grow up to 3 inches in 2-3 weeks.

Safety

The company from which we obtain these animals, raises them on special aquatic farms. They have *not* been obtained from the wild, which may result in bacteria contamination and degradation of the habitat. The eggs have been extensively tested for safety. They do not bite. The only possible harm, could come from a student drinking the tank water! The only precautions that should be taken, are the usual washing of hands with soap at the end of the lesson. Also, since the nutrient pack contains natural dried plant materials, it should not be placed near food or drinks.

**Safety
Note!**



Triops can be picked up, if the container is dropped. However, be careful in handling. They should not be kept out of the water for longer than a minute or so. If their gills are not kept moist, they may become injured.

Triassic Triops

The most intriguing thing about Triops is that they have remained unchanged since the Triassic period, that is, at the start of dinosaur evolution over 248 million years ago. The continents were in one big landmass known as Pangaea. How have they survived and outlived the dinosaurs? Scientists think this may be because they produce large numbers of eggs. They may do this without males, resulting in offspring identical to the mother. In addition, the unhatched eggs can remain dormant for many years, withstanding extremes of temperature and drought conditions.

Internet Sites

If you do a search using Triops and animal as key words, you would find over 350 sites! In fact, there are many good sites. Some have good resources, such as movies or pictures. Other sites deal with selling Triops kits. Web addresses are accurate at the time of printing. However, site addresses do change, and may not give forwarding addresses.

The best are as follows:

<http://www.triops.com>

Triops Inc. pages. This company currently supplies our kits. They will soon have lots of educational information.

<http://www.zoe.exec.gulf.net/Triops/kids1.htm>

Kids' Triops site.

Websites that are good for providing background information are:

<http://www.science.lander.edu/rsfox/triops.html>

Detailed information about anatomy of Triops.

<http://www.uakron.edu/biology/triops.html>

Pictures of Triops habitat.

<http://www.207.166.226.251/global/thompson/triops.htm>

A teacher's page from Mrs. Thompson's class.

http://www18.electrom.com/TriopsUSA/triops_pictures.htm

Good pictures of Triops and Triops hatching.

<http://www.microscopy-uk.org.uk/mag/artjul00/dwtriops.html>

A great U.K site with ideas for experiments and great pictures.

<http://nav.webring.yahoo.com/hub?ring=triops&list>

The Triops webring has links to 21 sites of differing quality, although the diaries might prove inspirational for students to post their own class diary.

<http://www.meltingpot.fortunecity.com/justin/247/triopmain.html>

Good pictures of triops.

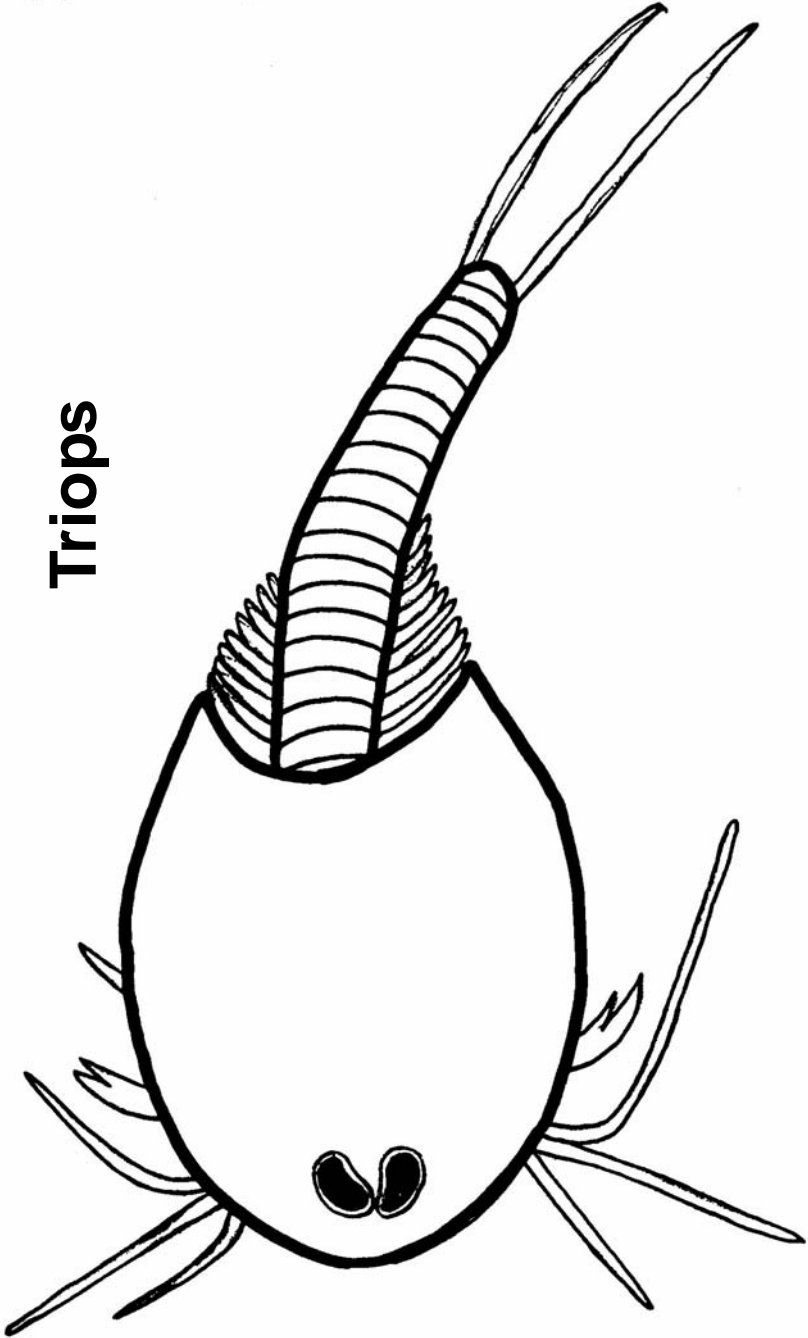
<http://www.proph.co.uk/steve/triops/members.tripod.com/~Johnkit/>

Good movie clips of triops.

