TEACHER'S GUIDE TO THE RUSSIAN ABACUS OR *S'CHYOTY*

The *s'chyoty* shown here rests on a desk built by Russian Orthodox Bishop Innocent during the mid-1800's. This abacus, desk, and other historical furnishings and artifacts reside in Sitka National Historical Park within the restored 1843 Russian Bishop's House (a National Historical Landmark).

Students can take a virtual tour of the Russian Bishop's House as a history extension of this mathematics activity at the park's extended website: http://www.nps.gov/sitk/home.htm.

OBJECTIVES (general)

- Students will be able to make and use a *s'chyoty*, or Russian abacus, model.
- Students will be able to represent quantities and solve mathematical computations using a Russian abacus.
- Students will explore Russian American history through a variety of activities.

INTRODUCTION

Sitka National Historical Park preserves the history and culture of the Tlingits who first settled in the Sitka area and the Russians who arrived in 1799 to colonize Alaska. From 1804-1867, Sitka was known as *Novo-Arkhangels'k* or New Archangel, the capital of Russian America. When the Russians arrived, they brought with them their religion, language, and culture to share with the Tlingit and other Europeans who colonized Alaska with the Russian American Company. They also brought along various business tools, like the Russian abacus, or *s'chyoty*. The Russian American Company kept extensive business records using the *s'chyoty*, or Russian abacus. The *s'chyoty* is used even to this day in some parts of Russia to determine sales totals.

In the 1840's, the first Bishop of the Alaska Diocese of the Russian Orthodox Church, Bishop Innocent, established a residence and seminary in Sitka. He also created an elementary school in the 1843 Russian Bishop's House, a building built by the Russian American Company to hold the seminary, a chapel, and the Bishop's personal quarters. The historical Russian Bishop's House was restored to its 1853 appearance by the National Park Service and is cared for by Sitka National Historical Park today. This special building is one of only three or four Russian American buildings left in all of North America, it is over 70% original, and it is the only one restored to its original historical period with original furnishings inside. It also contains the oldest Russian Orthodox church (a small chapel) in Alaska.

As Native Alaskans were converted to the Russian Orthodox Church, they became citizens of Russia and entitled to an education. Russian American Company officials wanted to ensure that local people would be able to function in the company as clerks, managers, accountants, etc. Curriculum in the mission schools included religious studies, arithmetic, history, languages, geography, penmanship, etc. Because of the regular use of the *s'chyoty*, therefore, students attending classes at the Russian Bishop's House would have used it for lessons in arithmetic. This arithmetic would also have been handy for the more practical skills of carpentry and blacksmithing also taught in the school.

Why use an abacus?

American students today can benefit greatly by knowledge of this tool that emphasizes place value in a base ten system. This manipulative tool can be used to model/represent quantities, round quantities to a specific place value, add, subtract, multiply, and divide (including regrouping).

This activity will take young people back in time – to when Russians lived in New Archangel and used the Russian abacus. Calculators had not been invented, although the abacus is thought to be the forerunner to the calculator. Activities included in this kit are specifically correlated to the Alaska Standards Benchmarks. These standards are derived from NCTM standards, therefore, this kit can be advantageous for students throughout Alaska as well as nationwide.

Teachers may choose from a series of lessons for each level included in the kit. Since each student should have his/her own abacus to work with throughout the school year, a recommended materials list is included, and students begin participating by making their own Russian abacus.

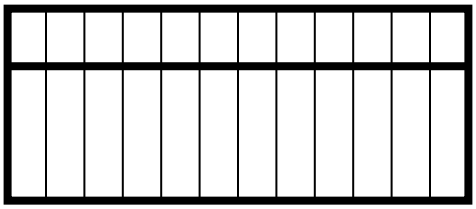
History of the Abacus

The term *abacus* is derived from the Greek word *abax* meaning "calculating board or table" also probably from the Phoenician word *abak* meaning "sand" or Hebrew word *abhaq* meaning "dust." Originally, it was an adaptation of a method of counting and keeping track of quantities by moving pebbles in the sand. Over time, beads threaded onto a wooden frame replaced the stones. It is believed that the Babylonians used this first place-value number system between 1000 BC and 500 BC.

