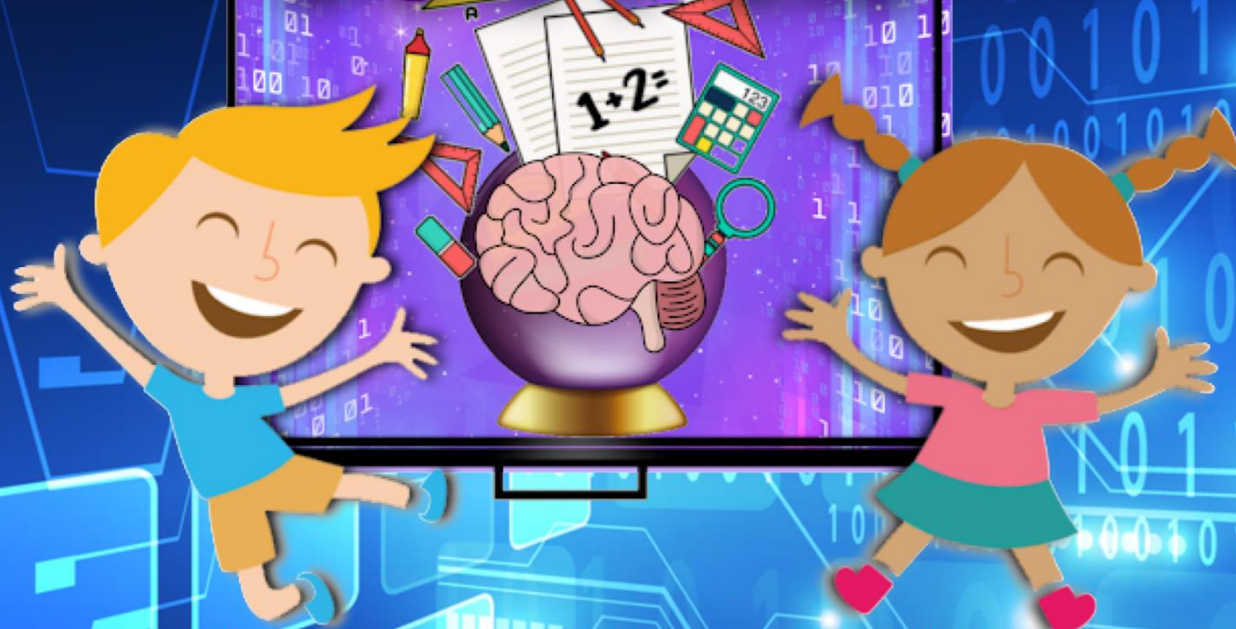


# STAGES

Productions

Presents

## NUMBERS DON'T LIE



**THE TRUTH ABOUT HOW MATH  
HAS CHANGED CIVILIZATION**

When two failing math students, Algie & Bree take a trip to an enchanted museum, anything can happen. (song-Endless Possibilities) After falling behind their tour group, the kids stumble upon an old broken-down exhibit called "The Brain." The premise is that you can ask the Brain any question in the world and it will answer the question using math. Curious about the exhibit, they try and get it to work, but to no avail so they start to leave. Suddenly, in a whiz bang flash, the brain comes to life and the excitement begins!

Weaving in the 5 basic strands of elementary mathematics, this multi-media musical proves how throughout civilization, math has led the way in every facet of our history. (title song-Numbers Don't Lie) Filled with fun audience participation activities like "Pollution Solution" and songs like "The Tap (tape) Measure", Algie & Bree can't wait to get back to the classroom and share their new-found knowledge. In the rousing finale, "Math Rules", the students learn that from sports to science, medicine to music, math is necessary in every part of our lives.

**Curriculum Connections: Operations & Algebraic Thinking, Numbers & Operations In Base Ten, Geometry, Measurement & Data, Number -Operation-Fractions.**

*Throughout the study guide, this symbol means that specific Florida Standards are being addressed that correlate activities directly to Florida Assessments. As new standards are created and approved by the Florida Department of Education, this may change. The Standards listed here are currently the most up to date. Please visit [www.cpalms.org](http://www.cpalms.org) for more information and to customize this guide to your specific grade level.*



## THE THEATRE IS A SPECIAL TREAT

Let us concentrate for a moment on a vital part of youth theatre: the young people. Millions of youngsters attend plays every season, and for some the experience is not particularly memorable or entertaining. The fault may lie with the production - but often the fault lies in the fact that these youngsters have not been properly briefed on appropriate theatre manners. Going to the theatre is not a casual event such as flipping on the TV set, attending a movie or a sports event. Going to the theatre is a SPECIAL OCCASION and should be attended as such. In presenting theatre manners to young people, we take the liberty of putting the do's and don'ts in verse, and hope that concerned adults will find this a more palatable way of introducing these concepts to youngsters.

