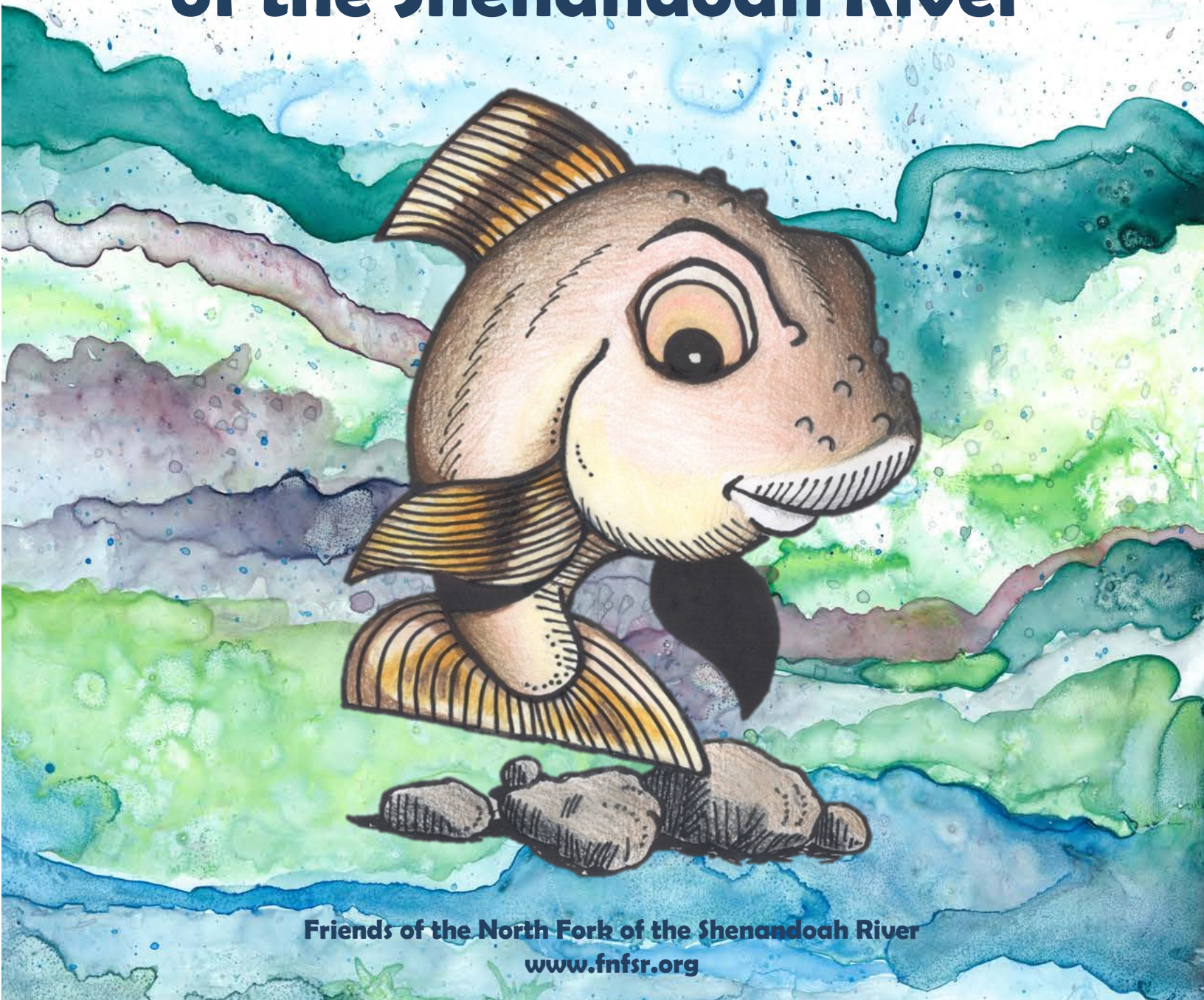
FRIENDS OF THE NORTH FORK
of the Shenandoah River™

Stanley Stands Up

for the North Fork of the Shenandoah River



Friends of the North Fork of the Shenandoah River
www.fnfsr.org

FRIENDS OF THE NORTH FORK
of the Shenandoah River™

Friends of the North Fork of the Shenandoah River
would like to thank all of the volunteers
who helped in preparing this book.

Written by Maggie Crisman and Cindy Frenzel

Illustrated by Tom Chipley

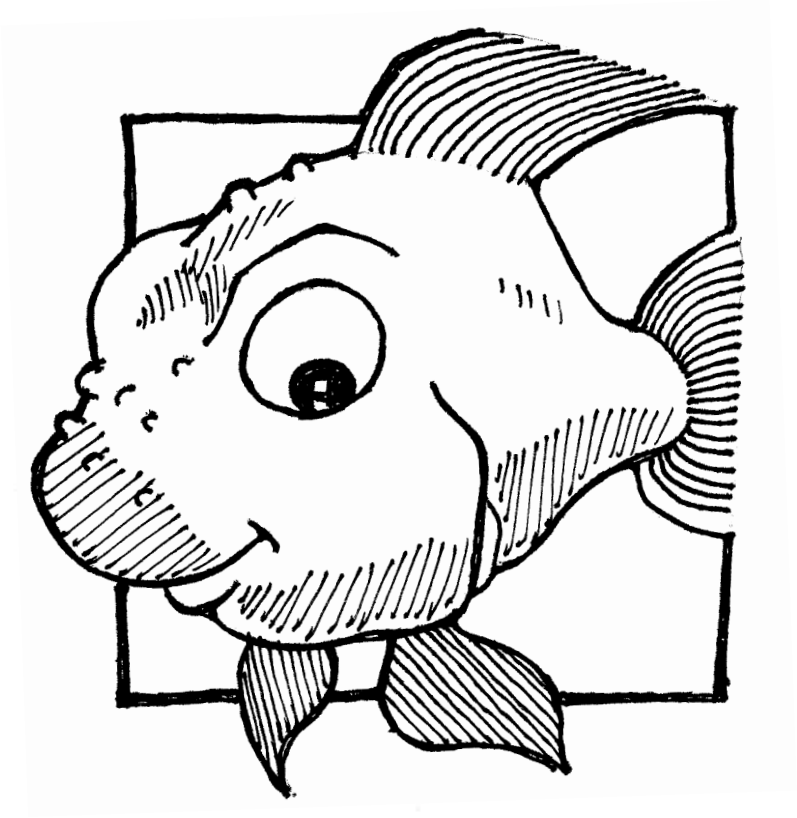
Cover by Jessica Frenzel

Made possible through a grant from the
Virginia Environmental Endowment
and generous donations.

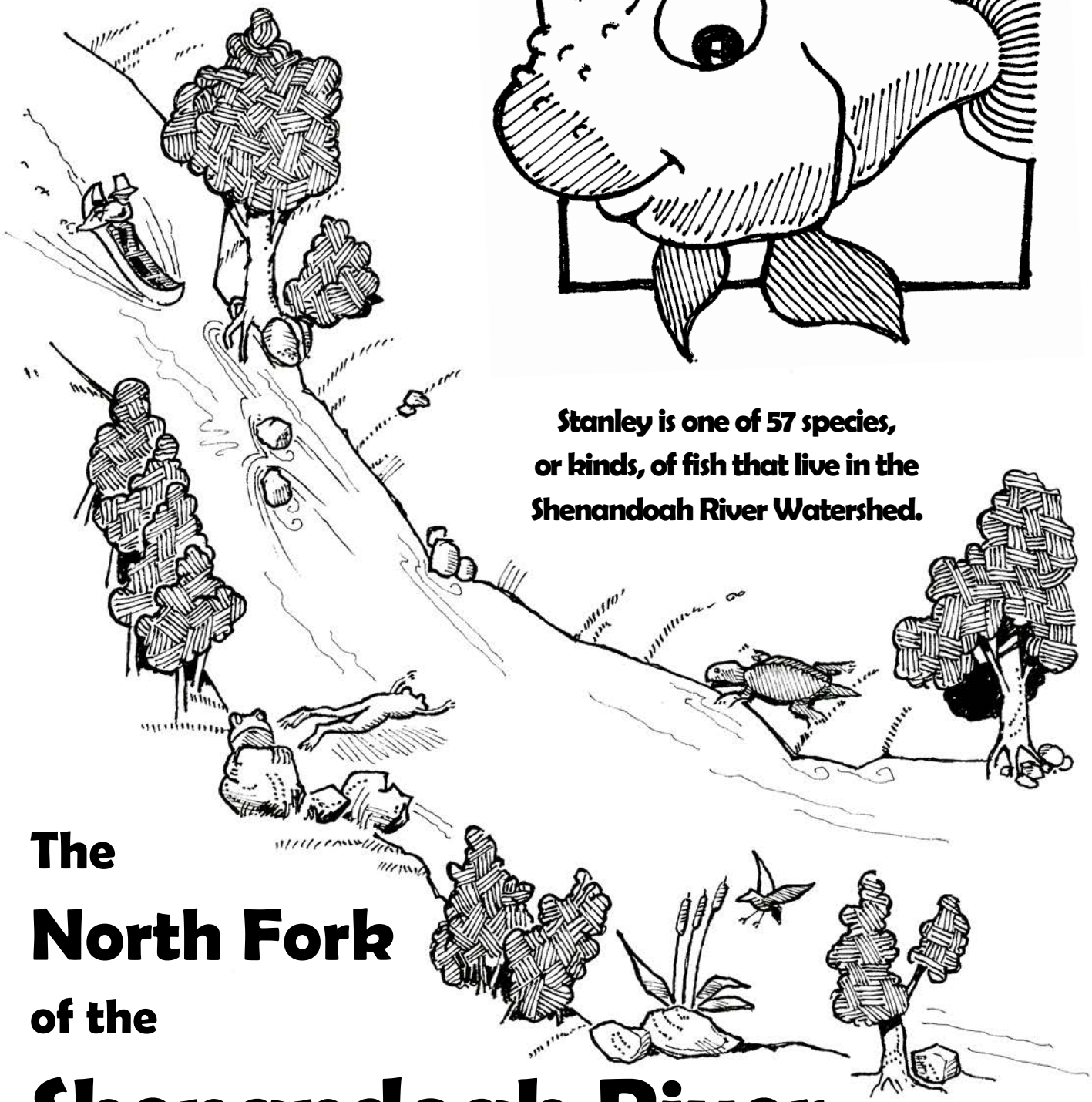
Friends of the North Fork of the Shenandoah River,
P.O. Box 746, Woodstock, Virginia 22664; 540-459-8550
friends@fnfsr.org.

We Help People Protect The River!

This is my home!

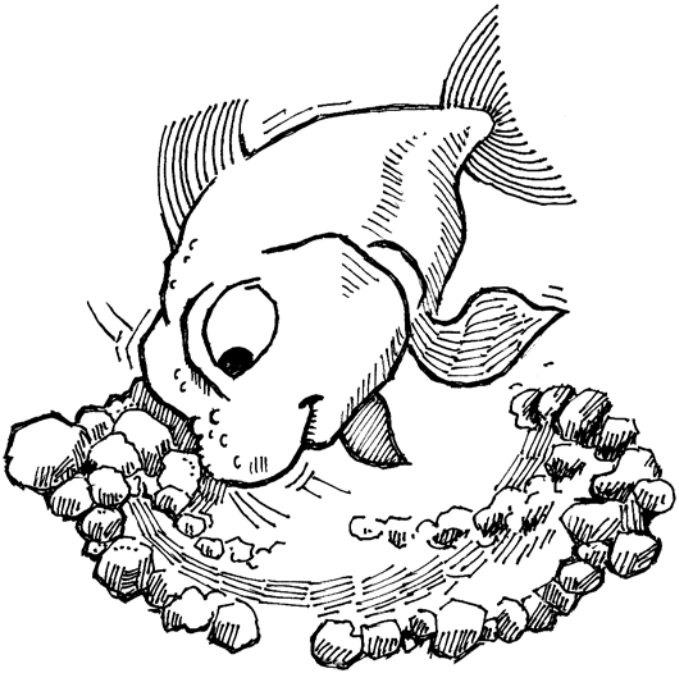


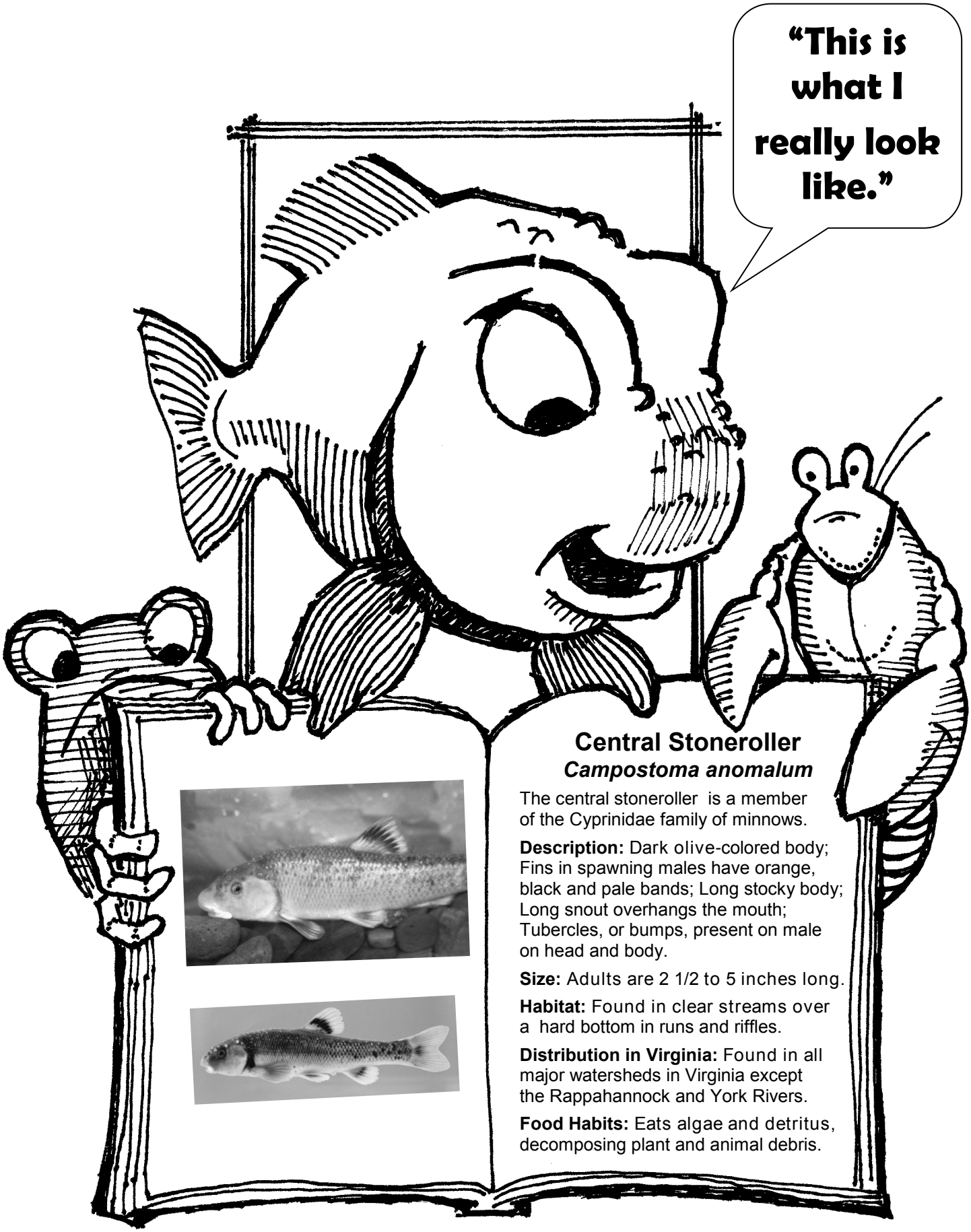
Stanley is one of 57 species, or kinds, of fish that live in the Shenandoah River Watershed.



The North Fork of the Shenandoah River

Stanley is a
"Central Stoneroller".
The name *Stoneroller* comes from the behavior of the male fish when he builds a bowl-shaped nest for a female fish by moving or rolling small stones or gravel with his nose.





Central Stoneroller

Campostoma anomalum

The central stoneroller is a member of the Cyprinidae family of minnows.

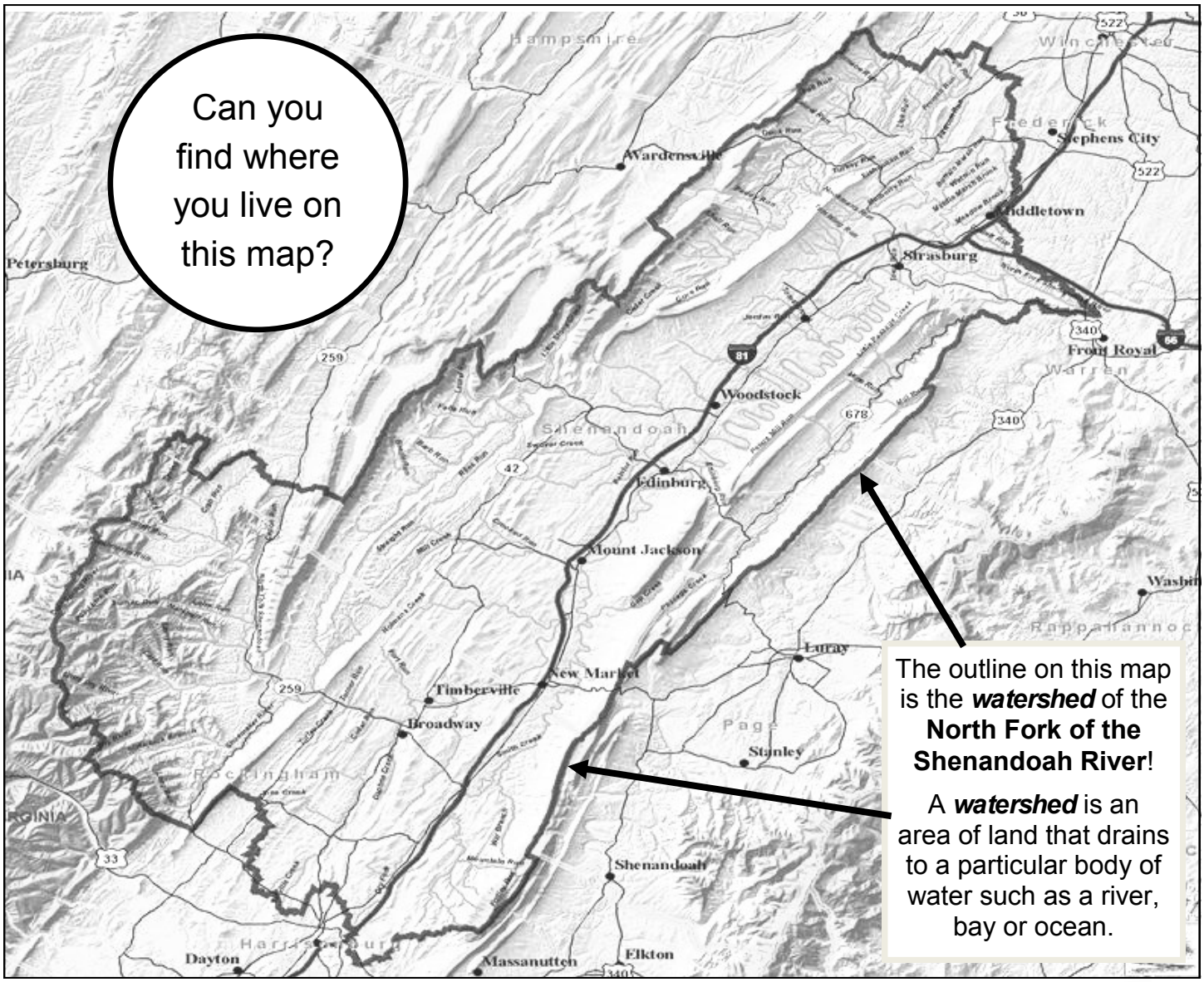
Description: Dark olive-colored body; Fins in spawning males have orange, black and pale bands; Long stocky body; Long snout overhangs the mouth; Tubercles, or bumps, present on male on head and body.

Size: Adults are 2 1/2 to 5 inches long.

Habitat: Found in clear streams over a hard bottom in runs and riffles.

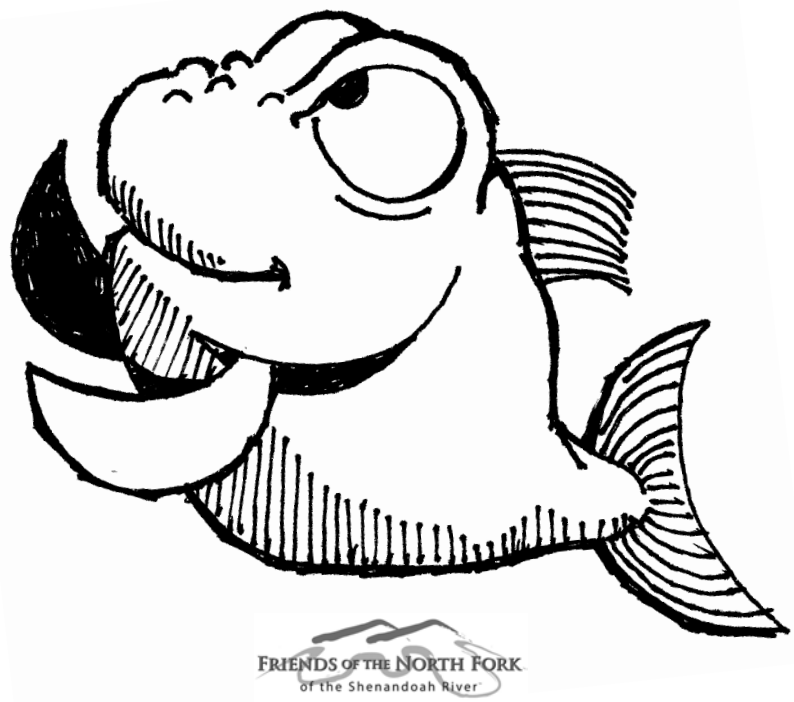
Distribution in Virginia: Found in all major watersheds in Virginia except the Rappahannock and York Rivers.

Food Habits: Eats algae and detritus, decomposing plant and animal debris.



What does the outline of the watershed look like to you? It looks like a bird to me!

Write & draw your answer here:



You Can Build a Watershed

Using salt dough or other materials, make a model of a watershed like the picture to the right. Make sure to have lower areas in the middle, surrounded by higher areas around the top and side edges.

Take a spray bottle filled with blue colored water and spray your watershed gently and sparingly. This represents rain.

Where does the water go?

Does water always flow downhill?

Look at your surrounding mountains. What happens to the water that rains on the very top of the mountains?

Are there areas where water pools or runs off?

Where do you think a river would form?

What does this say about the elevation of the Shenandoah River compared to the surrounding land and mountains?

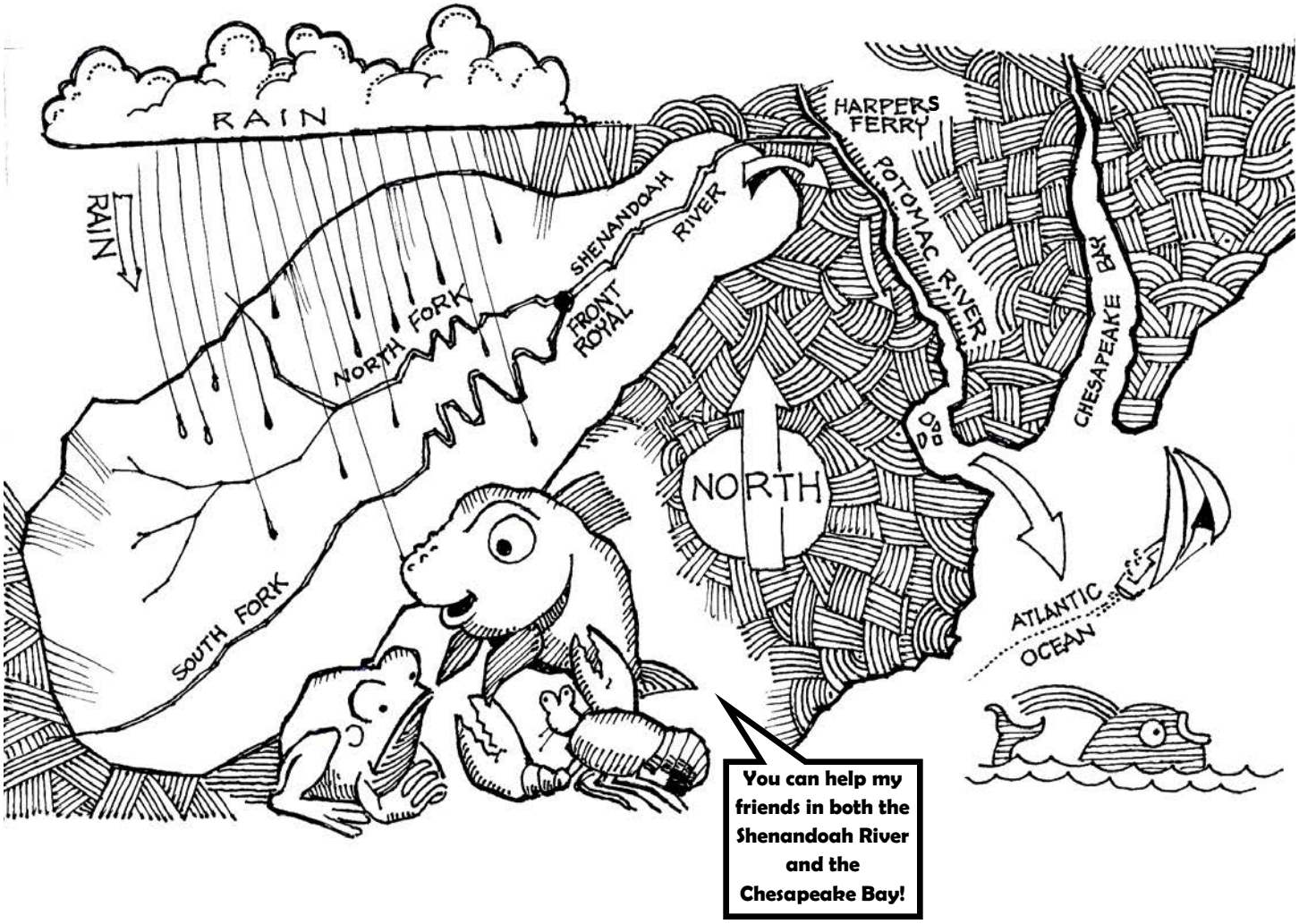
ANOTHER WAY TO MAKE A WATERSHED MODEL

Place small paper cups, crumpled newspaper or rocks at one end into a large shallow pan to represent mountains. Tear off a large piece of aluminum foil to fit into the pan and lay it over top of the “mountains”, making high and low points throughout the landscape to represent hills, valleys, rivers, streams and a bay or ocean.

SALT DOUGH RECIPE

Ingredients: 1 cup salt, 2 cups flour, 1 cup lukewarm water and 1 tbsp. vegetable oil.
Directions: In a large bowl mix salt and flour. Gradually stir in water and oil. Mix well until it forms a doughy consistency. If you want it to be colored, add green food coloring. With your hands form a ball with your dough and kneed it for at least 5 minutes. The longer you knead your dough the smoother it will be.

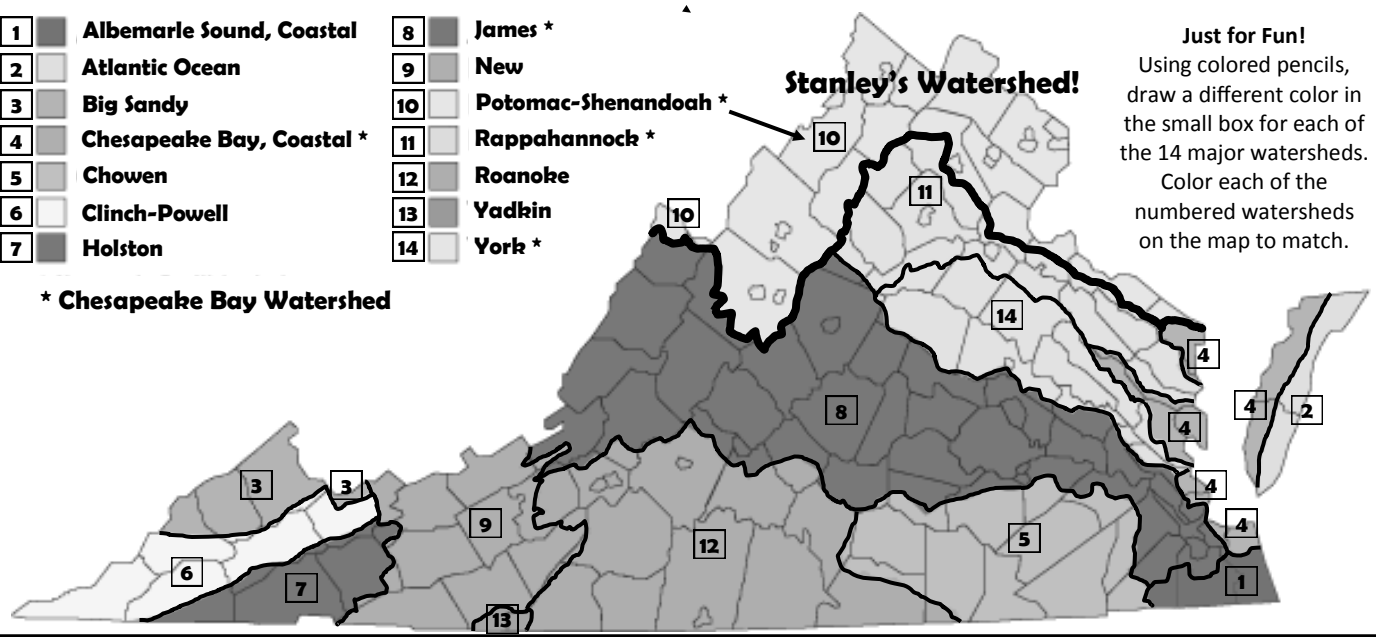
Follow my river to the Atlantic Ocean!



Major Watersheds in Virginia

1 Albemarle Sound, Coastal
2 Atlantic Ocean
3 Big Sandy
4 Chesapeake Bay, Coastal *
5 Chowen
6 Clinch-Powell
7 Holston
8 James *
9 New
10 Potomac-Shenandoah *
11 Rappahannock *
12 Roanoke
13 Yadkin
14 York *

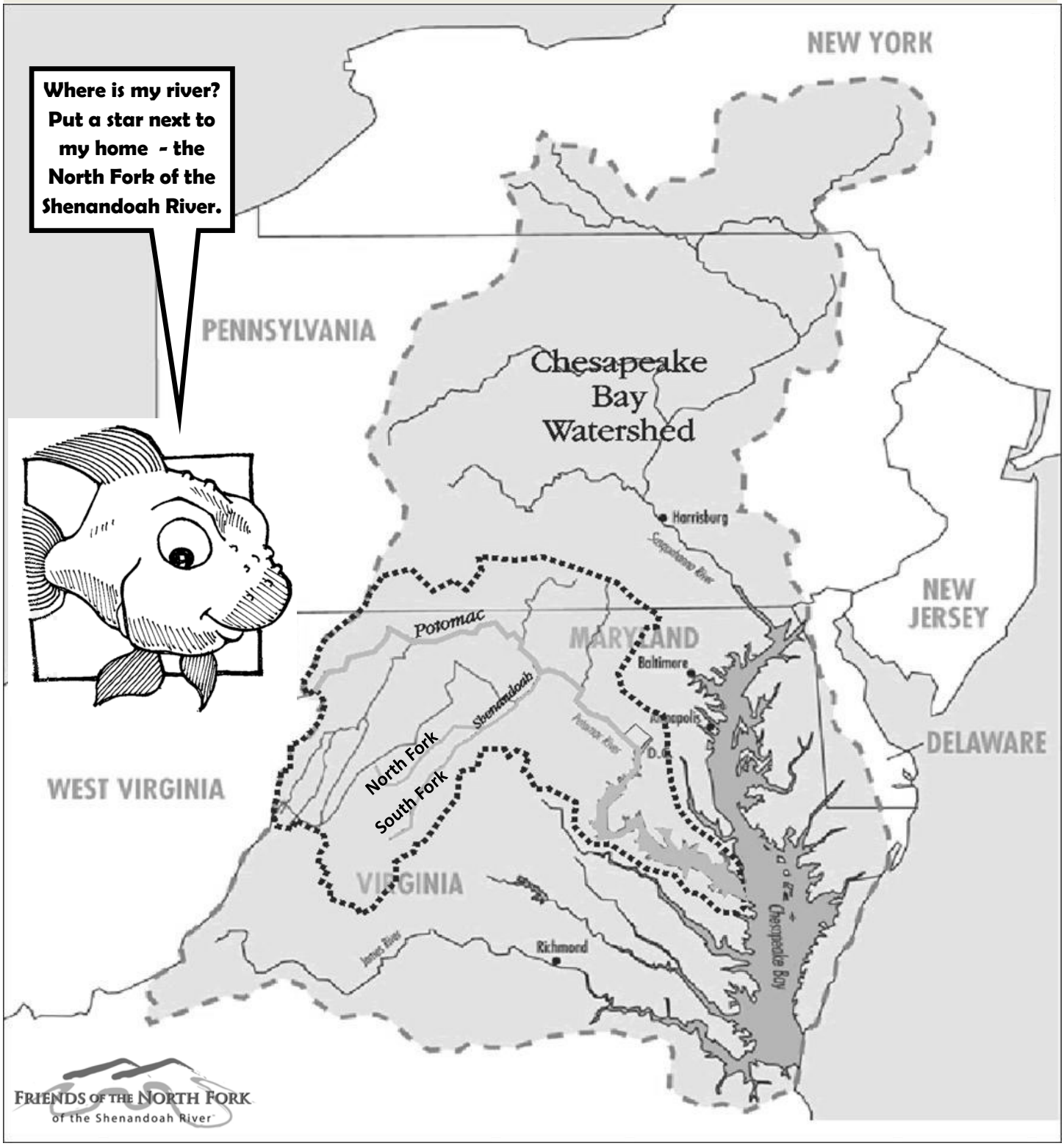
* Chesapeake Bay Watershed



Just for Fun!
Using colored pencils, draw a different color in the small box for each of the 14 major watersheds. Color each of the numbered watersheds on the map to match.

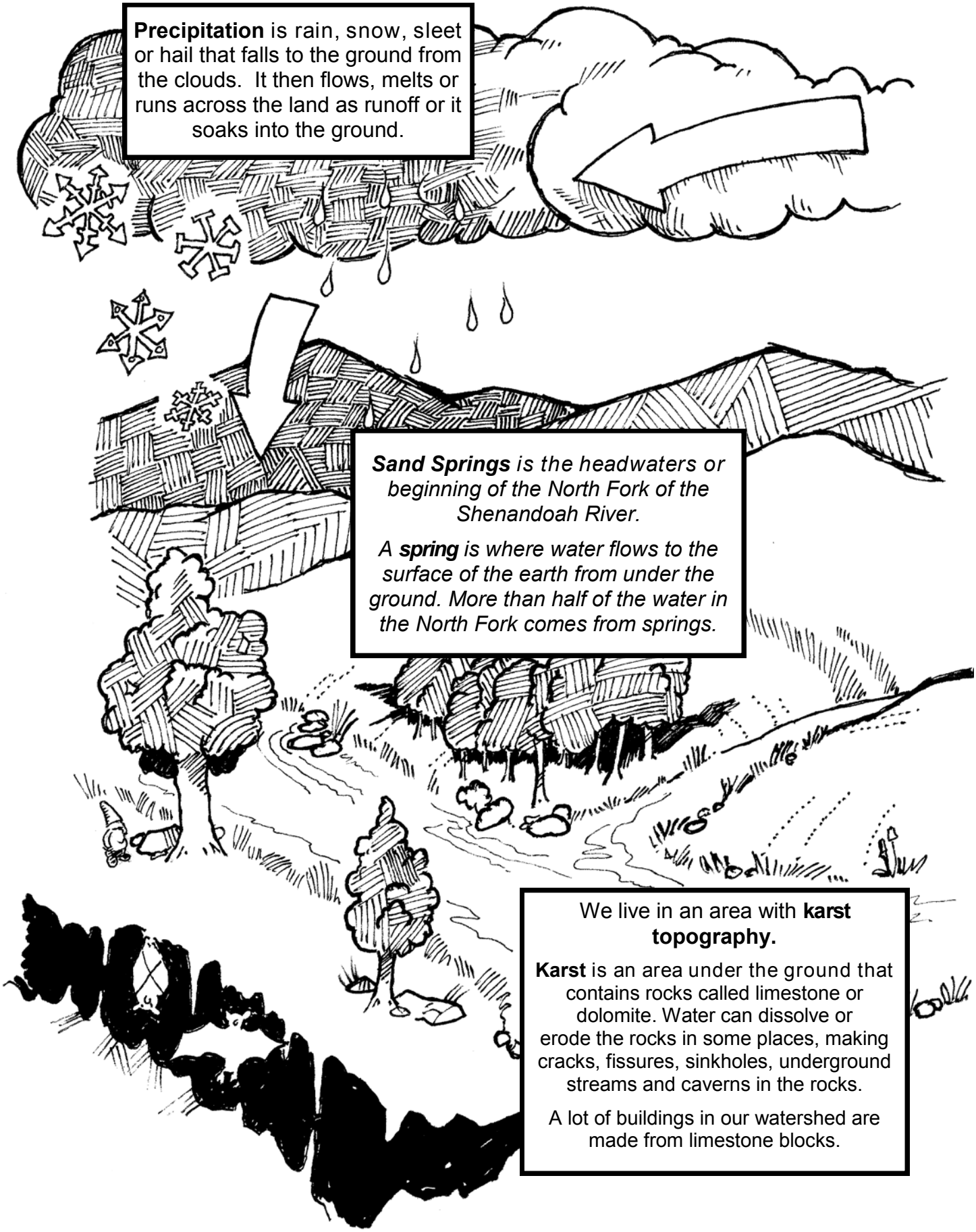
The **North Fork of the Shenandoah River** and the **South Fork of the Shenandoah River** meet to form the ***main stem* of the Shenandoah River** at Front Royal, Virginia. It then meets up with the **Potomac River** at Harpers Ferry, West Virginia.

The Potomac River passes by Washington, D.C. and flows into the **Chesapeake Bay**.



The health of the Chesapeake Bay is directly related to the health of our river, the North Fork of the Shenandoah River.

Where does river water come from?



Precipitation is rain, snow, sleet or hail that falls to the ground from the clouds. It then flows, melts or runs across the land as runoff or it soaks into the ground.

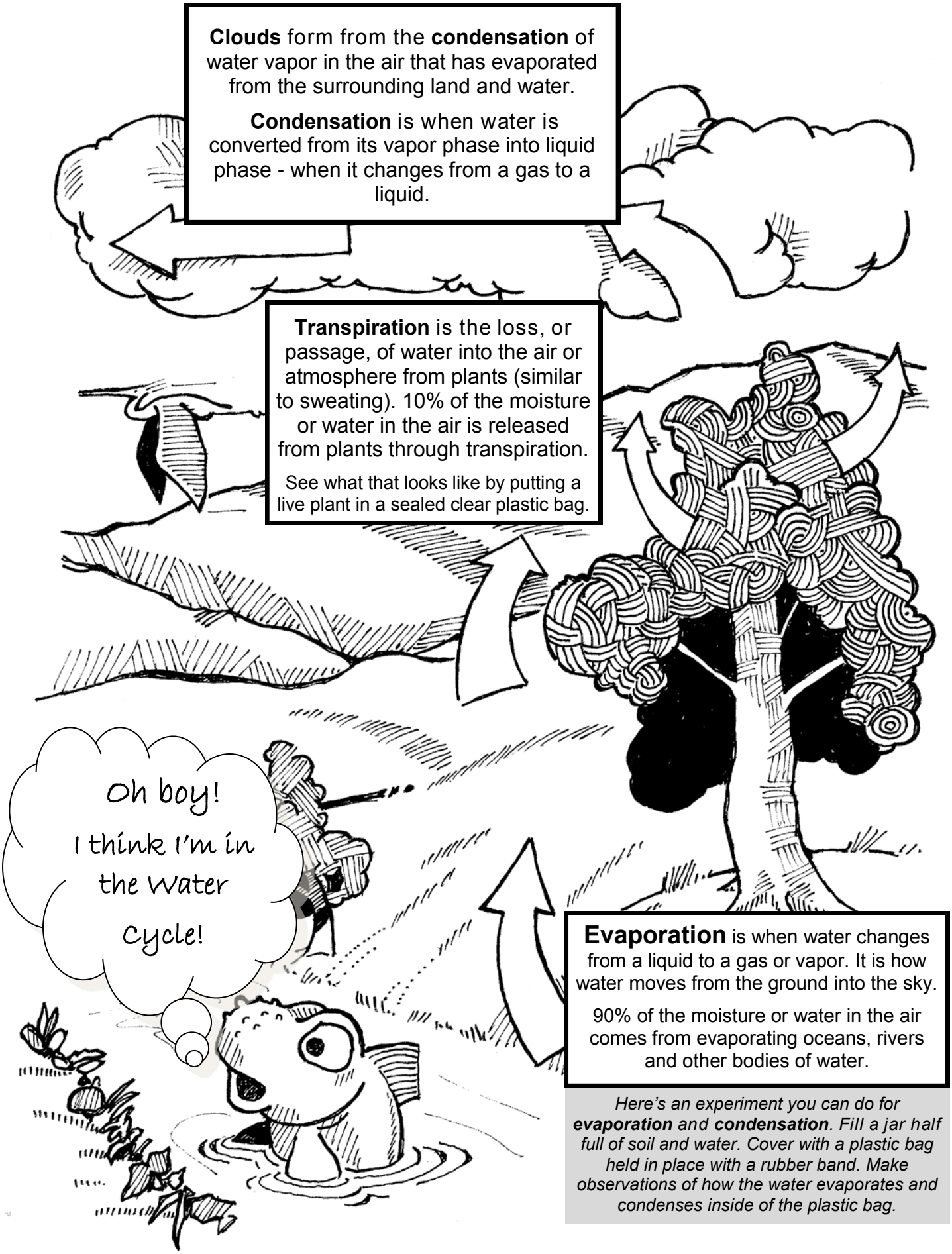
Sand Springs *is the headwaters or beginning of the North Fork of the Shenandoah River.*

A ***spring*** *is where water flows to the surface of the earth from under the ground. More than half of the water in the North Fork comes from springs.*

We live in an area with **karst topography.**

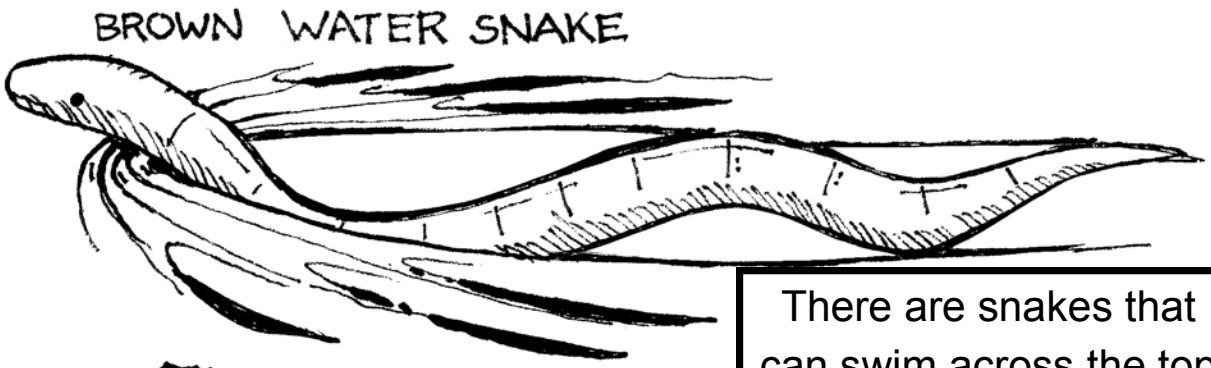
Karst is an area under the ground that contains rocks called limestone or dolomite. Water can dissolve or erode the rocks in some places, making cracks, fissures, sinkholes, underground streams and caverns in the rocks.

