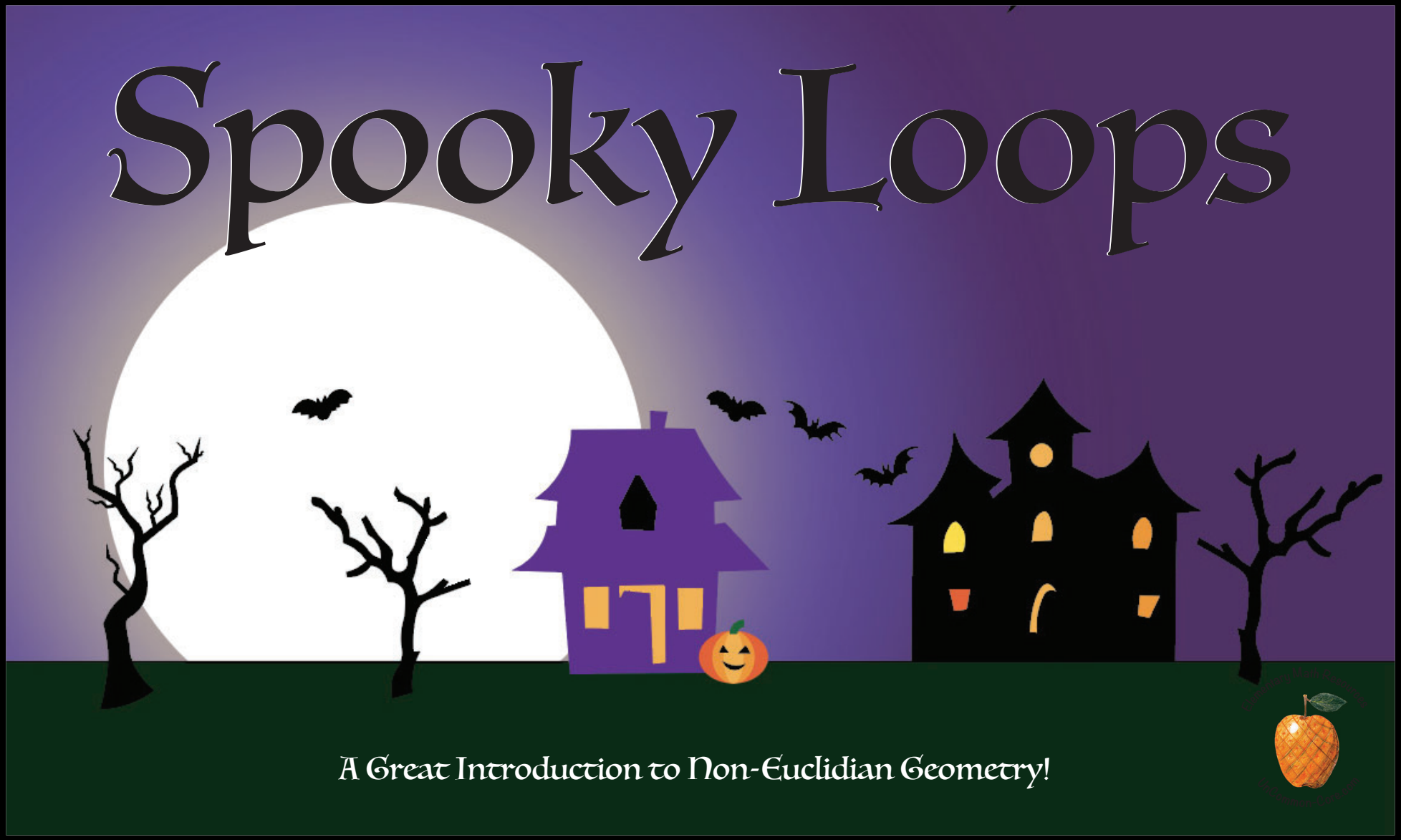
Spooky Loops



A Great Introduction to Non-Euclidian Geometry!

Hello Teachers,

Thank you for downloading this handout. After decades of teaching, now I am sharing some of the activities I designed for my students and some new ones as well.

Please, check out the self-paced teacher education courses on UnCommon-Core.com.

While you are there, sign up for your free copy of **Colorful Collections:** ***A Mindful Exploration of Proper Fractions.***

Also, visit my Teachers Pay Teachers store UnCommon-Core dot com.

Thank you again. All the best,

Isabelle

Isabelle Hoag M.Ed.
Director of Education
UnCommon-Core.com

Spooky Loops

Due to circumstances beyond control, the page numbers that print out are NOT the same as the page numbers indicated in Adobe PDF Reader. Use the page numbers from the PDF software when printing. I'm so sorry for the confusion!

Isabelle

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Planning Ideas

You could:

Make a big book and three large size loops. Demonstrate the activities as you read the story aloud. Show your students how to make twisted loops, or have prepared loops ready.

Plan an entire week of twisted loops. This would work particularly well if your class is having a Halloween party on Friday. If so, consider holding a Spooky Laugh event. Here is a suggested week long schedule:

Let students read the story and work on the activities in their free time. This project goes well with other academic subjects such as reading, writing, geography, geometry, and art.

Have your students repeat all the activities with loops made of plain, solid color paper in order to help them focus more on the shape and less on the illustrations.

Have your students try the activities on regular two-sided loops in addition to Möbius strips. Students might also be interested in seeing what happens when they use loops made with one complete twist. Use the regular and complete twist loops for comparison.

Let your students work with a buddy or work in small groups. If you have English language learners, introduce the vocabulary to them ahead of the activities. Have students who speak the same language at home work together in their first language to build comprehension.

Compose answers to writing prompts as a class. This helps everyone understand what happened in the activity. It also helps students find the language to describe what they did and it supports their reflective writing process.

Möbius Math Schedule

Day	Pages
Monday	2 - 3
Tuesday	4 - 7
Wednesday	8 - 9
Thursday	10 - 11
Friday	12 - 15

Vocabulary List:

Circumference, length around circle
Diameter, distance across a circle
Edge, border, perimeter
Fold, crease, bend, crimp
Height, distance from bottom to top
Inside out, reversed,
Loop, band, chain link, ring
Möbius Strip, a twisted loop with one side and one edge
Properties, characteristics, attributes, traits that can be listed to define an object or shape
Right-side up, vertical, not upside down
Twist, turn, flip, curve, warp
Upside down, inverted, wrong side up, upended, overturned

Preparation and Printing

This project relies upon printing out the pages correctly. The front and back pages should match perfectly. This is less important for the book, but imperative for the loops. Hold the paper up to a light in order to make sure the center lines match perfectly.

In the print dialog box, do not select 'print booklet.' Make sure to print at 100% or to scale all pages by the same amount. Set the page margins to zero in the 'page setup' tab.

Test your printer settings by printing out single copies of the book and the loops. Assemble the book and loops to ensure they printed correctly. Adjust settings as needed until you are ready to print copies for your students.

Print the pages of the book on white paper. Print loop 1 on green paper, loop 2 on pink paper, and loop 3 on blue paper.

Use a long arm stapler to reach the middle of the book. Fold the pages first, then staple in the middle crease. Put the rough edges of the staples on the outside of the book. Then cover them with some decorative tape. This prevents any chance of someone getting poked by a staple.

Each student will need a book and all three illustrated loops. Eventually, your students will be able to make Möbius strips without a template. This is a fantastic use for the paper in the recycling bin.

Finally, there is a Story Summary loop which students will enjoy making at the end of this project.

Materials

Pencil
Eraser
Scissors
Glue stick
Long arm stapler
Copies of handouts
Crayons or colored pencils
Washi tape or similar tape
White, pink, green, blue paper

Making Loops

Students need three loops in order to do the activities. All of the loops have similar illustrations. It will be a lot easier if you have students make one loop at a time.

The loops should be cut out very carefully. Tell your students to imagine that they are cutting down the middle of each solid line.

Each loop is made of two paper strips. Some of the strips have capital letters at the ends. Put glue on each set of matching letters. While the glue is sticky, hold the strips as shown in figure 1. Match A to A and B to B.

Flip the paper in the right hand over so that it is on top of the paper in the left hand. (figure 2) The glue and the letters are in between the strips of paper. Make sure there aren't any letters showing on the finished loop.

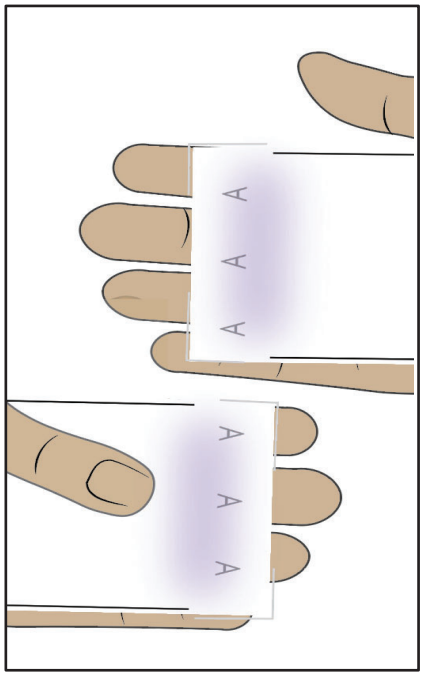
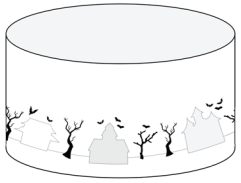


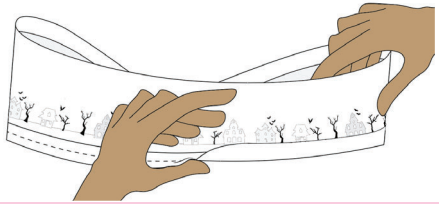
figure 1



Loop 1 Green
Normal loop

Activities:
1, 6 & 7

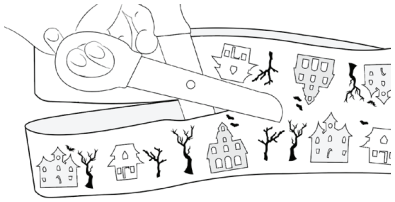
Two sides:
Front and back
Two edges:
Top & bottom edges fold independently
Two streets:
Orange and Green



Loop 2 Pink
Twisted loop

Activities:
1, 2, 3, 6 & 7

One side:
One line goes all around the loop
One edge:
Folding up 'bottom' edge shows one edge goes around twice
One street:
Bike ride shows one, long street



Loop 3 Blue
Twisted loop

Activities;
1, 4, 5, 6 & 7

One side:
One line goes all around loop
One edge:
Folding up 'bottom' edge shows single edge all around
One street:
Bike ride shows one, long street

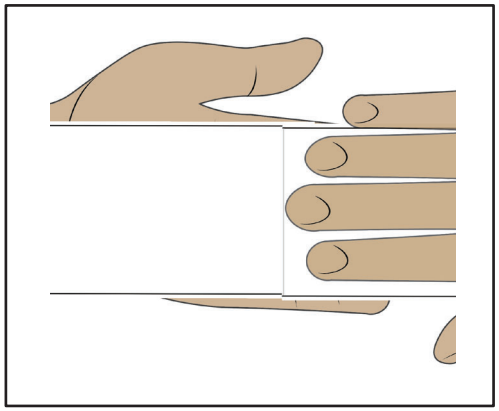
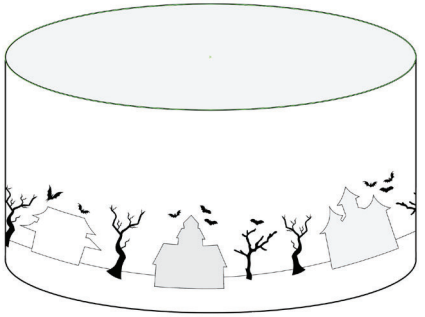


figure 2

Teacher Tips



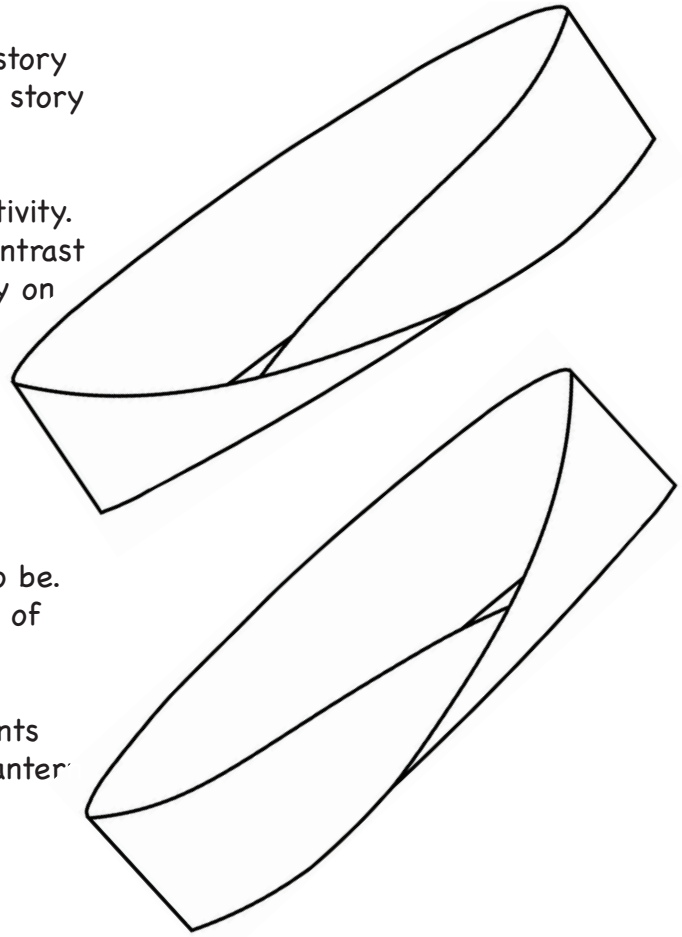
Introduction

When students first get their books, they will want to write their names on the cover and look through the pages. Do a picture walk through the book in order to familiarize them with the format. This will give them an idea of the types of activities they will do. Help students notice the story is presented on pages with even numbers, and the activities on the opposite pages.

As you work through the book, encourage students to find connections between the story and the activities. Have students highlight sentences that relate to the activities. The story will help students explain the unique properties of twisted loops.

Each activity page has two questions for students to answer after completing the activity. Use these questions to start a class discussion. Always have students compare and contrast what happens with twisted loops versus normal loops. Have them preform the activity on Loop 1 if there is any doubt as to what would happen.

Give students time to sketch the loops at various stages throughout the book.



1) Halloween and Make Three Loops

Loop 1 shows the village as it should be. Everything is the way we would expect it to be. The house with the jack-o'-lantern is on Orange Street. Trace along the bottom edge of Orange street and Green Street.

Ask students to find the moon on each loop. As the title of the story suggests, students can use the moon as a reference point. There is also a small, but important, jack-o'-lantern which can be used to help keep track of places on each loop.

Let students use the space on page 3 to make notes about the loops.

Discussion Questions: If this happened to you, how could you tell if you were right side up or upside down? In this story, you will play the part of The Powers That Be; what do you think you might have to do? How are each of these loops similar? How are they different? Is this fiction or nonfiction? How do you know?

2) Bike Ride and Draw the Bike Path

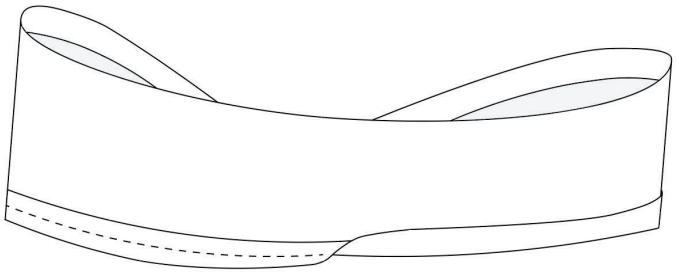
After reading page 4, have students color in the picture of the house, moon, and jack-o'-lantern, adding drawings of the children at the beginning of their bike ride.

The edge of Loop 2 has plenty of room for a bike path. Have students draw an orange line half way between the horizon and the edge of the paper.

Find the place on Loop 2 where the children look up and see their parents in front of their friend's house. Draw tiny pictures of the children looking up at their parents and their friend's house, and parents looking up at their children. Who do you think is upside down? The jack-o'-lantern is on the reverse side of the paper ~ if the loop was transparent, you would see it clearly.