## MATINEE MANNERS

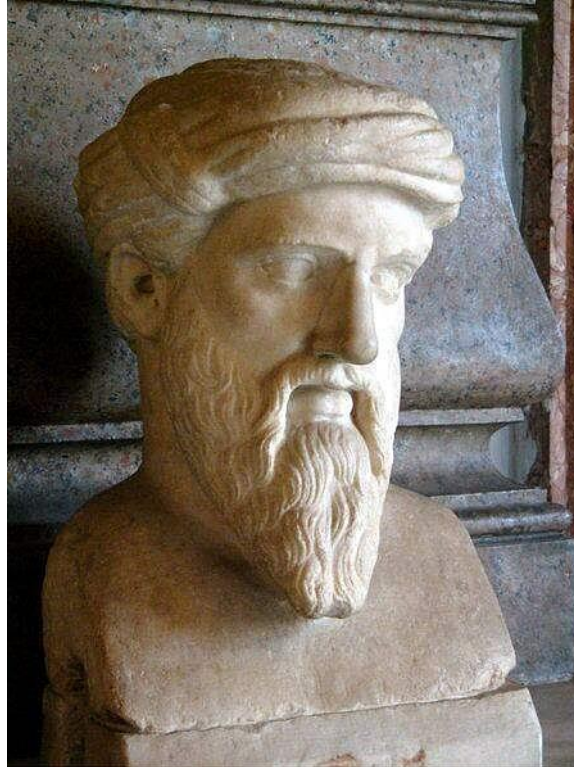
by PEGGY SIMON TRAKTMAN

**The theatre is no place for lunch,  
Who can hear when you go “crunch?”  
We may wear our nicest clothes  
When we go to theatre shows.  
Do not talk to one another  
(That means friends or even mother)  
When you go to see a show,  
Otherwise you'll never know  
What the play is all about  
And you'll make the actors shout  
Just to make themselves be heard.  
So, be still - don't say a word  
Unless an actor asks you to...  
A thing they rarely ever do.  
A program has a special use  
So do not treat it with abuse!  
Its purpose is to let us know  
Exactly who is in the show  
It also tells us other facts  
Of coming shows and future acts.  
Programs make great souvenirs  
Of fun we've had in bygone years  
Keep your hands upon your lap**

**But if you like something you clap  
Actors like to hear applause.  
If there is cause for this applause.  
If a scene is bright and sunny,  
And you think something is funny  
Laugh- performers love this laughter  
But be quiet from thereafter.  
Don't kick chairs or pound your feet  
And do not stand up in your seat,  
Never wander to and fro -  
Just sit back and watch the show.  
And when the final curtain falls  
The actors take their “curtain calls”  
That means they curtsy or they bow  
And you applaud, which tells them how  
You liked their work and liked the show.  
Then, when the lights come on, you go  
Back up the aisle and walk - don't run  
Out to the lobby, everyone.  
The theatre is a special treat  
And not a place to talk or eat.  
If you behave the proper way  
You really will enjoy the play.**

## FAMOUS MATHEMATICIANS

### PYTHAGORAS



**Pythagoras** (c. 571- c. 497 BCE) was a **Greek** philosopher whose teachings emphasized the immortality and transmigration of the soul (reincarnation), virtuous, humane behavior toward all living things, and the concept of “number” as truth in that mathematics not only cleared the mind but allowed for an objective comprehension of reality.

He is best known in the modern day for the **Pythagorean Theorem**, a mathematical formula which states that the square of the hypotenuse of a right triangle is equal to the sum of the squares on the other two sides. This formula has been applied to measuring distance and space as, for example, in planning and executing the construction of a building. Although attributed to Pythagoras by ancient writers, modern scholars cite evidence from Babylonian texts, written some time before Pythagoras, which discuss the same formula or, at least, one very similar.



## EUCLID



Very little is known of the **father of geometry**, also known as Euclid. Records show that he lived somewhere around 300 B.C., but that date is sketchy. He was a Greek mathematician and is probably best known for his work *Elements*. Since little is known about the personal life of Euclid, it is difficult to do a biography on him. His chief work, entitled *Elements*, is a comprehensive treatise on mathematics. It includes 13 volumes that entail such subjects as plane geometry dealing with the properties of flat surfaces and of planar figures, such as the triangle; proportion in general, a particular kind of relation between groups of numbers or quantities; the properties of numbers; incommensurable magnitudes; and solid geometry, branch of geometry that deals with the properties and measurement of geometric figures in three-dimensional space. Some people say that the geometrical sections of *Elements* were actually rearrangements of Exodius previous work. However, Euclid himself is said to have made several discoveries in his *Number Theory*, which is a branch of mathematics that deals with the properties and relationships of numbers. Most historians believe Euclid was educated at Athens. His teachers may have included pupils of Plato, who was a philosopher and one of the most influential thinkers in Western philosophy. Euclid taught geometry in Alexandria and opened a school of mathematics there. He also wrote *Data*, which was a collection of geometrical theorems; *Phenomena*, a description of the heavens; and *The Division of the Scale*, which is a mathematical discussion of music. But yet again many historians believe many of these works (other than the *Elements*) were spuriously credited to him, others disagree and say that indeed his works are that of his own.



**Creola Katherine Johnson** (August 26, 1918 – February 24, 2020) was an American mathematician whose calculations of [orbital mechanics](#) as a [NASA](#) employee were critical to the success of the first and subsequent U.S. crewed spaceflights.<sup>[1]</sup> During her 35-year career at NASA and [its predecessor](#), she earned a reputation for mastering complex manual calculations and helped pioneer the use of computers to perform the tasks. The space agency noted her "historical role as one of the first [African-American](#) women to work as a NASA scientist".<sup>[2]</sup> Johnson's work included calculating trajectories, [launch windows](#), and emergency return paths for [Project Mercury](#) spaceflights, including those for astronauts [Alan Shepard](#), the first American in space, and [John Glenn](#), the first American in orbit, and rendezvous paths for the [Apollo Lunar Module](#) and [command module](#) on flights to the Moon. Her calculations were also essential to the beginning of the [Space Shuttle program](#), and she worked on plans for [a mission to Mars](#). In 2015, President [Barack Obama](#) awarded Johnson the [Presidential Medal of Freedom](#). In 2016, she was presented the [Silver Snoopy Award](#) by NASA astronaut [Leland D. Melvin](#) and a [NASA Group Achievement Award](#). She was portrayed by [Taraji P. Henson](#) as a lead character in the 2016 film [Hidden Figures](#). In 2019, Johnson was awarded the [Congressional Gold Medal](#). Johnson spent her later years encouraging students to enter the fields of [science, technology, engineering, and mathematics](#) (STEM).<sup>[30]</sup>

## DIOPHANTUS OF ALEXANDRIA

**Diophantus was a Hellenistic Greek** (or possibly Egyptian, Jewish or even Chaldean) mathematician who lived in Alexandria during the 3rd Century CE. He is sometimes called “**the father of algebra**” and wrote an influential series of books called the “*Arithmetica*”, a collection of algebraic problems which greatly influenced the subsequent development of number theory.

He also made important advances in mathematical notation; and was one of the first mathematicians to introduce symbolism into algebra, using an abridged notation for frequently occurring operations, and an abbreviation for the unknown and for the powers of the unknown. He was perhaps the first to recognize fractions as numbers in their own right; allowing positive rational numbers for the coefficients and solutions of his equations.

Diophantus applied himself to some quite complex algebraic problems, particularly what has since become known as Diophantine Analysis, which deals with finding integer solutions to kinds of problems that lead to equations in several unknowns.



**Diophantus’ major work** (and the most prominent work on algebra in all Greek mathematics) was his “**Arithmetica**”, a collection of problems giving numerical solutions of both determinate and indeterminate equations. Of the original thirteen books of the “*Arithmetica*”, only six have survived, although some Diophantine problems from “*Arithmetica*” have also been found in later Arabic sources. His problems exercised the minds of many of the world’s best mathematicians for much of the next two millennia.

## ANCIENT MESOPOTAMIA

**Mesopotamia** is a name for the area of the Tigris–Euphrates river system, corresponding to modern-day Iraq, Kuwait, the northeastern section of Syria, and to a much lesser extent southeastern Turkey and smaller parts of southwestern Iran.