A lot of buildings in our watershed are made from limestone blocks.

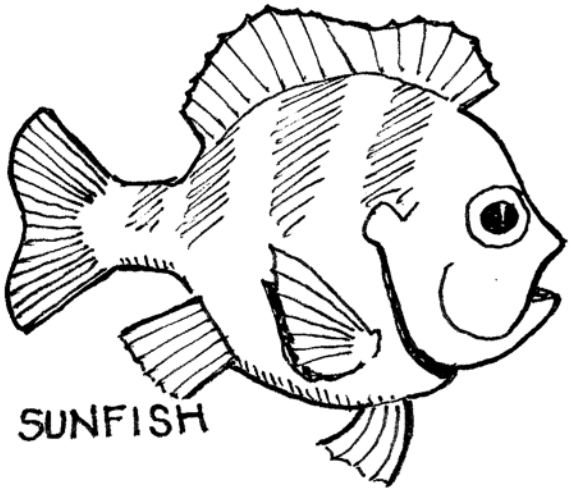


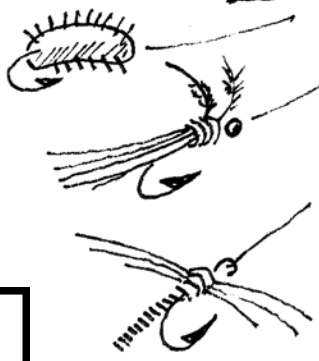
*Here's an experiment you can do for **evaporation** and **condensation**. Fill a jar half full of soil and water. Cover with a plastic bag held in place with a rubber band. Make observations of how the water evaporates and condenses inside of the plastic bag.*

Who lives in the river with Stanley?



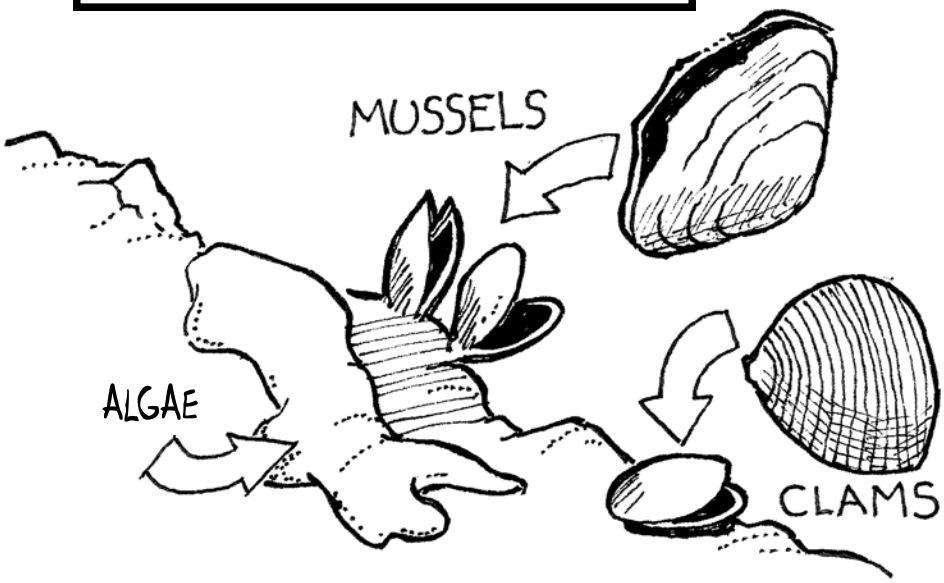
There are snakes that can swim across the top of the water in the river. They live on land and hunt for small fish.



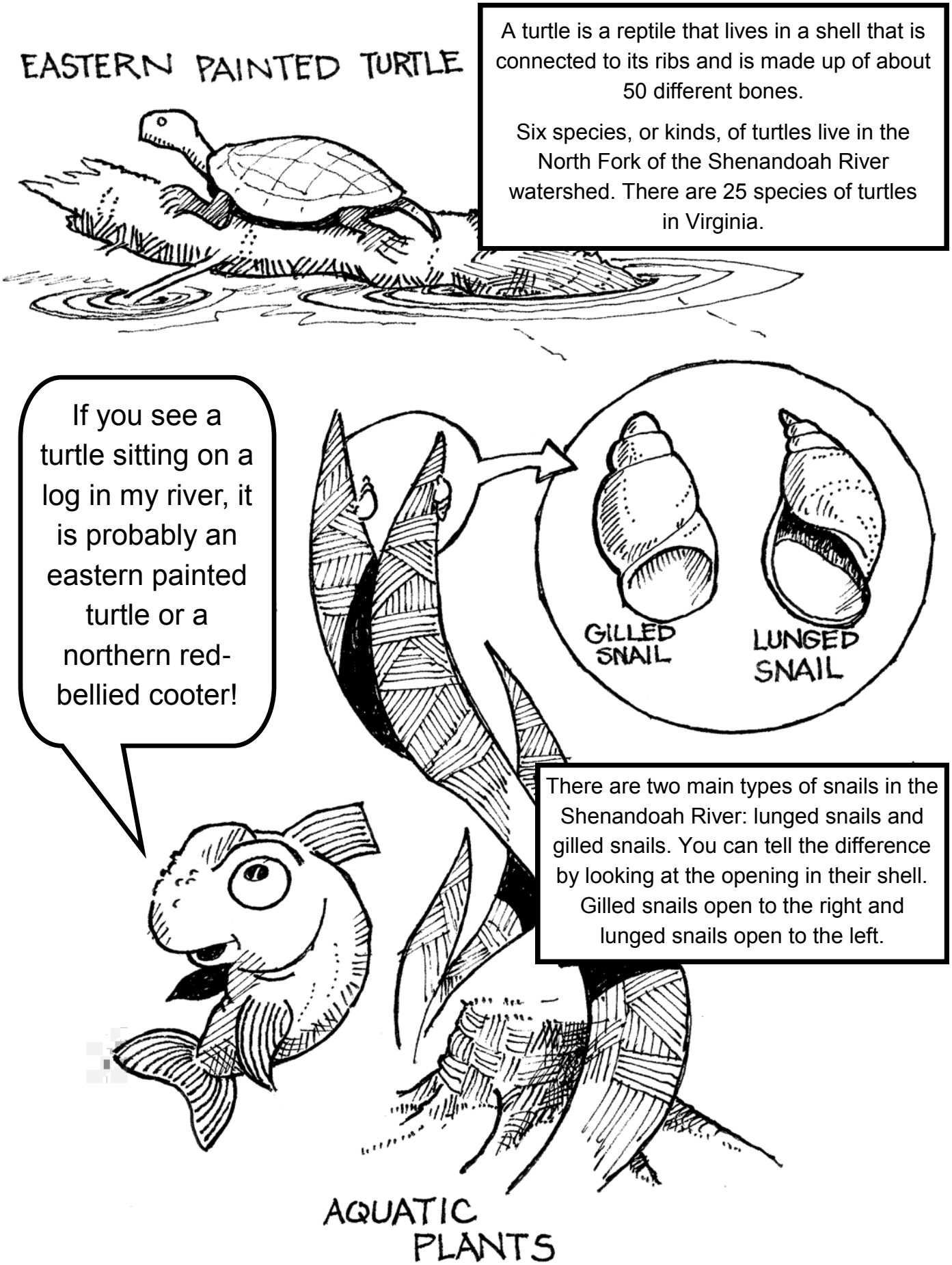


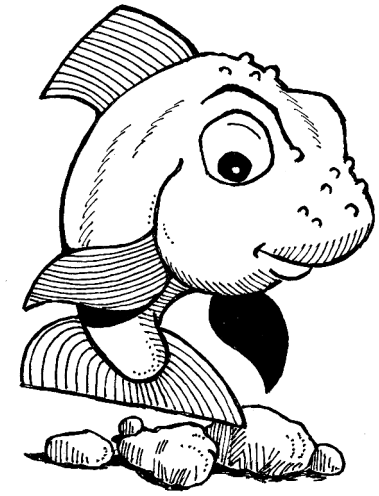
People who go fishing sometimes use lures called “flies” that look like river insects.

There are many different types of fish in the river, including bass, trout, and sunfish.



We can find freshwater clams and mussels in the river. Clams are rounder than mussels and are often lighter in color.


EASTERN PAINTED TURTLE
A turtle is a reptile that lives in a shell that is connected to its ribs and is made up of about 50 different bones.
Six species, or kinds, of turtles live in the North Fork of the Shenandoah River watershed. There are 25 species of turtles in Virginia.
If you see a turtle sitting on a log in my river, it is probably an eastern painted turtle or a northern red-bellied cooter!
GILLED SNAIL
LUNGED SNAIL
There are two main types of snails in the Shenandoah River: lunged snails and gilled snails. You can tell the difference by looking at the opening in their shell. Gilled snails open to the right and lunged snails open to the left.
AQUATIC PLANTS



Fish

My fish friends come in all shapes and sizes. What do you see in these descriptions that helps a fish fit into or adapt to living in the river?

Coloring

Fish have camouflage to hide from predators and disguise themselves from prey. They are colored to blend in with the river. When you are looking down at fish, they blend into the dark bottom of the river. When you look up underneath the fish, the lighter belly blends in with the sky.

Fish that have mottled coloring can hide in rocks and on the bottom. Fish with vertical or horizontal stripes can hide in vegetation.

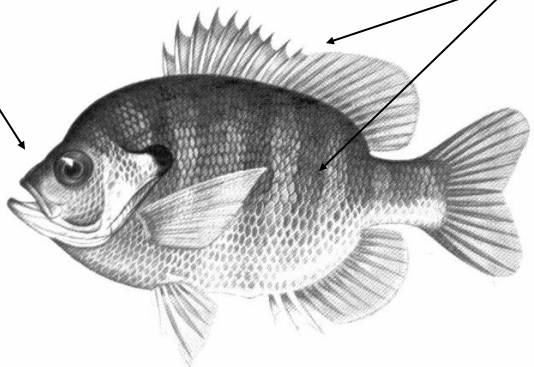
Mouths

A fish's mouth can tell you a lot about where they live and what they eat. A fish with a sucker shaped mouth feeds on very small plants and animals. A fish with a bottom facing mouth may eat algae off of rocks or bottom dwelling insects. A fish with an upward facing mouth may eat bugs off the surface.