The Chinese Abacus (suan-pan – "counting tray")

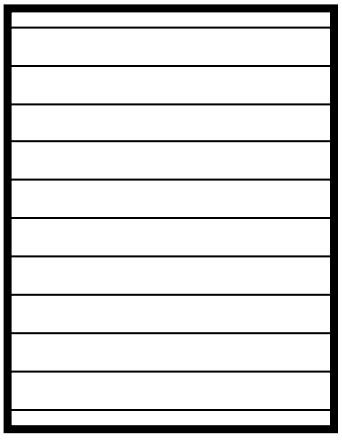
The first record of the Chinese abacus is from the Yuan Dynasty (14th Century). It can be used to add, subtract, multiply, and divide as well as work more complex problems involving fractions and square roots. The Chinese abacus is still commonly used in many Asian countries.

The Chinese abacus has a horizontal center bar with rows of beads above and below (2 beads above and 5 beads below). Numbers represented are read by their relationship to the center bar. Beads below the bar (earth beads) represent ones and beads above the bar (heaven beads) represent five's. So, if there is one heaven bead and one earth bead moved toward the center bar, the represented number is "6" – one 5 plus 1 one. Each vertical row represents place values (powers of 10). Unused beads are pushed away from the center bar.



The Russian Abacus

The "national calculator" or *s'chyoty*, was used until the mid-1990's in Russian businesses. This abacus consists of eleven wires with beads. Counting from the bottom, wires 1-3 have 10 beads, wire 4 has 4 beads, and wires 5-11 have 10 beads. For the 10 beaded wires, the first 4 beads and last 4 beads are one color and the middle 2 are a contrasting color to enable quicker, visual counting. The fourth wire seems to be a place holding wire (similar to decimal point). All wires above that represent whole number place values. Typically, the unit represented is the *ruble* (or Russian unit of currency). To enter the number 5874, move to the left edge in the eighth wire 5 beads, in the seventh wire 8 beads, in the 6th wire 7 beads and in the 5th wire 4 beads.



MAKING A *S'CHYOTY*:

Materials:

A combination of pony beads and 6mm pipe cleaners work ideally. The beads slide easily along the pipe cleaners and yet hold their position, even if the abacus is dropped. Also, the abacuses can be held upright for a quick teacher check without losing the integrity of the answer. Another aid for visual inspection of students' understanding is to color-code the pipe cleaners and beads so that each student has the same color for each place value. In addition, the greater the contrast within the place value, the easier it is to distinguish accuracy of students' work. For visually impaired students, try using beads with different shapes (round, square, and star, for example). Transparent beads can be used for an overhead projector version.

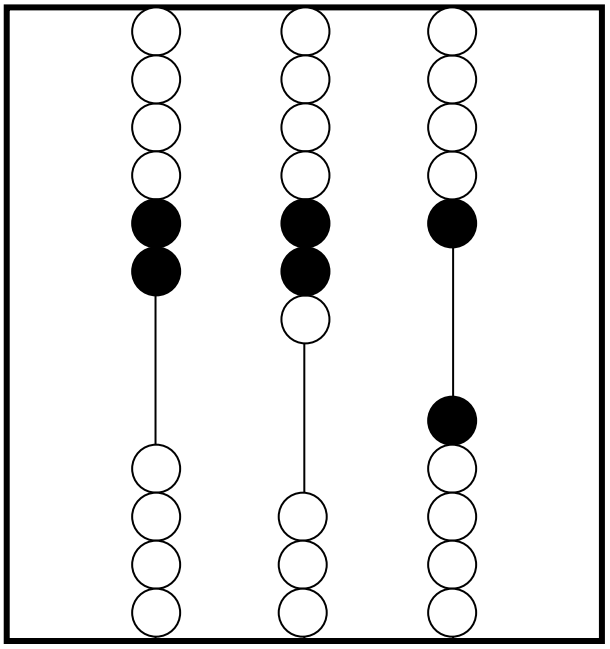
Adequate supplies for a classroom set of 30 abacuses costs approximately $10-$15. In addition, using the supplies suggested, each student should be able to continue to use his/her abacus throughout the school year.

- *Beads: plastic pony beads (6 x 9 mm.):*
  Ages 5-7: three different colors – 8 beads each, 6 beads contrasting color
  Ages 8+: ten different colors – 8 beads each, 20 beads contrasting color, 1 additional color for decimal point
- *"Wires": 6mm pipe cleaners – various colors*
  Ages 5-7: 3 each
  Ages 8+: 11 each
- *Frame:*
  Ages 5-7: bottom 2-3" of gallon milk jug (plastic) keeping bottom intact
  Ages 8+: shoebox lid
- *Several Hole punchers*

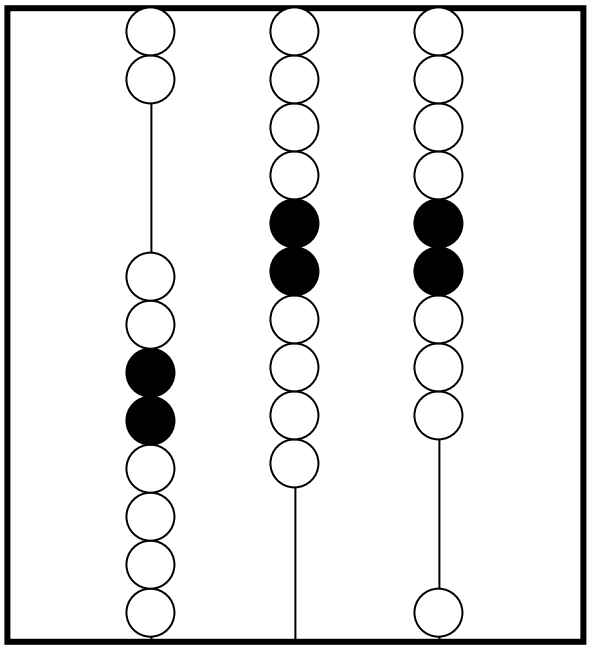
Method:

1. Punch holes (using hole punch) on opposite sides of frame (three holes on each side for ages 5-7 and 11 holes for 8+).
2. Thread beads onto pipe cleaners: 4 of first color, 2 of contrasting color, and 4 more of first color.
3. Thread pipe cleaners through punched holes and secure.
4. Teachers may wish to label place values for each strand of beads (using label tapes or permanent markers).
5. To use, orient the abacus so pipe cleaners are vertical to the student and all beads are pushed "up." Although the *s'chyoty* was traditionally oriented with horizontal beads, the vertical alignment would be easier to understand for younger users, especially while reinforcing place value concepts.
6. Slide appropriate beads "down" to represent specific quantities. (See example numerical representation in Fig. 1)

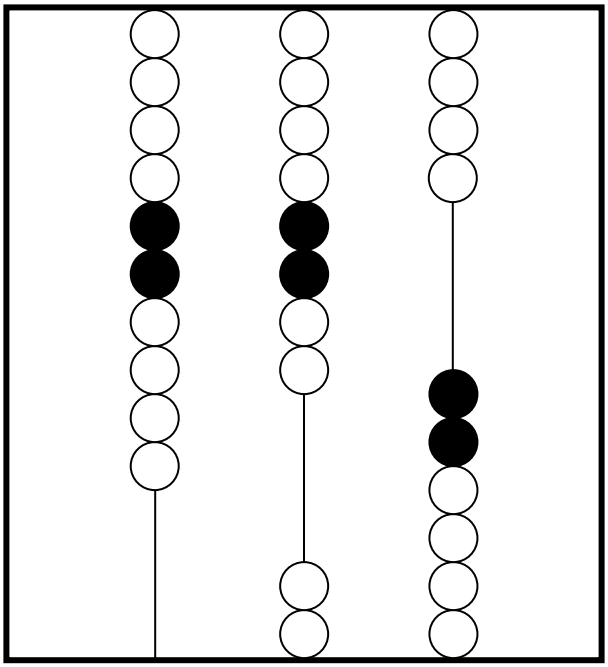
Name: Sample Numerical Representations Figure 1



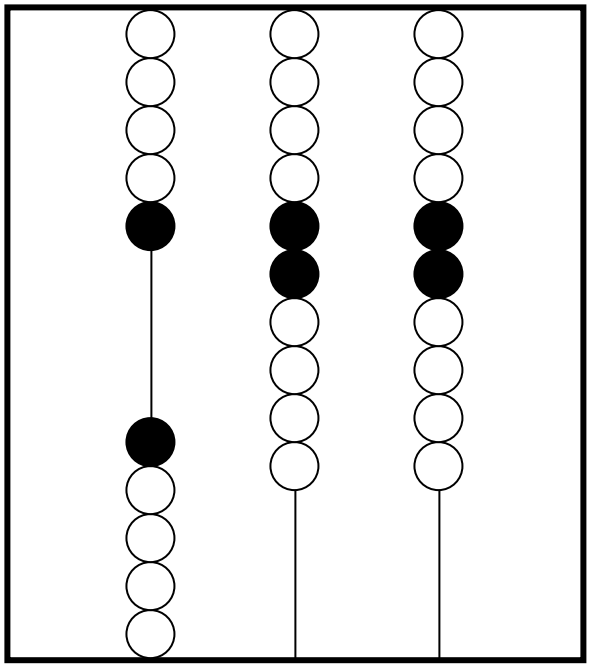
435



801



26



500

CORRELATION TO ALASKA PERFORMANCE STANDARDS

AGES 5-7 (Grades K-2)

Mathematics M.1 (Numeration)

- 1.1 Read, write, order, count, and model one-to-one correspondence with whole numbers to 100.
- 1.2 Use, model, and identify place value positions of 1's, 10's, and 100's.
- 1.3 Model and explain the processes of addition and subtraction, describing the relationship between the operation.
- 1.6 Identify, describe, and extend patterns inherent in the number system; skip count by 2's, 5's, and 10's.
- 1.7 Demonstrate the commutative property of addition.

Mathematics M.3 (Estimation and Computation)

- 1.1 Make reasonable estimates of "how many" and "how much"; estimate the results of simple addition and subtraction problems.
- 1.3 Add and subtract whole numbers to 100 using a variety of models and algorithms.
- 1.4 Model multiplication as repeated addition and grouping objects.

Mathematics M.4 (Function and Relationships)

- 1.1 Recognize, describe, create, and extend repeating and increasing patterns with a variety of materials including symbols, objects, and manipulatives.
- 1.2 Generate and solve simple functions by identifying and applying addition and subtraction patterns
- 1.4 Complete open space sentences with missing numbers; use appropriate vocabulary including "greater than," "less than," and "equal to."

Mathematics M.6 (Geometry)

- 1.6 Use comparative directional and positional words: above, below, inside, outside, on, in, right, left, horizontal, vertical, and middle.

Mathematics M.8 (Problem Solving)

- 1.2 Develop and apply strategies including guess and check, modeling and acting out, drawings, and extending patterns to solve a variety of problems.

Mathematics M.9 (Communication)

- 1.2 Use manipulatives, models, pictures, and language to represent and communicate mathematical ideas.
- 1.3 Use everyday language to explain thinking about problem-solving strategies and solutions to problems.

Mathematics M.10 (Reasoning)

- 1.3 Explain why a prediction, estimation, or solution is reasonable.

Mathematics M.11 (Connections)

- 1.1 Apply mathematical skills processes to literature.

AGES 8-10 (Grades 3-5)

Mathematics M.1 (Numeration)

- 2.1 Read, write, model, order, and count with positive whole numbers to 1,000,000 and negative whole numbers.
- 2.3 Use, model, and identify place value positions from 0.001 to 1,000,000.Model and explain the processes of addition and subtraction, describing the relationship between the operation.
- 2.3 Model and explain the processes of multiplication and division. Describe the relationships among the four basic operations. Demonstrate the commutative property of addition.
- 2.4 Identify and describe different uses for the same numerical representation.
- 2.5 Model and explain the process of adding and subtracting fractions with common denominators and decimals that represent money.

Mathematics M.3 (Estimation and Computation)

- 2.1 Describe and use a variety of estimation strategies including rounding to the appropriate place value, multiplying by powers of 10, and using front-end estimation to check the reasonableness of solutions.
- 2.2 Recall and use basic multiplication and division facts orally, with paper and pencil without a calculator Model multiplication as repeated addition and grouping objects.
- 2.3 Add and subtract whole numbers and fractions with common denominators to 12 and decimals, including money amounts, using models and algorithms.
- 2.4 Multiply and divide multi-digit whole numbers by 2-digit numbers, limiting the 2-digit divisors to those that end in 0; multiply and divide decimals that represent money by whole numbers.

Mathematics M.4 (Function and Relationships)

- 2.1 Use patterns and their extensions to make predictions and solve problems; describe patterns found in the number system including those formed by multiples, factors, perfect squares, and powers of 10.
- 2.2 Generate and solve simple functions by identifying and applying multiplication and division patterns.

Mathematics M.7 (Problem Solving)

- 2.2 Select and apply a variety of strategies including making a table, chart or list, drawing pictures, making a model, and comparing with previous experience to solve problems.
- 2.3 Explain and verify results of the original problem and apply what was learned to new situations.

Mathematics M.8 (Communication)

- 2.2 Represent mathematical and practical situations using concrete, pictorial, and symbolic representation.
- 2.3 Organize and communicate mathematical problem solving strategies and solutions to problems.

Mathematics M.9 (Reasoning)

- 2.1 Draw logical conclusions about mathematical situations.
- 2.2 Given a rule or generalization, determine whether the example fits.
- 2.3 Justify answers and mathematical strategies as reasonable.

Mathematics M.10 (Connections)

- 2.1 Apply mathematical processes to social studies.

ACTIVITIES

ACTIVITY ONE:
Represent various quantities on the abacus. Focus on place value, making sure all place values are understood.
Materials: abacus, place value chart

ACTIVITY TWO:
Addition without regrouping; commutative property of addition
Materials: abacus

ACTIVITY THREE:
Subtraction without regrouping
Materials: abacus

ACTIVITY FOUR:
Counting by 2, 5, and 10; multiplication as repeated addition
Materials: abacus

ACTIVITY FIVE:
Addition with regrouping
Materials: abacus

ACTIVITY SIX:
Subtraction with regrouping
Materials: abacus

ACTIVITY SEVEN:
Estimating sums and differences/ rounding
Materials: abacus

Note to teachers:
These activities are intended for use in conjunction with an elementary mathematics program. Choose activities appropriate for your students' academic level. In addition, many of the lessons can be easily adapted for higher grade levels by adding more place value "wires" and the addition of more complex activities. We have attempted to provide lessons for use of the *s'chyoty* to facilitate mastering the above skills as well as extension activity ideas to take students a step further both mathematically and culturally. Russian cultural information has been included in the appendix.

ACTIVITY ONE
Represent various quantities on the abacus; focus on place value, making sure all place values are understood (AK Standards M.A.1; M.A.5; M.C.1)

Objectives:
1. Students will be able to represent numbers from 1 to 1,000,000 (or less) on the abacus.
2. Students will be able to name the place value for specific digits in numbers.
3. Students will be able to transfer information on abacus to blackline master.

Materials:
1. Personal *s'chyoty*
2. Poster of *s'chyoty*
3. Place value chart (wipe-off version) – see Fig. 3 – copy onto film paper
4. Blackline master of *s'chyoty* (see Fig 2)

Procedure:
1. Orient the *s'chyoty* so that the wires are <u>vertical</u> to the student. Give a name to each wire: rightmost = ones; middle = tens; and leftmost = hundreds, etc. Teachers can use permanent markers to label these on each student's *s'chyoty,* if desired.
2. Using the place value chart, list various quantities to be represented on the *s'chyoty*. Discuss the significance of each place value as each student attempts to represent the same quantities on his/her *s'chyoty*. The correct answers can be demonstrated on teacher's *s'chyoty*.
3. Students can also volunteer their own quantities and represent them on the *s'chyoty*. When finished, teacher can ask students to identify specific place values of specific digits.
4. Students should also use pencil and paper to record solved place value examples/ problems (use blackline master).