Discussion Questions: The text says, ". . . Orange Street and Green Street were the same street." What does that mean? What happened to Orange Street and Green Street?

3) Village Meeting and Edges of a Twisted Loop



This might be a good time for a conversation about how to disagree with other peoples' ideas without being disagreeable.

Have eight students and a narrator read page six aloud. Highlight words inside quotation marks if needed. Explain that some of the dialog foreshadows events that will happen later in the story.

The Powers That Be are mentioned. Help students connect the story and activities. Invite students to explain how bringing ". . . the ground up closer to their houses," connects with the activity of folding up the bottom edge of loops.

Let students use the orange line around the edge of Loop 2 as a guide while they fold the edge of the paper up to meet the horizon line behind the houses. Remind them that the instructions say not to fold the top edge of the loop!

Discussion Questions: How many edges does a twisted loop have? (Hint: one.) How do they know? (They only folded up the bottom edge and yet when they got back to where they started, the entire edge of the loop had been folded.)

4) Plan A and Folding Loops in Half

Listen while students explain why they couldn't fold the twisted loop in half. What happened when they tried? You might borrow some vocabulary from folding origami models to help students explain the situation. Mountain folds arch up like the peak of a mountain and valley folds dip in the middle as the name suggests.

Discussion Questions: What is Plan A and how well do you think it will work? (Plan A part 1 was to fold up the edge of the loop to keep the houses grounded so they would stay in place. Part 2 is to have the sky folded in half.) Was anything that happened on this page foreshadowed on page six? (No.) How many sides does a twisted loop have? (One.)

5) Plan B and Cutting Loops in Half

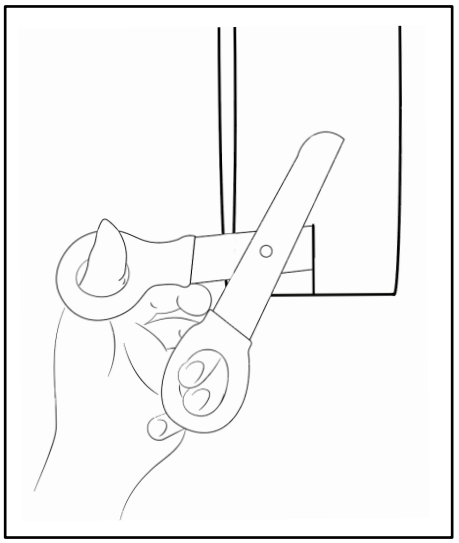
The last sentence on page ten says, "Watching giant scissors snip the dark blue air in half was **one of the scariest things** that happened in Tulane on Halloween." Challenge students to illustrate the page with other scary things that could be seen on Halloween. Set limits as needed. For example, you could challenge students to create a picture of a scary jack-o'-lantern, costumed character, bat, or even a hair-raising mathematical equation.

Discussion Questions: How can a twisted loop turn into a normal loop? (Encourage all thoughtful answers. The only way to really change a twisted loop into a regular loop is to cut it, untwist it, and paste it back together.)

6) The End?

Have students illustrate the wild Halloween party according the description.

The last sentence of the story links back to the beginning. The entire story is one big loop. Every year the village turns upside down for a day and every year the villagers forget it happened. This was foreshadowed in the conversation near the bottom of page six.



To start cutting in the middle of a loop, fold as shown. Snip both layers in the center of the folded edge.

6) Compare

Have students discuss all the similarities between the two types of loops. It might be easier for them to work on this activity in small groups.

This is a good time to have students draw a detailed pictures of each type of loop.

Discussion Questions: How can you be certain that you have listed all the properties these loops share?