Fish with jaws (like a bass) use their mouths to grasp or surround their prey or food. Fish with longer upper jaws feeds on prey below them, while fish with longer lower jaws feed on prey above them.

Sucker

Catfish



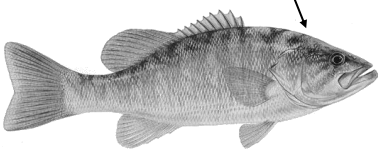
Sunfish

Protection

Some fish have spines to protect themselves from predators. Spines are usually part of fins.

Scales

Some fish have scales. Fish without scales (like eels and catfish) often have a slippery layer of mucous on their skin for protection.



Bass

Body Shape

A fish with a torpedo shape is a fast mover. A fish with a flat belly lives and feeds on the bottom. A fish with a hump on its back is stable in fast moving water.

Fish can also be shaped like a disk which is round and flat (like a sunfish).

Eel

FRIENDS OF THE NORTH FORK of the Shenandoah River

Design your own Fish!

Fish develop different parts or characteristics to fit into different environments or “niches”. When you design your fish think about where it would live in the river.

Can it swim fast? What does it eat? How far does it travel?

Does it need to protect itself? Does it need to hide? What color is it?

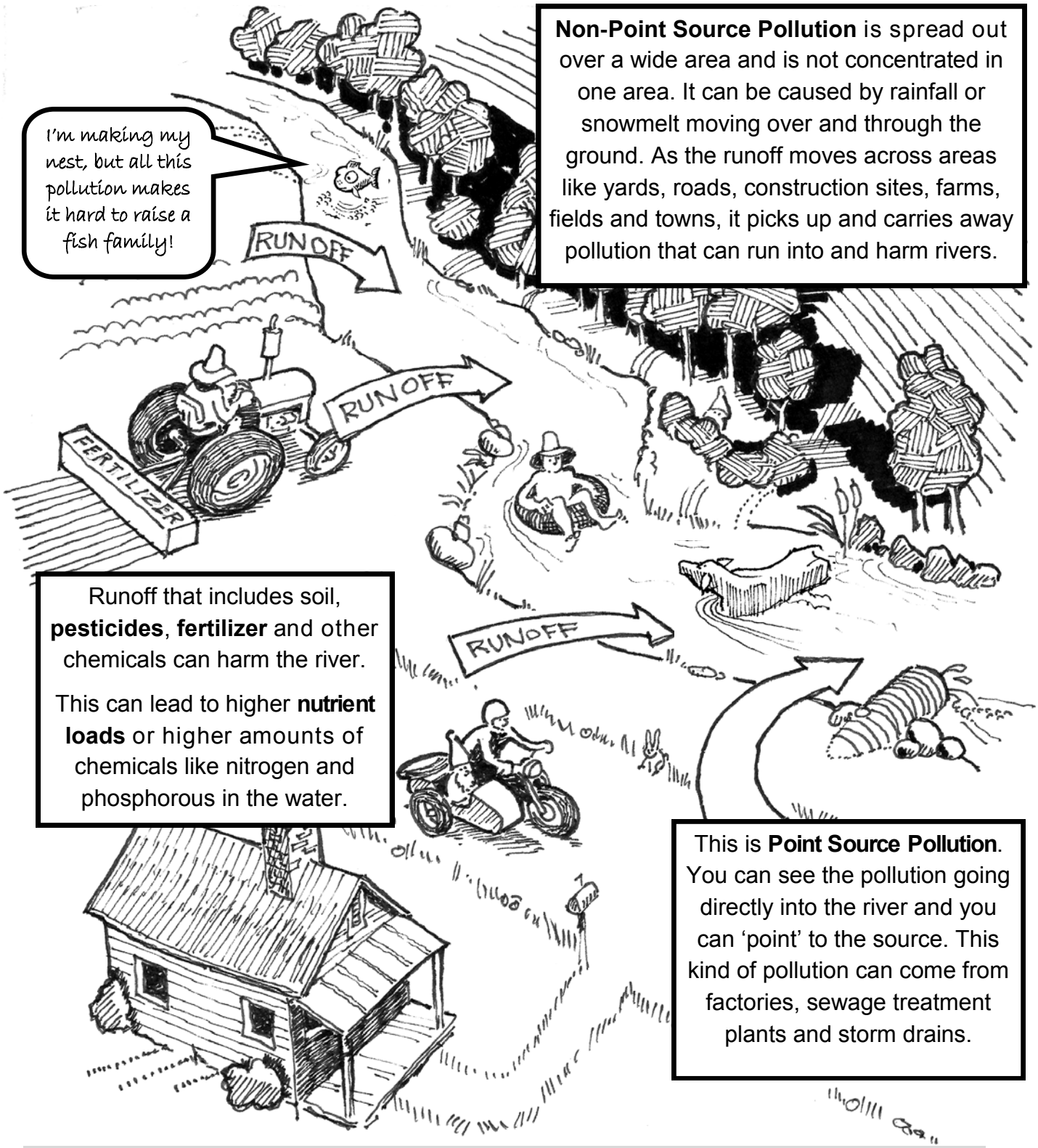
My Fish’s Name: _____

Where it Lives: _____

What it Eats:_____

FRIENDS OF THE NORTH FORK
of the Shenandoah River™

What Makes Rivers Dirty?



Non-Point Source Pollution is spread out over a wide area and is not concentrated in one area. It can be caused by rainfall or snowmelt moving over and through the ground. As the runoff moves across areas like yards, roads, construction sites, farms, fields and towns, it picks up and carries away pollution that can run into and harm rivers.

Runoff that includes soil, **pesticides**, **fertilizer** and other chemicals can harm the river.

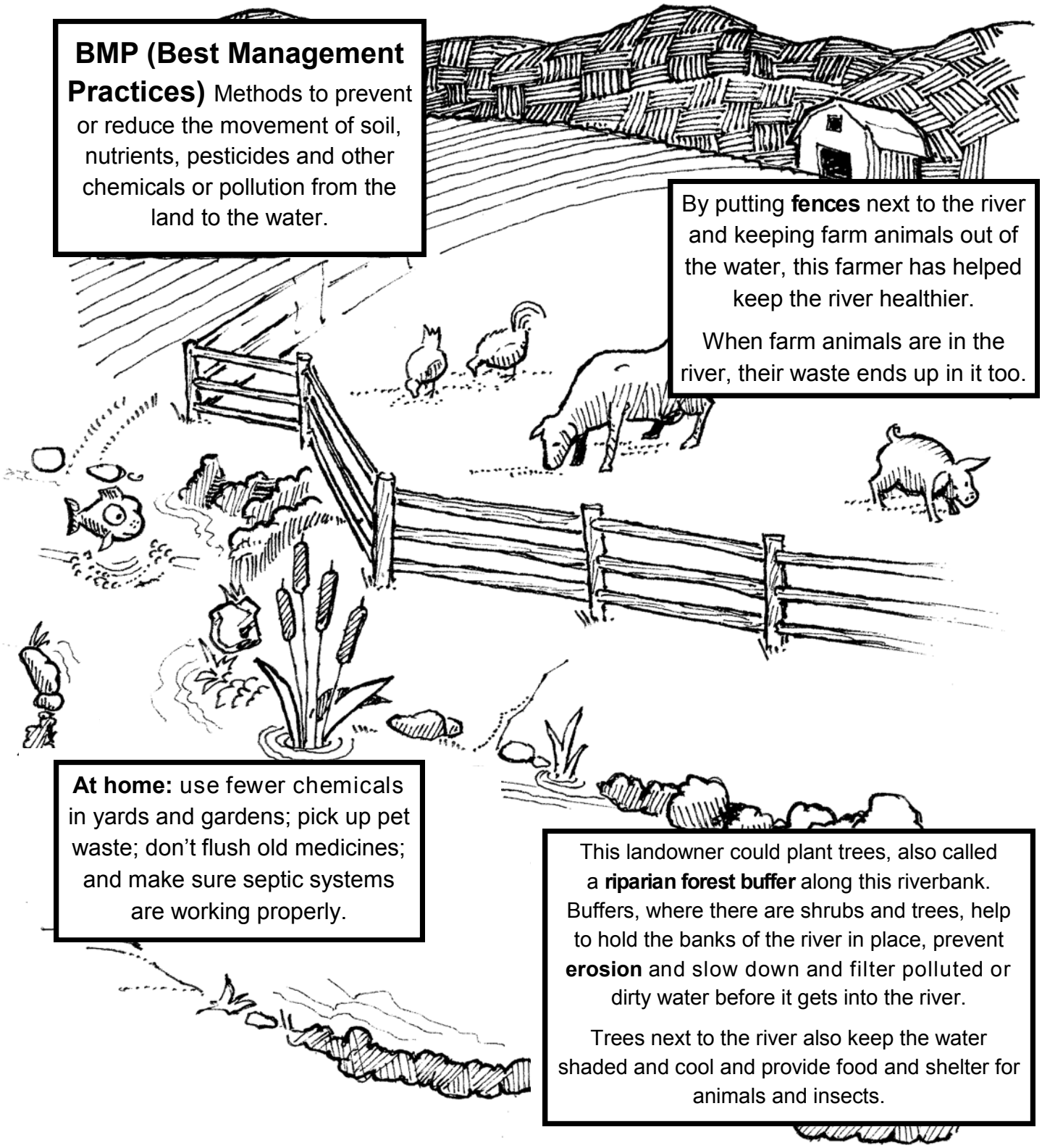
This can lead to higher **nutrient loads** or higher amounts of chemicals like nitrogen and phosphorous in the water.

This is **Point Source Pollution**. You can see the pollution going directly into the river and you can 'point' to the source. This kind of pollution can come from factories, sewage treatment plants and storm drains.

Here's an experiment you can do to show polluted runoff*. Lay a white plastic trash bag flat on the ground. Sprinkle the surface with colored sugar or spices. Spray it with water like it is raining.*

Make observations of how the water dissolves and carries the "pollution" into rivers of liquid on the bag.

How do we Protect Rivers?



BMP (Best Management Practices) Methods to prevent or reduce the movement of soil, nutrients, pesticides and other chemicals or pollution from the land to the water.

By putting **fences** next to the river and keeping farm animals out of the water, this farmer has helped keep the river healthier.

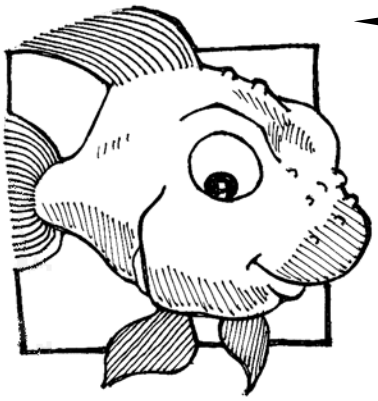
When farm animals are in the river, their waste ends up in it too.