### Key Facts & Information

- During the earliest years of recorded history, the Ancient Mesopotamians were experimenting with ways to count, measure, and **solve mathematical problems**. They were the first to give a number a place value and to recognize the concept of zero.
- These rivers flow into the Persian Gulf. The area is also known as “The Fertile Crescent”. Mesopotamia was approximately 300 miles long and 150 miles wide.
- The land of Ancient Mesopotamia experienced many floods, but today the area is mostly desert. The flooding was a challenge to the farmers. They had to learn to control and work with it.
- The invention of irrigation was extremely important because it allowed the people to plant during the hot, dry season. The fertile land produced crops such as many fruits, vegetables, flax, barley, wheat, and sesame.
- Sheep, cattle, goats, and pigs were being raised by the farmers. The seeder plow, invented by the Mesopotamians, was a major achievement. It allowed farmers to plow their land and seed it at the same time.
- Ancient Mesopotamia is considered the cradle of civilization because the people of this culture developed many things such as government, written language, religion, agriculture, and cities. The Ancient Mesopotamians developed sanitation techniques, the **Pythagorean theorem**, and glass.
- They revolutionized transportation around 3500 BC by inventing the wheel and were among the first to harness the wind as an energy source by using the sail.
- The Sumerians of Ancient Mesopotamia are credited with inventing the earliest form of writing. The writings on tablets were of simple pictures, or pictograms, which represented an object or an idea.
- Most of Ancient Mesopotamia was located in what today is the country of Iraq. Mesopotamia was known as the land between two rivers. The Tigris River ran along the north and the Euphrates River ran along the south.




Primitive people counted using simple methods, such as putting notches on bones, but it was the Sumerians who developed a formal **numbering system** based on units of 60. At first, they used reeds to keep track of the units, but eventually, with the development of cuneiform, they used vertical marks on the clay tablets. Their system helped lay the groundwork for the mathematical calculations of civilizations that followed.




## Before The Play

1. Read to your students the following stories *What's your angle Pythagoras? Fraction Fun, Ten Apples on Top, Why Pi?, Sir Cumference and the First Round Table*. Explain to them that the live show that they will see is an original musical created for the stage, and although some of the content will be the same, it will not be exactly like the books or instructional video. Identify characters, settings and the basic plot of the stories.


 **TH.1.O.3.1:** Compare a play to an animated movie that tells the same story.


 **TH.2.O.1.1:** Compare the differences between reading a story and seeing it as a play.

 **LAFS.2.RL.3.9:** Compare and contrast two or more versions of the same story (e.g., Cinderella stories) by different authors or from different cultures.


2. Have the students learn the following **vocabulary words** and listen for them during the play. See how many words they can recall and how they were used in the context of the play.


bar graph	ellipse	museum	query
binary	fractions	nonagon	recipes
calculate	hexagon	numerator	rectangle
circle	hypotenuse	octogen	rhombus
decagon	infinity	parallelogram	square
denominator	measurement	pentagon	tick
domains	Mesopotamia	quadrilaterals	trapezoid

 **LAFS.1.RF.3.3:** Know and apply grade-level phonics and word analysis skills in decoding words.


 **LA.FS.1.RF.4.4** Read with sufficient accuracy and fluency to support comprehension..


3. Ask your students to discuss the difference between television and live theatre. It is important that they know about theatre etiquette, or manners. Refer to the poem *Matinee Manners* on page 2.

 **TH.1.S.1.1:** Exhibit appropriate audience etiquette and response.

 **LAFS.1.SL.1.3:** Ask and answer questions about what a speaker says in order to gather additional information or clarify something that is not understood.

4. Have the students look and listen for patterns during the play. See how many patterns they can recall and how they were used in the context of the play. Encourage students to be aware of patterns that may occur in music, dance, scenery, costumes and dialogue. Students may also notice architectural patterns in the theatre.


 **MAFS.K.CC.1.1:** Know number names and count sequence.


 **MAFS.1.NBT.1.1:** Extend the counting sequence.


## **After the Play**

### **Part I**


1. Discuss the production with your students. What did they like or dislike about the play? Who was their favorite character? What was their favorite song? Why? Have the students draw a picture or write a letter to the cast of Numbers Don't Lie telling them what they have learned from the performance.

 **TH.K.0.2.1:** Draw a picture of a favorite scene from a play.


 **TH.K.C.2.1:** Respond to a performance and share personal preferences about parts of the performance.


 **TH.2.C.1.2:** Respond to a play by drawing and/or writing about a favorite aspect of it.

2. Who are the main characters in the play? (Algie and Bree)
  - a. What is the main conflict they face? (can't understand math)
  - b. How do the other characters make them feel better about math comprehension? (teacher is patient and encouraging, Chris is compassionate, The Brain is creative with learning methods)
  - c. Have you ever wanted to be the smartest student in class but had a mental block about a subject? How did it make you feel? What sacrifices might be necessary to achieve great grades? (extra studying, tutoring, etc.)
  - d. How do the main characters finally prove their "math worth" to the other teachers and students?

 **LAFS.2.C.1.1:** Tell a story or recount an experience with appropriate facts relevant, descriptive details speaking audibly in coherent sentences.

3. Talk about the different characters in the show. Have the students compare and contrast the characters by their personality traits. What are their relationships?

 **TH.2.C.1.1:** Describe a character in a story and tell why the character is important to the story.

 **LAFS.1.R1.3.9:** Identify basic similarities in and difference between two texts on the same subject.

## Part II

1. In scene one, Ms. Hatcher asks the students who can name one thing that in some way, does not involve math? They quickly realize that from football to eating lunch to video games; all things somehow involve math. Have your students divide into groups and come up with ten everyday things that DO involve math and explain how.
2. The character of The Brain is actually Principal Lawson incognito. At the museum, he teaches them a lesson by telling them that they can't leave until they "release the brain".
  - a. At what point in the show do Algie and Bree realize that they need to release their own brains, not the character of The Brain in order to be better learners?
  - b. Research shows that humans actually use a very small percentage of their brain. Taking this concept from the show, imagine what we can accomplish if we could release the full potential of our brain. Discuss.
3. During the game show portion of the play, The Brain allows the students to phone a friend for help with math problems. We meet some great historical math figures from the past.
  - a. Imagine how these early pioneers developed the roots of mathematics without the modern conveniences of everyday living that we enjoy today
  - b. Think of five things that we use daily and take for granted in our lives. (electricity, indoor plumbing, computers!)
4. Pascal invented the first rudimentary calculator in the sixteen-hundreds. This led to the first computer hundreds of years later.
  - a. How have calculators/computers advanced throughout the years?
  - b. How have they (math) improved our lives significantly?
5. The measurement marks on a ruler are known as ticks. In the song Tap Measure, the students learn to engage their brains by using fractions to measure items.
  - a. Using rulers, measure a variety of objects in the classroom.
  - b. Ask your students to measure common items at home. Make a bar graph to represent these items.
6. Musical notes provide a fantastic lesson in fractions. Without math, time signatures would not exist in music. The most common time signature in music is 4/4 time, thus it is known as common time. The top number tells us how many beats are in each measure. The bottom number tells us the type of beat, and those beats are fractions.
7. Ms. Hatcher explains the huge environmental problem that Florida has with landfill pollution. Make a bar graph similar to the one in the show that represents all the different types of pollution in the landfill. Now remove the percentage of items that represent recyclables. Help the students to understand how they can be a part of the solution to pollution by simply recycling everyday items.

## Curriculum/Domain Connections

- ✎ MAFS.3.OA.1.1 -Interpret products of whole numbers, e.g., interpret  $5 \times 7$  as the total number of objects in 5 groups of 7 objects each. *For example, describe a context in which a total number of objects can be expressed as  $5 \times 7$ .*
- ✎ MAFS.3.NBT.1.3 -Multiply one-digit whole numbers by multiples of 10 in the range 10–90 (e.g.,  $9 \times 80$ ,  $5 \times 60$ ) using strategies based on place value and properties of operations.
- ✎ MAFS.3.NF.1.1 -Understand a fraction  $1/b$  as the quantity formed by 1 part when a whole is partitioned into  $b$  equal parts; understand a fraction  $a/b$  as the quantity formed by  $a$  parts of size  $1/b$ .
- ✎ MAFS.3.MD.4.8 -Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters
- ✎ MAFS.3.G.1.1 -Understand that shapes in different categories (e.g., rhombuses, rectangles, and others) may share attributes (e.g., having four sides), and that the shared attributes can define a larger category (e.g., quadrilaterals). Recognize rhombuses, rectangles, and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories.
- ✎ MAFS.4.OA.1.1 -Interpret a multiplication equation as a comparison, e.g., interpret  $35 = 5 \times 7$  as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations.
- ✎ MAFS.4.NBT.1.3 -Use place value understanding to round multi-digit whole numbers to any place.
- ✎ MAFS.4.NF.3.6 -Use decimal notation for fractions with denominators 10 or 100. *For example, rewrite 0.62 as  $62/100$ ; describe a length as 0.62 meters; locate 0.62 on a number line diagram.*
- ✎ MAFS.4.MD.2.4 -Make a line plot to display a data set of measurements in fractions of a unit ( $1/2$ ,  $1/4$ ,  $1/8$ ). Solve problems involving addition and subtraction of fractions by using information presented in line plots. *For example, from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection.*
- ✎ MAFS.4.G.1.1 -Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.
- ✎ MAFS.5.OA.2.3 -Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns and graph the ordered pairs on a coordinate plane. *For example, given the rule "Add 3" and the starting number 0, and given the rule "Add 6" and the starting number 0, generate terms in the resulting sequences, and observe that the terms in one sequence are twice the corresponding terms in the other sequence. Explain informally why this is so.*