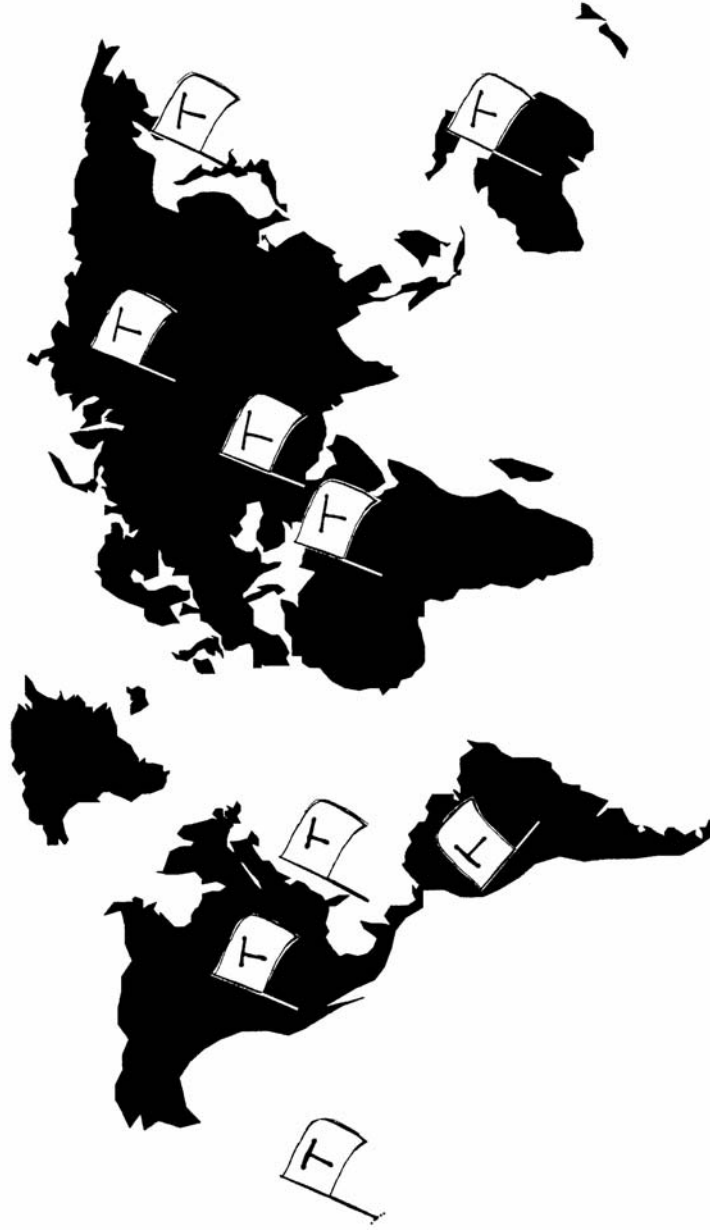
<http://www.enchantedlearning.com/subjects/dinosaurs>

Site that has good information on dinosaurs and other reptiles that lived in the Triassic period.

Triops



Where Can We Find Triops?



Name _____

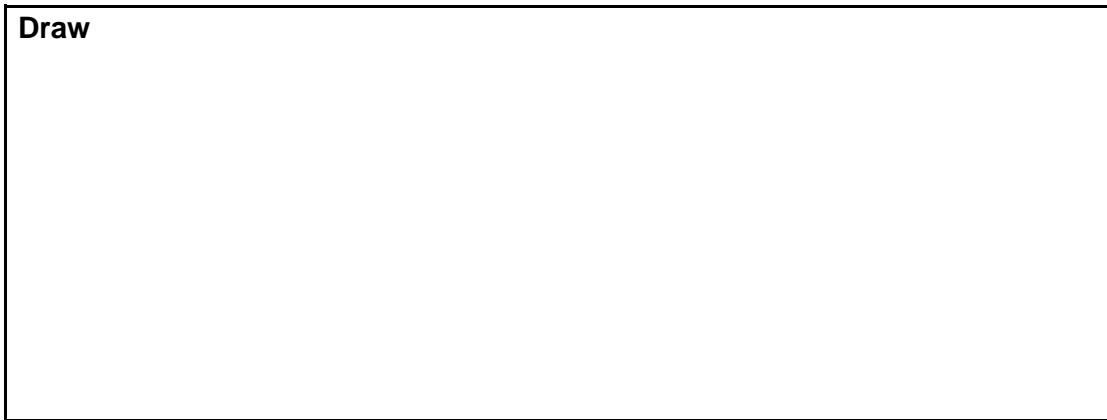
Date _____

Triops Journal Page

Today is day _____

This is what I observed:

Draw



Notes:

We noticed:
