



# Expressions Learning Arts Academy

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## **Arts and Mathematics: An Integrated Approach to Teaching**

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## ***Arts and Mathematics: An Integrated Approach to Teaching***

*“There is no separation of mind and emotions; emotions, thinking, and learning are all linked.” (Eric Jensen, *Teaching with the Brain in Mind*, 1998).*

When thinking about arts and mathematics, people frequently view them as two separate domains. For a long time in education, mathematics was treated as a cognitive, thinking, rational, left-brain activity, while art was considered to be an affective, feeling, right-brain activity. This dichotomous view of arts and mathematics has greatly influenced the degree to which each has been taught separately from the other. In truth, math and the arts share some inherent qualities that make them capable not only of integration, but of interdependence.

There are many examples which demonstrate the interdependence of math and the arts. For instance, what would music be like without the mathematical elements of time, tempo, beat, and measure? How would a circle or square be drawn in an artistic composition without knowledge of geometric shapes? How can movement be choreographed to music without the counting of beats? How would the specifications of a set design be met without proper measuring tools?

Both mathematics and the arts can be used to observe, describe, and imitate the natural world. Indeed, it seems they were born of the very human desire to comprehend and re-create experience. Natural shapes are observed, drawn, measured, and erected into new structures. Detailed maps of human exploration mark where we have been and where we will go next. Magnificent machines are created that approximate or harness the powers of nature.

Scientific studies support an integrated learning environment. Brain research demonstrates that learning activities which stimulate both the cognitive and affective areas of the mind are vital to its optimal development. The combined stimulation of these areas increases the amount of neural connections that are present throughout the brain, in effect allowing the brain itself to become more wholly integrated. Learning mathematics and the arts together fosters this whole-brain development.

There are additional benefits to teaching math and the arts in an integrated fashion. The “hands-on” nature of teaching art and math in combination helps build bridges between concrete and abstract mathematical ideas. Whether drawing circles to divide and cut out fractional parts, measuring out recipe ingredients, or writing out problem-solving steps in math journals, students are learning more while using more of their minds. Moreover, integrating math with art meets the needs of diverse learning styles and multiple intelligences. Lastly, the pleasant effects of artistic experiences may help kids to enjoy math more or to alleviate math anxiety.

## **Teaching Philosophy**

The pedagogical method employed by a teacher/school to a large degree reflects beliefs and experiences about teaching and learning. As a part of a school with a curriculum rich in the arts, I feel fortunate to have beliefs that are aligned with school aims. In our school community, there are three underlying beliefs which fuel an enthusiasm for artistic learning experiences.

1. *The belief that a sound, standards-based, academic curriculum rich in the arts provides an environment of learning that is effective, engaging, and enriching.*

Children are engaged when they are being artistic. To engage in an artistic experience, a learner is required to think and to feel. Singing songs, playing recorders, memorizing scripts, performing plays, learning dance routines are all a regular part of an arts-enhanced curriculum. Children are learning through the arts. Comprehension, critical thinking skills, problem-solving, and expression are all strengthened through art. Standardized test scores consistently support the fact that the arts do not take away from key academic learning, as argued by proponents of school budget cuts for the arts, but rather help to unlock its doors.

2. *The belief that teaching should reflect current as well as time-tested methods of pedagogy.*

Certain time-tested teaching techniques and tools are still used today because they are still effective and still have value to learners. For example, teaching children to sound out phonemes has for a long time been a strategy for reading. Likewise, the use of a chalkboard, and more recently a whiteboard, as a visual aid dates back to the colonial schoolhouses of America. An effective school utilizes what educational history has demonstrated to be vital to teaching. However, sticking to the “tried-and-true” methods without remaining knowledgeable of current educational research is akin to the colorful expression “If it ain’t broke, don’t fix it.” Teaching is as dynamic as life itself, and teachers must strive to learn new things.

3. *The belief that artistic experiences help to create a sense of well-being in an individual. (“Art makes you feel good!”)*

Not surprisingly, an arts-enhanced curriculum appeals to people with artistic interests and inclinations. Many of the students and staff at our school regularly engage in some form of artistic expression or discipline. Among us are actors, musicians, dancers, and visual artists. The benefits we have received through arts in our own lives strongly impact our belief in their educational value.

***However, the successful integration of the arts into the curriculum does not necessitate working in an arts-infused school, it simply takes the effort of teachers who know, and who care.***

Even if teachers feel reluctant to use art or do not personally value it very much, most would agree that children learn best when they are enjoying what they are doing. Math can be a challenging, disinteresting, scary, or unpleasant for kids who struggle with, or are less oriented toward, mathematics. Integrating the arts into mathematical experiences brings a creative, enjoyable quality to the learning and often makes it more comprehensible for those less inclined toward math.

In the artistic process we are making, we are doing, we are creating something real. Likewise, it is the most realistic experiences which are essential to learning and enjoying math. If one proceeds from the premise that artistic experiences significantly enhance all learning, then it follows that students' understanding and appreciation for math will be deepened when it is presented to them in an artistic way.

### ***Concluding Thoughts***

In the realm of education, there are ever greater demands being placed upon the lives of children, their families, and educators. The emphasis on improving student performance has compromised essential areas of study. Sadly, the arts are one of these areas. Artistic experience is essential to learning. The arts enhance the regular academic curriculum, offering children so much more than merely a perfunctory education, as is reflected student attitudes and classroom performance. Integrating the arts into other subject areas such as math fosters development of the whole brain, linking and strengthening both the cognitive and affective regions of the mind. Art brings enjoyment to the lives of those who embrace it. This truth will emerge as you and your students, using these lessons or ones that you endeavor to create, experience it for yourselves.

In the next section, sample lesson ideas for integrating math and art are provided. They range in degree of difficulty in terms of preparation and implementation, but all are cost-conscious and well within the capabilities of every teacher.

## **Lesson One: The Immigrant Marketplace**

**Lesson Summary:** In this lesson, students will engage in dramatic play to simulate a cultural marketplace where they will buy and sell goods using “play” money.

**Grade Levels:** 2-4

**Time Investment:** teacher preparation: about one hour (prepare money/coin bags, make sales sheet, set up room, “thinking and planning,”) student preparation: (varies; 1-several hours; make product, gather costume)

**Lesson Length:** One hour or one math period

**Materials:** paper, markers, pens, crayons, poster board, articles of clothing, “kid” coins/paper money, plastic bags, and sales sheet.

### **Learning Objective(s):**

1. The students will engage in multiple behaviors including purchasing and selling, exchanging money, and interacting with one another as shoppers and vendors.
2. The students will use mathematical and interpersonal problem-solving skills to buy and sell items and to work out conflicts with others.
3. The students will experience a simulated cultural marketplace.
4. The students will develop a deeper appreciation for diverse cultures.

**Key Words:** immigrants, market, vendor/producer, shopper/consumer, coins, paper money, goods, services, bargain, culture, products, add, subtract, make change.

### **Background Knowledge/ Setting the Stage for Learning:**

The Immigrant Marketplace was a main component of a thematic unit on immigration to America and cultural diversity. Students had already learned where the immigrants came from and what they brought with them to the New World. Each child presented a report on a family immigrant group which contained information such as country flag, foods, agriculture, and type of government. In math, students had experience with addition and subtraction of whole numbers, and were learning how to add, subtract, and make other calculations using money.

### **The Lesson:**

Students were given the task of preparing a culturally significant item to sell at the Immigrant Marketplace. Marketplace items ranged from fruits and vegetables, to wine, cheese, and bead bracelets. One students’ family built a life-size replica

of a Puerto Rican fruit stand much like the one her grandmother used in Puerto Rico. Students dressed in the traditional attire of the immigrant countries they were representing. They were also encouraged to be “in character,” using any accent, gesture, or body language to authenticate their character. Each student was given the exact same amount of money. The class was transformed into a cultural marketplace. I was able to observe students counting money, making change, and recording expenditures and sales. (A clipboard with a rubric attached and space for notes works well when moving about such a lively scene.) Toward the end, an impromptu “Let’s make a deal!” session sent the buyers and sellers into a frenzy, as prices were slashed and kids haggled with one another to get a bargain buy or make a sale.

After all buying and selling ceased, the students shared their profits, purchases, and even some “market” strategies. The students remained active in the experience, performing as immigrant vendors and shoppers, learning how to use money, interacting, and having a bit of fun.

**Assessment:** rubric, observational notes, student participation, post-experiential discussion.

**Tips for success:**

1. Make sure from time to time that students working in pairs switch, so that each gets an opportunity to be a buyer and a seller.
2. If possible, get one or two parent volunteers to help with the activity.
3. Remain aware of student interactions and behavior.

**\*Educational Standards:**

Language Arts: LA.C.1.1.3, LA.C.2.1.2, LA.C.3.1.1(1-2), LA.C.3.1.2, LA.C.3.1.3, LA.C.3.1.4

Math: MA.A.1.1.4, MA.A.2.1.1(1,5), MA.A. 3.1.1(3), MA.A.3.1.2 (1), MA.A.4.1.1

Social Studies: SS.A.1.1.2, SS.A.1.1.3, SS.A.4.1.4, SD.D.2.1.2, SD.D.2.1.4

Theatre: TH.A.1.1(1)

**\*Note:** *The educational standards listed in these lessons are the benchmarks for the Sunshine State Standards used in the state of Florida.*

## **Lesson Two: “Makin’ Shapes, Writin’ Riddles and Rhymes”**

**Lesson Summary:** This lesson combines the use of poetry, movement, and knowledge of geometric shapes for a fun activity that can be enjoyed inside or out.

**Grade Levels:** 2-4

**Time Investment:** teacher preparation: about 15-20 minutes (prepare riddles, think and plan)

**Lesson Length:** approximately 20-30 minutes.

**Materials:** math text or art books with various geometric shapes, index cards, teacher riddles, white/chalkboard, blanket (for outside)

### **Learning Objective(s):**

1. The students will demonstrate their understanding of basic geometric shapes through listening, interpreting, and physical formation of shapes.
2. Students will interpret riddles and rhymes to determine shapes.
3. Students will use kinesthetic awareness, movement, and cooperative effort to form geometric shapes.
4. Students will work cooperatively to achieve goals.
5. Students will write and create their own riddles and rhymes describing geometric shapes.

**Key Words:** shapes, angles, sides, vertex, curved line, base, triangle, square, rectangle, circle; etceteras, cooperation

### **Background Knowledge/ Setting the Stage for Learning:**

Students will need to have learned about characteristics of two and three dimensional shapes such as sides and angles. They must also be able to differentiate between shapes, as well as know their names. The students should also have experience with writing and interpreting poetry. The students have also gained experience working in cooperative groups.

### **The Lesson:**

To begin the lesson, stimulate student responses that identify, review, and define characteristics and terms related to geometric shapes. Drawing an example shape and ask the children to describe it with mathematical language is an effective way to begin. Once the teacher determines that the class is focused and demonstrates a capability to describe shapes, explain clearly the learning objectives to the class. Keep it simple by telling the kids that you will read riddles to the class and they will work together to figure out the riddles and form the

shapes with their own bodies. Answer any questions the students might have. Take the class outside if it is nice out or make ample space in the classroom. Lay down the “shape blanket.” The teacher begins reading the riddles. Below are two examples:

1. “I have no sides or angles, but still I hang around. Eyes, wheels, and coins are some places I am found. What shape am I?” (circle) A group of two children would then make a circle.
2. “I am a shape with sides of four. Two sides of same length long, two sides of same length short. I could be a table, a rug, or a door. What shape am I?” (rectangle) Four children form the shape.

If you are inside, you can draw the shape after it is made to reinforce the written form of the shape, or you can bring an easel and dry erase board outside. Depending on how things are going, you can progress to more challenging riddles and shapes. You can also include other geometric concepts such as symmetry, by creating mirror image shapes, asking higher order questions, and having the students do “flips” and “turns” with their shapes. This will keep the attention of the advanced students and enrich the others. It is also fun to include riddles about letters of the alphabet, making sure to brush up on ordinal number and language arts skills. Example:

1. “I am the 7<sup>th</sup> letter of the alphabet. I’m a consonant, not a vowel. You cannot make *good guesses* without me. What letter am I?” (G)

**Follow-Up/Enrichment Activity:**

When all students have had an opportunity to make at least one shape or letter, have them work in cooperative groups to write some shape riddles of their own. If you like, you may give them creative license to come up with riddles about other objects, as long as they make a riddle for at least one shape using geometric terms.

**Assessment:** teacher observation, students able to make shapes/letters, cooperative effort, written riddles

**Tips for Success:**

1. Pre-determine small, cooperative groups.
2. Have at least 8-10 riddles.
3. Be creative!

**Educational Standards:**

Math: MA.C.1.1.1(1-5), MA.C.2.1.1(1-5), MA.C.2.1.1(1-5), MA.C.1.1(1-3)

Language Arts: LA.A.2.1.3, LA.B.2.1.2(1), LA.B.2.1.4, LA.C.1.1.1

Theatre: TH.A.1.1(2)

Visual Arts: VA.A.1(1)

Physical Education: PE.A.1.1(1,6), PE.A.2.1(2,4)

## ***Arts, Math, and More: Multiple Integrations***

Another way to combine the arts into the curriculum is to incorporate them into a science or social studies unit that is already rich with mathematical data. I have chosen a science unit on the Solar System as the basis for the following lesson ideas. To make a Solar System unit that is “out of this world,” here are a few simple and fun lessons you can use.

### **Lesson One: “Math in a Model”**

**Lesson Summary:** In this lesson, students create models that display the following mathematical data pertaining to each planet of the Solar system: distance from the Sun, length of day and night, length of year, and day and night surface temperatures. The students also measure the materials needed for a glue mixture.

**Grade Levels:** 2 - 5

**Time Investment:** Teacher preparation: 30 minutes to 1 hour (constructing models)

Student preparation: (for hanging mobile) about 1 hour

**Lesson Length:** Several class periods

#### **Materials:**

1. **Paper models:** paper, circular shapes of various sizes to draw planets and Sun, poster of Solar System/book reference, scissors, glue, markers/crayons, and background paper.
2. **Planet sticks:** paper drawings of planets, paper towel rolls, black paint, glue, model of Solar System.
3. **\*Hanging mobile:** wire/fishing string, coat hanger, paint, markers, foam planet kits or foam spheres (can use clay as well), model of Solar System  
**\*Note:** Students are responsible for gathering the materials for the hanging mobile.
4. **Paper mache planet set:** newspaper, brown paper bag strips, glue, flour hot water, measuring cup, balloons, bowls/containers for glue mixture, tempera/acrylic paints.

#### **Learning Objective(s):**

1. Students will display mathematical data for each planet; its distance from the Sun, its length of day/night/year, and its day/night temperature in Fahrenheit.

2. Students will measure and mix parts of glue, flour, and water to make paper mache mixture.
3. The students will demonstrate knowledge of the differing spherical sizes of the planets relative to one another by creating representative models.
4. The students will demonstrate knowledge of the order of the planets from the Sun through construction of models.
5. The students will create artistic replicas of the planets and Sun in the Solar System.

**Key Words:** planets (names), Sun, model, mobile, spheres, order, distance, orbit, rings, day, night, year, rotation

**Background Knowledge/Setting the Stage for Learning:**

This activity would be most appropriate to do after students have gained knowledge about the Solar System. Visual aids such as posters can help students identify the order and sizes of the planets. Teach the children mnemonic devices to help them remember the order of the planets (for example, Seven Merry Very Elves May Juggle Under Some New Potatoes; Sun, Mercury, Venus, Earth, Mars, Jupiter, Uranus, Neptune, Pluto.) Gather lots of books about the Solar System with vivid illustrations for your unit. This will not be difficult as there are a multitude of them at your local library. Give children several opportunities to peruse the books. Provide instruction that gives specific information about planetary sizes and distances from the sun, as well as lessons demonstrating orbit, rotation, and the effect each has on a planet.

**The Lesson:**

Begin by eliciting student responses to questions about size, distance, and order of the planets. To assist young learners, a class chart/worksheet can be filled out to determine the distances of the planets from the Sun. Next, inform the class of the objectives of the art assignment. Provide each student with a hand-drawn or worksheet copy of the Solar System. Allow them ample time to cut out, color, and paste onto background page. In the next phase of the lesson, students are given a paper towel roll, black tempera paint, glue, and another paper copy of the Sun and planets. They construct their “planet stick” and work in class and at home to complete required data. If a student chooses to do a mobile, s/he may complete it in class and/or at home. However, they should gather the materials for this on their own.

The last phase of the lesson is for the class to construct a set of planets and the Sun out of paper mache. First, the teacher will measure and mix paper mache glue for the class to use. Next, give each student a balloon to use as a base. Following suggested techniques for paper mache, work cooperatively to construct planets, allowing drying time between applications of each layer. When complete, paint with appropriate colors, hang with string in your classroom, and enjoy!

**Follow-up/ Enrichment Activity:**

Take a large piece of poster board and paint it black. Leave to dry overnight. In the morning, have the class work together on making a Solar System mural. They can paint stars, planets, space ships, moons, comets, or whatever else they might imagine. Leave to dry overnight, then hang up to further accentuate the room during your study of the Solar System.

**Assessment:** completion of paper models, construction of planet stick or mobiles, math/science data, cooperative effort, teacher observations and notes.

**Tips for Success:**

1. Provide support for younger learners still developing fine motor skills, assist with drawing and cutting of small shapes.
2. Have extra copies of the cut-out page because, invariably, someone will lose one or cut a planet in half.

**Educational Standards:**

Math: MA.B.1.1.1(1,2,5,6), MA.B.2.1.2, MA.B.3.1.1(1), MA.B.4.1.2(1), MA.C.1.1.1(1,2,4)

Art: VA.A.1.1(1,2,4)

Science: SC.A.1.1.2 (1-2), SC.A.1.1.1, SC.B.1.1.1, SC.B.1.1.3, SC.C.1.1.2, SC.E.1.1.1, SC.E.1.1.2, SC.E.2.1.1

## Lesson Two: “Fizzy Lifting Rockets”

**Lesson Summary:** In this lesson, students practice estimating, measuring, recording, and plotting data. The data is gathered from the launch heights of simple rockets which the students design and create. In addition to measurement, data gathering, and experimental design, the students learn basic principles of force and motion while having a blast!

**Grade Levels:** 2-4

**Time Investment:** teacher preparation: ½ hour to an hour (drawing template for rocket parts, going to pharmacy to collect film canisters and effervescent tablets, make teacher model)

**Lesson Length:** one class period to construct, one period for launching

**Materials:** 8 ½ by 11 inch paper (regular thickness), plastic 35 mm film canister (the kind where the cap fits inside of the rim, not over it), cellophane tape, scissors, effervescent (fizzing) tablets (2 for each kid), paper towels, H<sub>2</sub>O, eye protection, class graph page

### Learning Objective(s):

1. The students will estimate the launch height of their rockets.
2. The students will be able to measure their launch height in inches, feet, and yards.
3. The students will be able to plot the height their rocket rose to on a class graph.
4. The students will determine the mean, median, and mode of the class graph.
5. The students will create and launch a bubble powered rocket.
6. The students will design or use a teacher-made template to construct the rocket.
7. The students will be able to explain what they observe when they launch their rockets.

**Key Words:** estimate, measure, inches, feet, yards, plot, graph, mean, median, mode rocket, effervescent, film canister, water, action, reaction, nosecone, fin, design

### Background Knowledge/Setting the Stage for Learning

The students should understand the role that rockets play in space exploration. They should know that there is a pushing force acting upon the rocket (action) to lift in up into the air (reaction). The students should observe and discuss a teacher-made model.

**The Lesson:**

First, the class will briefly discuss rockets, using graphic organizer to record ideas. Next, tell students what they will be making. Hand out materials, assist as needed. Invite students to use teacher-made pattern or design one of their own. Once students have made their rockets, go outside for a launching. Demonstrate a launch for the kids. A yardstick will be used to measure launch height in inches, feet, and yards. Record data.

**Follow-Up/Enrichment Activity:**

Plot on a class graph upon returning and discuss designs, observations, and what students thought was causing the rockets to launch. Don't forget to find the mean, median, and mode together! Explain and re-teach. Have students do homework assignment of finding websites or information on rockets, space travel on the internet or in reference books.

**Assessment:**

Estimated, measured, and worked with data, completed rocket design, successfully launched rocket, (teacher observation/notes and/or rubric).

**Tips for Success:**

1. Tell children ahead of time the launch date so they can bring extra fizzing tablets.
2. Some students will require help with cutting and taping on rocket parts.
3. Check out <http://spaceplace.jpl.nasa.gov/rocket.htm> for a more detailed lesson plan.

**Educational Standards:**

Math: MA.A.4.1.1(5), MA.B.1.1.1(1,2), MA.B.2.1.1(3), MA.B.2.1.2, MA.B.3.1.1(1), MA.B.4.1.2(1), MA.E.1.1.1, MA.E.1.1.2, MA.E.2.1.1(2,3)  
Art: VA.A.1.1 (1-4), VA.B.1.1(3)  
Science: SC.C.1.1.1, SC.C.1.1.2, SC.C.2.1.2

## **Lesson Three: “Singin’ and Dancin’ Through the Solar System”**

**Lesson Summary:** In this lesson, students create original songs with choreography that contain specific mathematical information about the Solar System (such as planetary distance, temperature, number of moons, diameter, etceteras.)

**Grade Levels:** 3-5

**Time Investment:** teacher preparation: about one hour to create example for class. Student preparation: home practice 1-2 hours

**Lesson Length:** 1-2 weeks, 20-30 minute daily blocks

**Materials:** tape recorder, CD player, CD’s and tapes (students provide), books, notes on math and science Solar System facts, CD “Rockin’ through the Solar System” (optional.)

### **Learning Objective(s):**

1. The students will convey mathematical facts pertaining to the Solar System through their song and dance routine.
2. The students will create a performance number that is at least one minute and no more that two minutes long.
3. Students work in cooperative groups to create a song-and-dance performance piece.

**Key Words:** mathematical data, Solar System, scientific fact, lyrics, choreography, song, lip synch, rehearse, perform, create, observation

### **Background Knowledge/Setting the Stage for Learning:**

This activity would work well toward the end of the integrated unit, once students have become familiar with data pertaining to the Solar System. Students should be familiar with information in books from the classroom library. The students should have basic experience with singing, dancing, and lyrical poem writing.

### **The Lesson:**

It may be helpful to begin by using the board or having a discussion to make sure children have a clear idea of the difference between scientific fact and opinion or speculation. It is important for them to know that scientific facts contain mathematical data that has been collected and studied. Once this is established, explain the learning objectives to the class and demonstrate for them a teacher-made song-and-dance. Do not feel intimidated to perform, for your students will enjoy watching you. (Besides, if you’re expecting them to do it, why can’t you?) Next, place children in heterogeneous groups of 3-5, depending on class size. Allow them several class periods to choose topics, gather data, and rehearse.

Assist as needed. It might be helpful to provide a written example or brainstorm some song lyrics together. An example might be:

“Scientists say you’re an ordinary star,  
93 million miles away, you’re pretty far.  
You are my sunshine, my only sunshine.  
Though you do not move,  
I cannot find you at night  
It takes 8.5 minutes for Earth to see your light.  
You are my sunshine, my only sunshine.”

Extra ideas: group names, costumes, stage make-up. When all groups are ready to perform, make a fun event out of it. Give it a name such as “Star Search Two” or “Rockin’ through the Solar System.” Filming it is a great idea, so the kids will have the opportunity to themselves perform. Invite the principal in for a special treat!

**Follow Up/Enrichment Activity:**

If there is an interest, the students might perform for another class or for their parents. If it can be filmed, the students can view themselves performing.

**Assessment:** rubric; song contained math facts about the Solar System, song was 1-2 minutes long, song had lyrics and movement, students participated individually and as part of a group

**Tips for Success:**

1. Monitor group progress to make sure each child is participating and creative differences can be worked out.
2. Collaborate with the music and dance teacher (if you have one) for help and ideas.

**Educational Standards:**

Math: MA.A.1.1.3(1), MA.B.1.1.1(1), MA.B.2.1.2, MA.B.4.1.2(1)

Language Arts: LA.A.2.1.3, LA.A.2.1.4, LA.A.2.1.5(1-4), LA.B.1.1.1, LA.B.1.1.2(1,2,4,7), LA.B.2.1.1, LA.B.2.1.2(3), LA.D.2.1.2, LA.D.2.1.3

Theatre: VA.A.1.1

Music: MU.A.1.1(1-2), MU.B.2.1, MU.D.1.1(1,4), MU.D.2.1(1-2)

Dance: DA.A.1.1(1-4), DA.A.2.1(1-3), DA.B.1.1, DA.E.2.1

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