At home: use fewer chemicals in yards and gardens; pick up pet waste; don't flush old medicines; and make sure septic systems are working properly.

This landowner could plant trees, also called a **riparian forest buffer** along this riverbank. Buffers, where there are shrubs and trees, help to hold the banks of the river in place, prevent **erosion** and slow down and filter polluted or dirty water before it gets into the river.

Trees next to the river also keep the water shaded and cool and provide food and shelter for animals and insects.

How do Stanley's FRIENDS protect the river?



Look at all my human friends! They are looking at river bugs and testing the river water to see if the levels of pollution are decreasing!

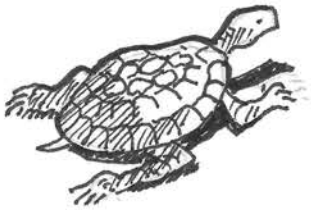
You can measure how healthy a river is by looking at what lives there. Volunteers use nets to catch "**benthic macroinvertebrates**", otherwise known as river bugs.

Benthic means they live on the bottom of the river.

Macro means they are big enough to see without a microscope.

And **invertebrates** means they are organisms that don't have a backbone.

By seeing what types of bugs or organisms are the most common, they can tell how healthy a river environment is, or if the water is polluted or dirty.



What can we measure?

Sometimes too much of a good thing can be a bad thing, especially with nutrients like **phosphates** and **nitrates**. Both of these **nutrients** can come from runoff of fertilizers used on farms and lawns. Too many **nutrients** can lead to an **algal bloom** (or a large amount of algae) where the algae blooms, dies, and sinks to the bottom. Once this massive amount of organic matter begins to decay, the bacteria take all of the oxygen out of the water, which in turn kills any other organisms that need oxygen to survive.

This is known as **eutrophication** and can lead to **dead zones** in the river and in the Chesapeake Bay.

pH

This measures the **acidity** or **alkalinity** of water. Neutral is 7. The range that the average freshwater fish can live at is between 6.5 to 7.5.

Nitrates

Too many **nitrates** from fertilizer runoff is the main cause of eutrophication.

Phosphates

High levels can be caused by pollution from fertilizers, but it is an important nutrient for organisms in appropriate amounts.

Dissolved Oxygen

Fish and other aquatic organisms need oxygen to survive. Colder water tends to be able to hold more oxygen than warmer water.

E. coli

A bacteria called *Escherichia coli* or E. Coli is a sub-group of fecal coliforms. Coliform bacteria grow in the intestinal tracts of warm-blooded animals and humans and are excreted in their feces.

Temperature

Temperature impacts both the chemical and biological characteristics of a river. It affects the dissolved oxygen level in the water, photosynthesis of aquatic plants, metabolic rates of aquatic organisms, and the sensitivity of these organisms to pollution, parasites and disease.

Turbidity

Turbidity is the cloudy appearance of water caused by the presence of suspended matter or solids. Higher turbidity increases water temperatures and reduces the concentration of dissolved oxygen. Suspended materials can also clog fish gills, blanket the stream bottom, and smother fish eggs and river bugs.

Help Stanley identify these macroinvertebrates or river bugs. Use the dichotomous key on the next page to help you identify and draw each river bug like the sample in #1.

FRIENDS OF THE NORTH FORK of the Shenandoah River

1

- Shell
- Single Shell
- Spiral, Opening on Right

Answer:

Gilled Snail

2

- No Shell
- Legs
- Three Pairs of Legs
- No Wings
- Three Tails
- Long Tails, Gills on Abdomen

Answer:

_____

3

- No Shell
- No Legs
- Worm-Like
- Suckers, Expands and Contracts

Answer:

_____

4

- No Shell
- Legs
- 10+ Legs
- Lobster-Like

Answer:

_____

5

- No Shell
- Legs
- Three Pairs of Legs
- No Wings
- No Obvious Tails
- Lives in Stone House

Answer:

_____

6

- No Shell
- Legs
- Three Pairs of Legs
- Wings
- Leathery Wings
- Swims Right Side Up, Back Black

Answer:

_____

7

- No Shell
- Legs
- Three Pairs of Legs
- No Wings
- One or Two Tails
- Tails Long and Stiff

Answer:

_____

8

- No Shell
- No Legs
- With Tentacles, Brushes or Tails
- Large, Grey With Tentacles

Answer:

_____

Key to Macroinvertebrate Life

FRIENDS OF THE NORTH FORK of the Shenandoah River

Adapted from a key developed by University of Wisconsin-Extension in cooperation with the Wisconsin Department of Natural Resources.

Shells

Single Shell

Spiral, opening on left

Lunged or Pouch Snail

Spiral, opening on right

Gilled Snail

Double Shell

2-8 inches

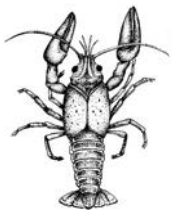
Freshwater Mussel

No Shells

Legs

10+ Legs

Lobster-like



Crayfish

Shrimp-like, swims on side

Amphipod or Scud

Four Pairs of Legs

Runs on top of water

Fishing Spider

Three Pairs of Legs

Wings

Beetle-Like, Wings Hard

Small, crawls on bottom

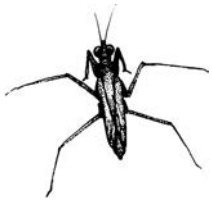
Riffle Beetle

Swims on surface

Whirligig Beetle

Leathery Wings

Lives on surface



Water Strider

Swims right side up, back black

Water Boatman

No Wings

No Obvious Tails

Large, hinged mouth

Dragonfly Nymph

Suction cup-like

Water Penny

Lives in stone house

Caddisfly Larvae

One or Two Tails

Dark head, green or tan body

Caddisfly Larvae

Tails long and stiff

Stonefly Nymph

Large mouthparts, spines on side

Dobsonfly or Fishfly Larvae

Three Tails

Plate-like tails, no gills on abdomen

Damselfly Nymph

Long tails, gills on abdomen

Mayfly Nymph

No Legs

With Tentacles, Brushes or Tails

Large, grey with tentacles

Cranefly Larvae

Small, black, attaches to rocks, etc

Blackfly Larvae

Worm-Like

Suckers, expands and contracts

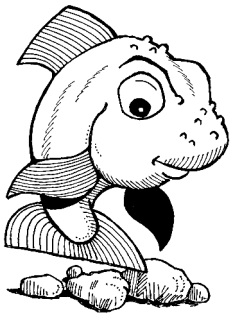
Leech

Glides along bottom

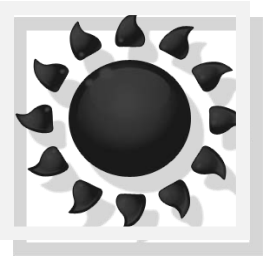
Planaria or Flatworm

Small, hairlike, swims in S shape

Thread-worm

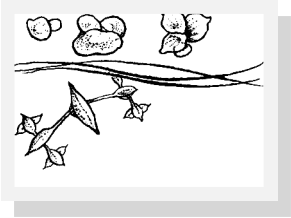


Help Stanley label the Food Chain in the river!



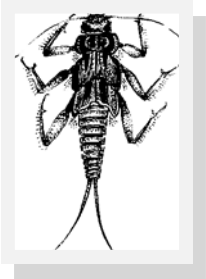
Energy from the sun enters an ecosystem through the process of photosynthesis, and is passed from plants through the ecosystem as one organism eats and is in turn, eaten. This energy flow can be modeled through relationships expressed in food chains or webs.

A food chain is the order or sequence of ***who eats whom*** for food and energy in an ecosystem.

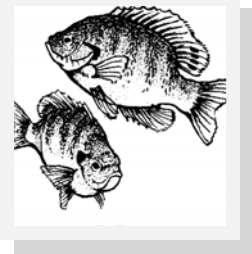


Match the words to the pictures by coloring in the boxes the color indicated.

Third Order Consumer	**White**
Decomposer (recycles nutrients)	**Black**
First Order Consumer (plant eater)	**Brown**
Producer (of energy)	**Green**
Energy Source	**Yellow**
Second Order Consumer	**Blue**

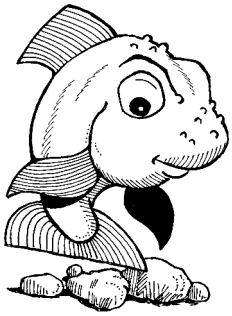


Draw arrows between the boxes to show the direction or transfer of energy.



Answers: Energy Source—Sun; Producer—Plants; First Order Consumer—Mayfly Larvae; Second Order Consumer– Fish; Third Order Consumer—Bird; Decomposer—Fungi.

Sun —> Plants —> Mayfly Larvae —> Fish —> Bird —> Fungi —>



Stanley's Word Search

FRIENDS OF THE NORTH FORK
of the Shenandoah River

S Y F S L I P N O H E Z D D T C A Z I Y
U C T R V L O R O T M D R C R K P S W V
M A C R O I N V E R T E B R A T E M X R
A I J R S P O A M C H T C X N Q H M K E
W L Z O U U M G I A I O W T S R A K N T
R A R W P N R B O R N P U Q P X V L C A
N E T O W I O D C D A Q I J I N M W U W
P O C E V H N F E G S P G T R K L P P D
O S I E R A Q N F N D A I N A F H T V N
L Z R T N S S I U E L Z E R T T L N F U
L C T E A A H T S P R I N G I L I I S O
U N H P T R R E L L O R E N O T S O K R
T S W I C I O Z D I H L I E N B I G N G
I Y O P E C S P C H E S A P E A K E Q Z
O N K N V I T R A M E Z D N A S I D V N
N N T Y C H R P K V M N H Q E K H A F E
N S X A D T E V K A E Q Z J G Y K J Q S
R Z S B A N A G G G N L J W F E C E X K
V F L E P E M S L A C I M E H C W W X N
V A U M P B D J X U D T B W Q N H S O K

BAY
BENTHIC
BMP
CHEMICALS
CHESAPEAKE
CONDENSATION
EROSION
EVAPORATION
GROUNDWATER
KARST
MACROINVERTEBRATE
NUTRIENTS
POLLUTION
PRECIPITATION
RIPARIAN
RIVER
RUNOFF
SHENANDOAH
SPRING
STONEROLLER
STREAM
TRANSPIRATION
WATERSHED

River Scavenger Hunt

Visit a river or stream and find these things!

Or if you can't go outside, hunt for pictures on a computer or in books or magazines. Or you can write the words on index cards and place or hide them along a pretend river in a room or along a hallway. Then have your friends, family or classmates look for them.