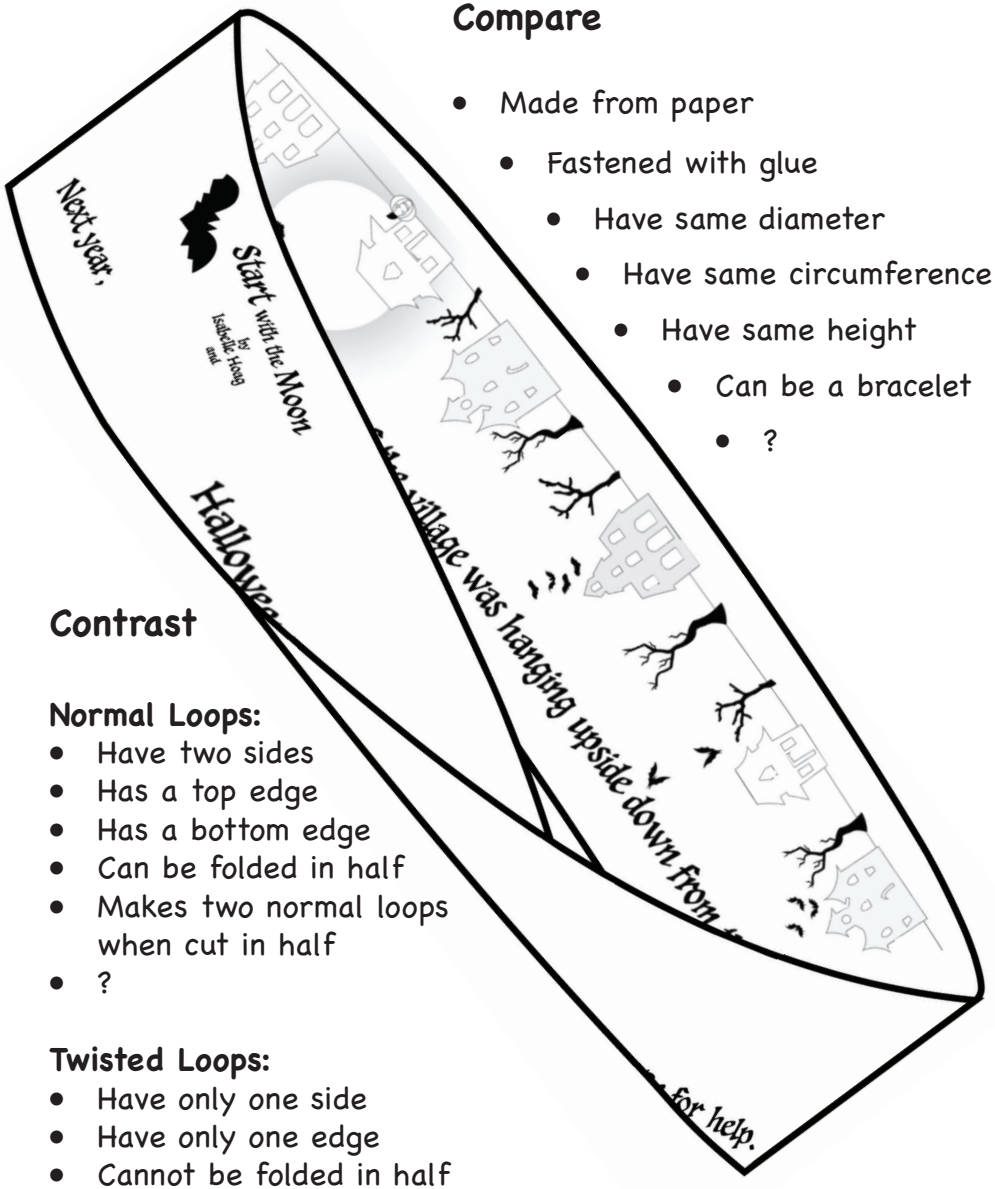
7) Contrast

Encourage students to list all the unique characteristics of each loop separately. Help them review each activity to make sure their lists are complete.

Discussion Questions: What other activities could you do with the loops to test for more unique properties? For example, after folding up the 'bottom' edge of a twisted loop, what would happen if you cut along that line?

Story Summary Loop

Your students will enjoy making one, final, twisted loop to show how the story repeats itself every year. Students could illustrate the prepared story loop, or they might want to write their own summary
on a blank loop.



Compare

- Made from paper
  - Fastened with glue
    - Have same diameter
      - Have same circumference
        - Have same height
          - Can be a bracelet
            - ?

Contrast

Normal Loops:
- Have two sides
- Has a top edge
- Has a bottom edge
- Can be folded in half
- Makes two normal loops when cut in half
- ?

Twisted Loops:
- Have only one side
- Have only one edge
- Cannot be folded in half
- Make a single two-sided twisted loop when cut in half
- ?

Answer Key

2) Draw the Bike Path

What happened? The orange line went all around the twisted loop and ended up back where it started. Even though the line was made along the 'bottom' edge it ended up at the top sometimes.

Does that happen when you go for a bike ride? No. We would have to bike around the world to end up back where we started. When we bike around town we have to change direction to get back to where we started.

3) Edges of a Twisted Loop

What happened? The folded edge goes all around the entire loop.

What would happen if you folded the bottom edge of a normal loop? Only one edge would be folded.

4) Folding Loops in Half

What happened? It wasn't possible to fold the twisted loop in half. When it got around to the beginning of the fold, one fold was like a valley and the other was like a mountain!

Do you think this would happen if you folded a normal loop in half? No, a normal loop would fold in half like a mountain all the way around.

5) Cutting Loops in Half

What happened? The twisted loop changed into one long two-sided loop. That long, thin loop was still twisted. The illustrations were all facing up.

What would happen if you cut a normal loop in half? It would make two, thin normal loops.

6) Compare

Both:

Are made from paper
Were fastened with glue
Have same illustrations
Have one moon pictured
Have a jack-o'-lantern
Were made by me

7) Contrast

Normal Loops:

Have two sides
Has a top edge
Has a bottom edge
Can be folded in half
Makes two normal loops when cut in half

Twisted Loops:

Have only one side
Have only one edge
Cannot be folded in half
Make a single two-sided twisted loop when cut in half