✎ MAFS.5.NBT.1.4 -Use place value understanding to round decimals to any place.

✎ MAFS.5.NF.1.1 -Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators. *For example,  $2/3 + 5/4 = 8/12 + 15/12 = 23/12$ . (In general,  $a/b + c/d = (ad + bc)/bd$ .)*

✎ MAFS.5.MD.2.2 -Make a line plot to display a data set of measurements in fractions of a unit ( $1/2, 1/4, 1/8$ ). Use operations on fractions for this grade to solve problems involving information presented in line plots. *For example, given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were redistributed equally.*

✎ MAFS.5.G.2.4 -Classify and organize two-dimensional figures into Venn diagrams based on the attributes of the figures.

## The Art of Florida Assessments

Contributed by Patricia Linder

✎ **Visual and Performing Arts Field Trips provide an excellent source of support for the development of skills necessary for success on the Florida Assessments. We invite you to use these instructional strategies to enhance preparation through your theatre field trip.**

### Theatre Activities / Cognitive Level 1

Read the story (or play) your field trip performance is based on.

Name the main character.

List all the characters.

Identify the setting.

List the story events in the order they happened.

Describe a character (or setting).

Explain the problem (or conflict) in the story.

Explain how the actors used stage props to tell the story (or develop characterization).

Discuss how the blocking, or positioning of the actors on stage affected the performance.

Discuss how unusual technical elements (light, shadow, sound, etc.) were used in the performance.

Draw a picture of a character.

Illustrate or make a diorama of a scene from the performance.

Draw a poster to advertise the performance.

Work with other students to act out a scene.

Demonstrate how an actor used facial expression to show emotion.

Write a narrative story to summarize the plot of the performance story.

Use a map and/or timeline to locate the setting of the story.

Make a mobile showing events in the story.

## Cognitive Level II

Would the main character make a good friend? Write an expository essay explaining why or why not.

Create a graph that records performance data such as: female characters, male characters, animal characters or number of characters in each scene, etc.

Compare/Contrast a character to someone you know or compare/contrast the setting to a different location or time.

Solve a special effects mystery. Use words or pictures to explain how “special effects” (Lighting, smoke, sound effects) were created.

Imagine the story in a different time or place. Design sets or costumes for the new setting.

You’re the director. Plan the performance of a scene in your classroom. Include the cast of characters, staging area, and ideas for costumes, scenery, and props in your plan.

Create a new ending to the story.

Did you enjoy the performance? Write a persuasive essay convincing a friend to go see this production.

Write a letter to the company nominating a performer for a “Best Actor Award.”

Create a rubric to rate the performance. Decide on criteria for judging: Sets, Costumes, Acting, Lighting, Special Effects, Overall Performance, etc.

## THE PRODUCER

**STAGES PRODUCTIONS** is a professional theatre ensemble that specializes in bringing classic stories and educational programming to over 150,000 young people each year throughout Florida.

STAGES' show credits include critically acclaimed performances of: *Charlotte's Web*, *School House Rock*, *The Three Little Pigs*, *Mother Goose* and *Elephant and Piggie*. Be sure to join us for our 35th anniversary season featuring; *Numbers Don't Lie* *Holiday Traditions Around The World*, *the Frog Prince* and *The Ugly Duckling*.

Stages Productions is dedicated to making drama an integral part of education, and lesson plans are available to incorporate these plays into the student's curriculum. Thank you for supporting this mission by choosing a STAGES PRODUCTIONS play! [www.stagesproductions.com](http://www.stagesproductions.com).

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