- ☐ a fish in the water
- ☐ a bird in flight or a feather
- ☐ a nest in a tree
- ☐ someone fishing, canoeing, kayaking or swimming
- ☐ a spider web
- ☐ an insect living in the water
- ☐ a turtle or salamander
- ☐ a snail living in the water
- ☐ tallest tree you can see
- ☐ a plant living in the water
- ☐ algae
- ☐ a snake
- ☐ a deep water hole
- ☐ an area with riffles or rapids
- ☐ trash or trash can
- ☐ a seed or seed pod
- ☐ a squirrel
- ☐ something yellow or red
- ☐ an animal other than a squirrel
- ☐ a flower that smells sweet
- ☐ a very small flower
- ☐ tree bark on the ground
- ☐ a frog or toad
- ☐ a fallen tree or hollow log
- ☐ animal tracks
- ☐ human tracks
- ☐ a rock big enough to stand on
- ☐ a rock that looks like an animal or an arrowhead
- ☐ something blue (not water!)
- ☐ something square
- ☐ a sign of soil erosion
- ☐ a hole in a tree or in the ground where an animal might live
- ☐ something black
- ☐ three different kinds of leaves
- ☐ animal scat (animal poop)
- ☐ something round

What runs all day but never walks; often murmurs but never talks; has a bed but never sleeps; has a mouth but never eats? *(A River)*

Fred the Frog's MATCHING GAME

To Learn How to Love Rivers and Help the Earth in 24 Easy Steps!

Take More Science Classes

Make Fewer Footprints

No Fertilizer Where It's Not Needed

Don't Burn Everything

Talk to Everyone About Rivers

Recycle Used Motor Oil + Chemicals at the Landfill

Take Shorter Showers

Volunteer

Don't Mow Everything

Take a Frog to Lunch

Drive Less

Plant Streamside Forests or Riparian Buffers

Read

Follow Directions for Pesticides

Don't Run Dish Washers Half Full

Clean Up After Your Dog

Use a Rain Barrel

Plant a Rain Garden

No Yard Trimmings to Landfill

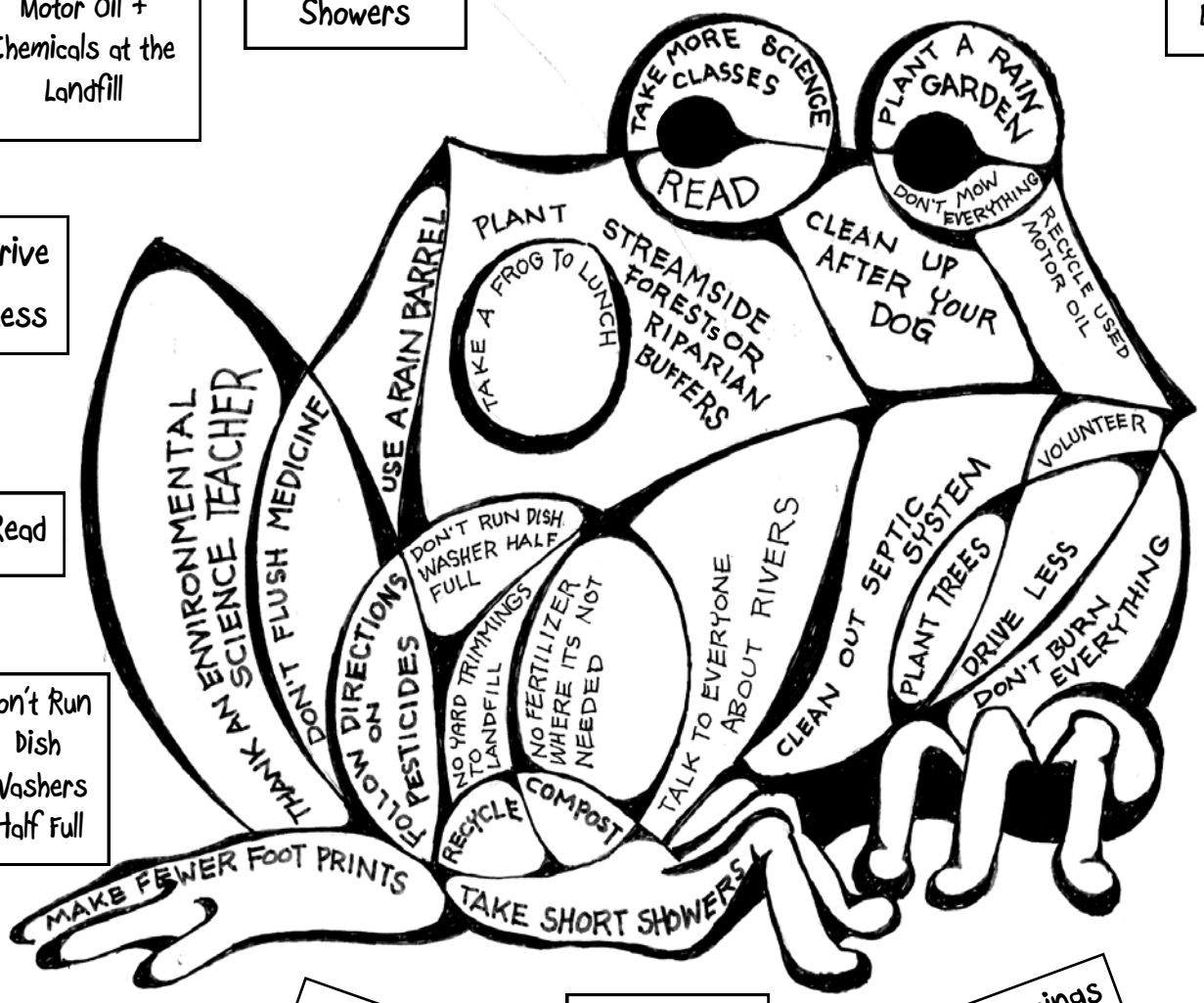
Thank an Environmental Science Teacher

Compost

Recycle

Plant Trees

Clean Out Your Septic System



Glossary/Key Terms

Algae: Organisms that are closely related to higher plants that perform photosynthesis and are commonly found in or near water.

Aquatic Macroinvertebrates: A group of organisms found in or near water that are large enough to be seen with the naked eye, yet lack a backbone.

BMP (Best Management Practices): Effective, practical methods which prevent or reduce the movement of sediment, nutrients, pesticides and other pollutants from the land to surface or ground water.

Chesapeake Bay: The largest estuary in North America.

Condensation: When water is converted from its vapor phase into liquid phase - when it changes from a gas to a liquid.

Dissolved Oxygen: Microscopic bubbles of oxygen that can be found within water.

Downstream: In, at or towards the end of a stream where it flows into a larger body of water.

Ecosystem: A community of living organisms and their interrelated physical and chemical environment.

Erosion: The wearing away of the land by water, wind or ice.

Estuary: The location where fresh water from a stream or river mixes with salt water from an ocean. Subject to the rise and fall of tides.

Eutrophication: Having water rich in nutrients that promote excessive growth of plant life, like algae. The algae overproduce and die off resulting in decomposition of the algae which reduces the dissolved oxygen content in the water. This may cause other organisms, such as fish and macroinvertebrates, to suffocate and die.

Evaporation: When water changes from a liquid to a gas or vapor. It is how water moves from the ground into the sky. Ninety percent of the moisture or water in the air comes from evaporating oceans, rivers and other bodies of water.

Fertilizer: A synthetic or non-synthetic product developed to enhance plant growth and health. High concentrations of fertilizer can be damaging to aquatic environments and creatures.

Groundwater: The water that flows beneath the ground, and comes to the surface in seeps and springs.

Headwaters: The upstream sources of water for a river or watershed.

Karst: An area that contains rocks called limestone or dolomite under the ground where water has dissolved or eroded the rocks in some places, making cracks, fissures, sinkholes, underground streams and caverns in the rocks.

Nitrogen: An element whose atomic number on the periodic chart is 7 and symbol is N. It is a required nutrient for many organisms, especially plants.

Non-Point Source Pollution: Spread out over a wide area and is not concentrated in one area. It is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves across areas like farms, fields, yards, roads and towns, it picks up and carries away pollution that can run into and harm rivers.

Nutrient: A compound or ingredient that is a source of nourishment to a living organism. If there are too many nutrients like nitrogen and phosphorous in a river, it can cause overgrowth of plants and algae.

pH: A classification of acid or base materials on a scale of 0 to 14, with 7 representing neutrality; numbers less than 7 indicate increasing acidity; and numbers greater than 7 represent increasing alkalinity (basic conditions).

Pesticide: A synthetic or non-synthetic product designed to control unwanted insects, animals, weeds or pathogens.

Point Source Pollution: You can see the pollution going directly in the river and you can 'point' to the source. This kind of pollution can come from factories, sewage treatment plants, storm drains and leaking septic systems.

Pollution: A harmful chemical or material that contaminates or "dirties" water, soil or air.

Precipitation: Rain, snow, sleet or hail that falls to the ground from the clouds. It then flows, melts or runs across the land as runoff or it soaks into the ground.

Riparian Forest Buffer: Areas where there are shrubs and trees help to hold the banks of the river in place and prevent erosion. They also slow down and filter polluted or dirty water before it gets into the river. Trees next to the river also keep the water shaded and cool and provide food and shelter for animals and insects.

Sediment: Soil that washes into streams and rivers.

Spring: A place where water naturally flows from under the ground.

Transpiration: The loss or passage of water into the air or atmosphere from plants (similar to sweating). Ten percent of the moisture or water in the air is released from plants through transpiration.

Stream: Any body of running water moving under gravity's influence through clearly defined natural channels to progressively lower levels.

Silt: Soil particles carried by runoff from unstable stream banks, construction sites, plowed fields, and residential areas.

Upstream: In, at or toward the source of a stream.

Watershed: An area of land that drains to a particular body of water such as a river, bay or ocean.

Water Quality: Refers to characteristics of water that make it suitable for human and ecological uses, such as drinking, swimming and maintaining healthy fish

Resources:

Cacapon Institute
www.cacaponinstitute.org

Chesapeake Bay Foundation
www.cbf.org

Friends of the North Fork of the Shenandoah River
www.fnfsr.org

Friends of the Shenandoah River
www.fosr.org
www.fosr.org/monitor.cfm

Lord Fairfax Soil and Water Conservation District
www.lfswcd.org

Natural Resource Conservation Service
www.nrcs.usda.gov

Potomac Conservancy
www.potomac.org

Shenandoah River Keeper
www.potomacriverkeeper.org/shenandoah

Trout Unlimited
www.tu.org

Virginia Department of Conservation and Recreation
www.dcr.virginia.gov

Virginia Department of Environmental Quality
www.deq.virginia.gov

Virginia Department of Forestry
www.dof.virginia.gov

Virginia Department of Game and Inland Fisheries
www.dgif.virginia.gov

Virginia Master Naturalist
www.virginiamasternaturalist.org

United States Environmental Protection Agency
www.epa.gov

USDA Forest Service - George Washington and Jefferson National Forests
www.fs.usda.gov/main/gwj/home

FRIENDS OF THE NORTH FORK
of the Shenandoah River

Friends of the North Fork

of the Shenandoah River™