FRONT Loop 1 Green Normal loop

Used in activities: 1, 6 & 7

A A A A A

B B B B B

BACK Loop 1 Green Normal loop

Used in activities: 1, 6 & 7

FRONT Loop 2 Pink Twisted loop

Used in activities: 1, 2, 3, 6 & 7

B B B

A A A

B B B

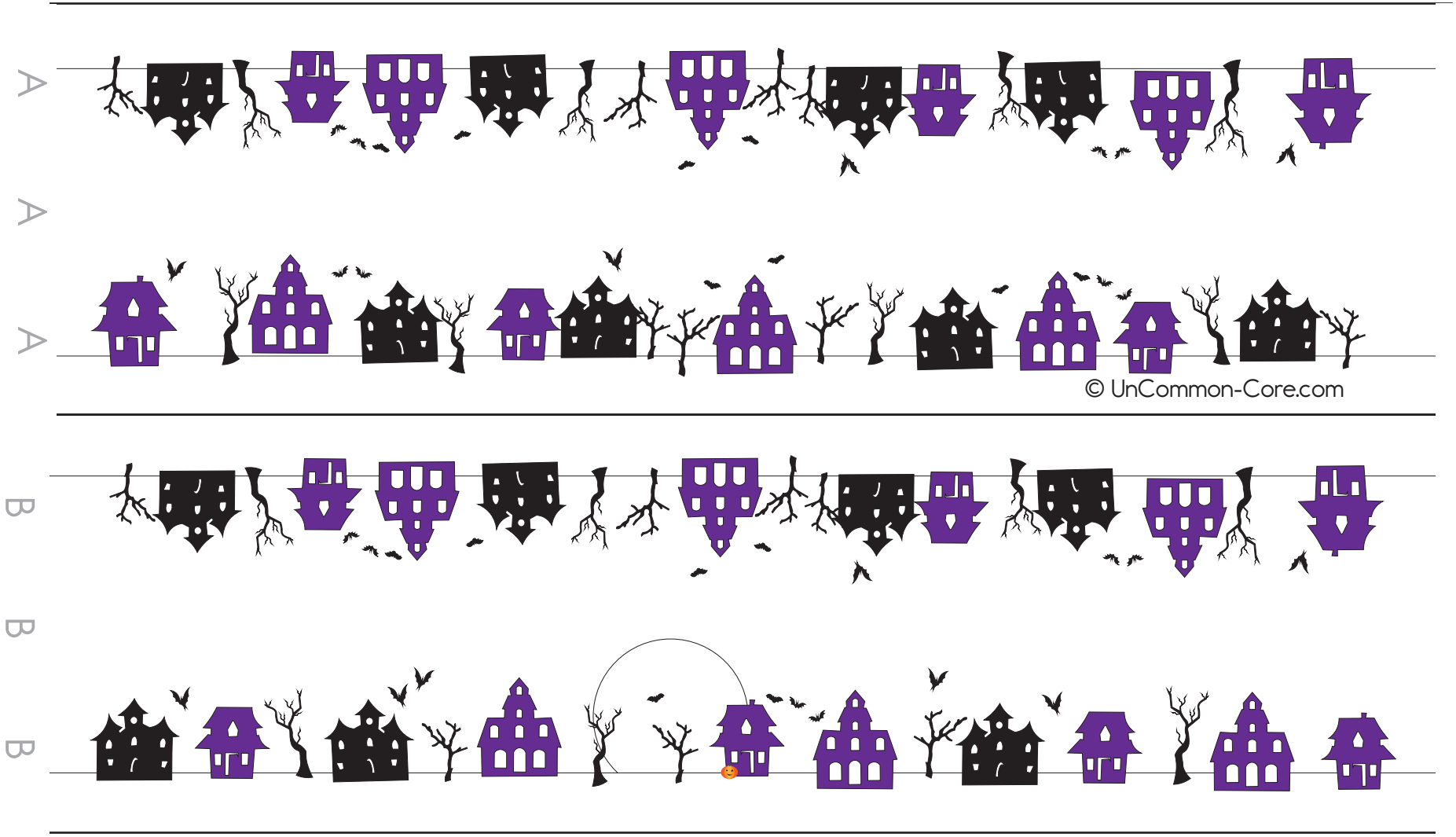
A A A

Back Loop 2 Pink Twisted loop

Used in activities: 1, 2, 3, 6 & 7

FRONT Loop 3 Blue Twisted loop

Used in activities: 1, 4, 5, 6 & 7



B B B

BACK Loop 3 Blue Twisted loop

Used in activities: 1, 4, 5, 6 & 7

FRONT Story Summary

Twisted loop

Start with the Moon

by
Isabelle Hoag
and

Next year, Halloween came early to the village of Tulane.

B B B

Everyone in the village cheered! Then they had a wild Halloween party.

A A A

That morning, half of the village was hanging upside down from the sky!

B B B

YIKES! The villagers asked the Powers That Be for help. The plan worked!

A A A

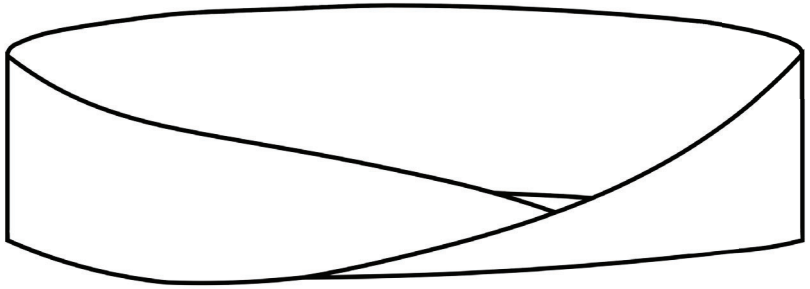
BACK Story Summary

Twisted loop

Story and Activity Book

Spooky loops do not act like normal loops. This book combines a quirky Halloween story with activities that explore the properties of twisted loops.

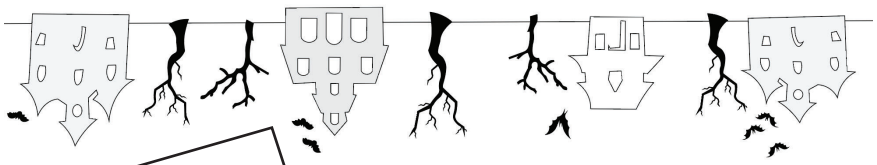
Invite your students on an endless journey, discovering the crazy things happen because of a single, little twist.



Möbius strips provide students with a thoughtful introduction to topology ~ the area of mathematics that studies geometric properties of shapes.

Start with the Moon

by
Isabelle Hoag
and



Dear Reader,

In this story you play the part of The Powers That Be.

You're welcome,

Isabelle

Halloween

Halloween came early to the village of Tulane.

Strangely, that morning all the houses on Green Street could be seen hanging upside down above the houses on Orange Street. Well, some said that the houses on Orange Street were hanging upside down over those on Green Street.

"This is a surprise!" neighbors called up to their friends above.

"Happy Halloween!" their friends called back.

At first, the situation seemed kind of silly. It was funny to see large houses, trees, buses, cars, bikes, cats, dogs, and people hanging from the sky as if they weren't upside down at all.

7) Contrast

List ways normal and twisted loops are different.

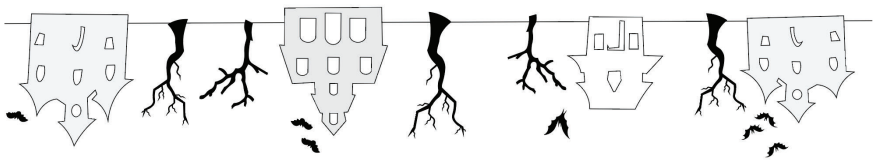
6) Compare

List ways normal loops and twisted loops are alike.

Möbius Math

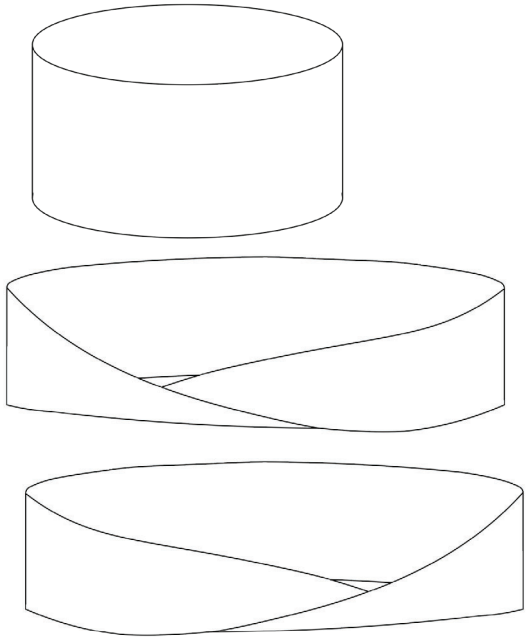
Twisted loops were first discovered in 1858 by Johan Listing and August Möbius. Since then, mathematicians have been fascinated by the properties of these shapes.

Möbius strips have just one side and one edge. This is why turning up the 'bottom' edge creates a continuous fold along the whole loop. These unusual properties are also responsible for other strange things that happen when folding, drawing on, or cutting up Möbius strips.



1) Make Three Loops

Make the loops one at a time. Cut out the paper strips. Paste over the letters. Match letters and wait for the glue to dry. Write your name on all of them.



Bike Ride

Some children went out for a bike ride. They noticed that Orange Street and Green Street were the same street. They started their bike ride in front of a friend's house. They followed the road straight ahead. They didn't turn left or right. They didn't change direction.

The children on bikes were completely amazed when they saw their friend's house hanging above them! The whole house, the jack-o'-lantern, and all the houses on that street were hanging from the sky! Their upside down parents were next to the upside down house wondering why the children were upside down.

"How did you get up there?" mothers called up to their children.

"Why are you hanging from the sky?" asked the fathers.

"We rode our bikes in a straight line," the children called up to their parents. "We aren't hanging from the sky ~ you are!"

The children kept biking straight ahead. They didn't turn left or right. They didn't change direction. Eventually, they got back home.

Under the light of a full moon, the entire village went to a wild Halloween party. Everyone wore terrifying costumes. The village radio played weird music. They bit at apples floating in a tub of water. For the children, there was a Best Spooky Laugh contest.

By and by, the villagers forgot all about upside down houses. Maybe they dreamt the whole thing.

Next year ~

The End?

When it was done, everyone cheered! The people thanked The Powers That Be. They were overjoyed that nothing was hanging upside down from the sky. All the houses, trees, buses, cars, cats, dogs, and people were right side up once more. Tulane had two streets again.

2) Draw the Bike Path

The children met in front of a friend's house to go on a bike ride. Their friend's house has a jack-o'-lantern next to it. Since their friend lived on Orange Street, use an orange color to draw the path.

The children were always right side up. If they had turned upside down, they would have fallen off their bikes! Draw the line along the bottom edge of the loop. Keep drawing until they get back home.

What happened?

Does that happen when you go for a walk or bike ride? Please explain.

Village Meeting

The villagers called a meeting.

"Since there is only one street now, let's call it Orange Street," said some who had always lived on Orange Street.

"Hang on," others replied. "Why not call it Green Street? We have always lived on Green Street."

A few wanted to change the name of the village from Tulane to Langston and name their only road Same Street. That wouldn't really solve the problem, though.

One old man said, "The Sun and Moon shine on all streets."

"Didn't this same thing happen last year?" some asked.

"Did it?"

"I don't recall."

"Doesn't anyone remember?"

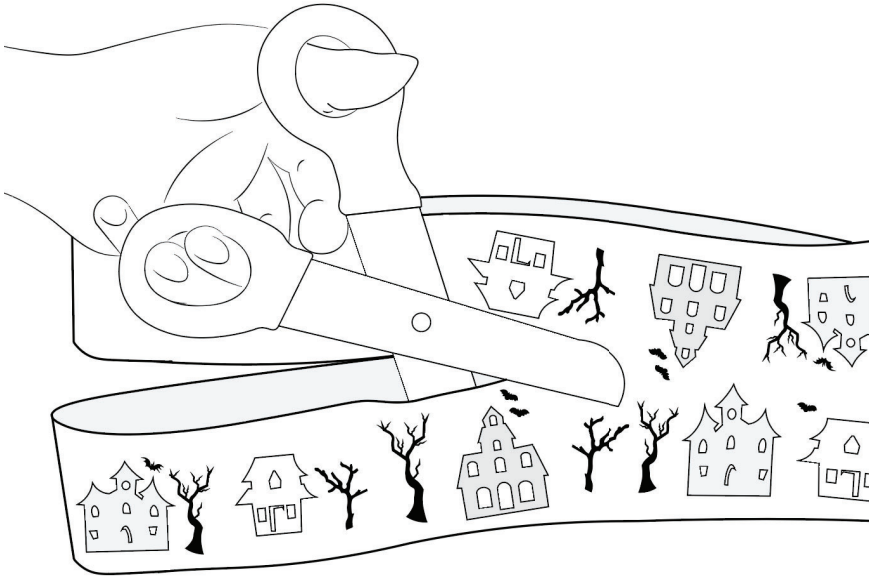
"I thought we dreamt that."

By the time the sun set, and a full moon was rising, the villagers had agreed upon a plan. First, they had to stop the houses from drifting closer. Then, they had to get things back to normal.

They asked The Powers That Be to bring the ground up closer to their houses. The people hoped that bringing the ground closer to their houses would keep them from moving any more.

5) Cutting Loops in Half

Use Scissors to cut straight along the middle of the loop. Follow the line you drew earlier.



What happened?

Explain what would happen if you did the same thing to a normal loop.

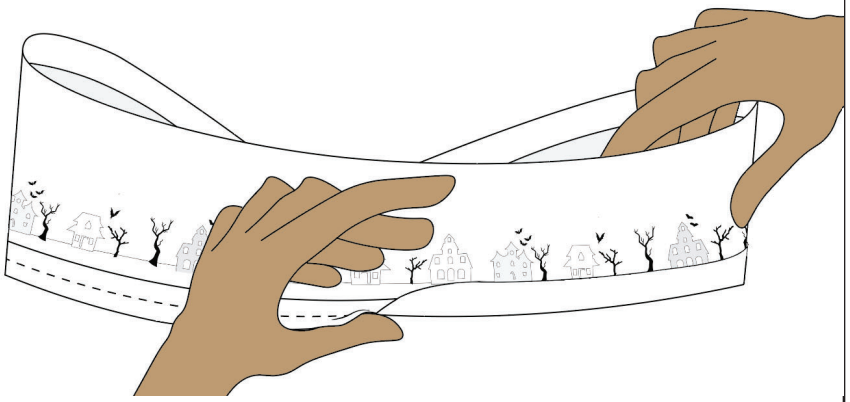
Plan B

At first, it seemed as if this idea was going to work. However, at the last minute, with only a few upside down houses left in the sky, the plan fell apart.

Since that idea didn't work, the villagers asked The Powers That Be to separate the sky in two along the middle. Watching giant scissors snip the dark blue air in half was one of the scariest things that happened in Tulane on Halloween.

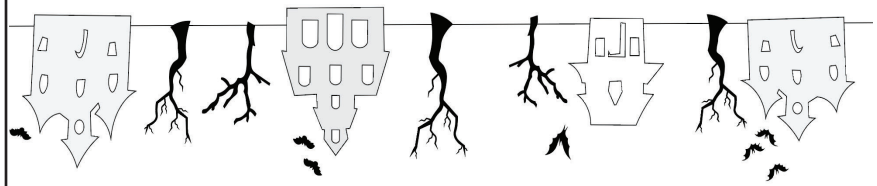
3) Edges of a Twisted Loop

Fold the bottom edge of the strip up until it meets the horizon line. Continue around the bottom edge of the loop. Do not fold the top edge of the loop.



What happened?

What do you think would happen if you did the same thing to a normal loop?



Plan A

It worked!

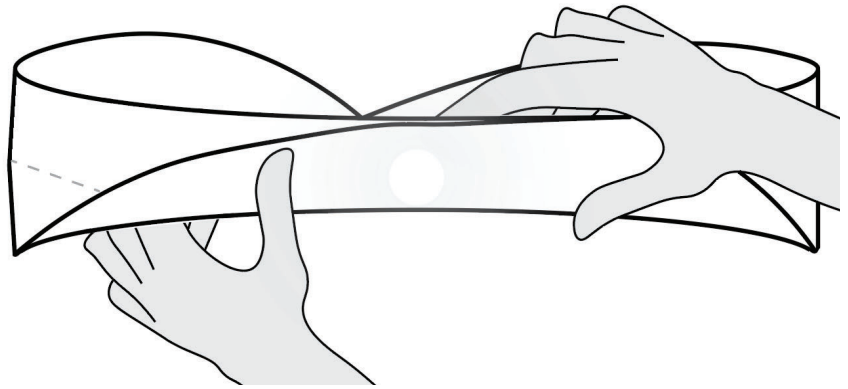
The extra earth anchored each house firmly. Everyone was pleased and encouraged.

Next, villagers asked The Powers That Be to fold the sky in half so that people on both streets would once again agree on which way was up and which way was down.

4) Folding Loops in Half

First, draw a line down the middle of the loop keep going in the same direction do not turn left do not turn right.

Fold the twisted loop in half. Bring both edges together so they line up. Then crease along the middle of the loop.



What happened?

Explain what you think would happen if you folded a normal loop in half.

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