Extensions:
1. Have students learn Russian vocabulary – count to ten in Russian (see appendix).
2. Students can search for numbers and mathematics problems in the newspaper and represent them on the Russian abacus.

Assessment:
1. Teachers can randomly choose students to show them a quantity represented on the abacus.

2. Teachers can randomly select students to name a place value of a specific digit represented on the abacus.

ACTIVITY TWO
Addition without regrouping (AK Standards M.A.1; M.A.3; M.A.4; M.A.5; M.C.1)

Objectives:
1. Students will be able to add numbers (no regrouping needed) using the abacus.
2. Students will be able to transfer answers from abacus to blackline master.
3. Students will be able to list facts for addition.

Materials:
1. Personal *s'chyoty*
2. Blackline master of *s'chyoty* (see Fig 2)

Procedure:
1. Review place value representation on the abacus.
2. Begin with one-digit numbers and have students represent them on the abacus. Then, add another one-digit number to it by counting and sliding the appropriate number of beads down on the wire. The sum of these two numbers should not involve any regrouping – i.e. 3+1, 5+2, 4+4, etc. Once the second number is counted and beads moved, count the total number of beads for the answer. Record results on blackline master. Students should look for patterns based on results and draw conclusions about basic addition facts. List these facts on worksheet "Addition Facts" in appropriate columns. A list of "addition facts" is included in the appendix.
3. Once comfortable with one-digit numbers, try expanding to two-digit numbers (once again, no regrouping involved) – first 2-digit + 1-digit and then 2-digit + 2-digit. Record results on blackline masters.
4. Once 2-digit addition is mastered, try moving on to three-digit addition. Do the same addition facts hold true for 3-digit addition?

Extensions:
1. Have students use a variety of manipulatives to solve addition.
2. Solve simple problems requiring addition using the abacus and/or other manipulatives.
3. Summarize by listing addition facts.
4. Tie to Russian cultural history (see appendix)
5. Introduce the commutative property of addition (if a+b=c, then b+a=c).

Assessment:
1. Randomly have students demonstrate addition using the *s'chyoty.*
2. Have students orally state one or more basic addition facts.

ACTIVITY THREE
Subtraction without regrouping (AK Standards M.A.1, M.A.3, M.A.4, M.A.5, M.C.1)

Objectives:
1. Students will be able to model subtraction with no regrouping needed.
2. Students will be able to list subtraction facts.
3. Students will be able to state fact families for addition and subtraction (i.e., 2+3=5, 5-3=2, 5-2=3).
4. Students will be able to transfer answers from abacus to blackline master.

Materials:
1. Personal *s'chyoty*
2. Blackline master of *s'chyoty*

Procedure:
1. Review place value and addition facts.
2. Introduce subtraction as the "opposite of addition" or "taking away" a value. Since addition resulted in sliding beads "down," subtraction is accomplished by sliding beads up, or away.
3. Begin with single digit subtraction. Start by representing the first value on the *s'chyoty*. Then, slide the beads representing the second quantity up or away from the original value. The remaining beads represent the answer or difference. Record results on worksheets. Students should look for patterns and compare these results with addition facts from previous lesson. Group the related facts into fact families. See appendix for sample fact families.
4. Once comfortable with 1-digit subtraction, continue with 2-digit minus 1-digit, then 2-digit minus 2-digit. No regrouping should be necessary at this time.
5. Continue the process with three-digit subtraction. Once again, no regrouping.

Extensions:
1. Have students solve simple subtraction without the use of abacus – i.e. paper and pencil.
2. Russian cultural activity (see appendix)
3. Solve simple story problems requiring subtraction.

Assessment:
1. Randomly select students to demonstrate subtraction done on an abacus.
2. Addition/subtraction bee
3. Students create story problems requiring subtraction and describe how the problem can be solved.

ACTIVITY FOUR
Counting by 2, 5, and 10 (AK Standards M.A.1, M.A.4, M.A.5, M.C.1)

Objectives:
1. Students will be able to model counting by 1's (including regrouping) on the abacus.
2. Students will be able to model counting by 2, 5, and 10 (including regrouping) on an abacus.

3. Students will be able to demonstrate and explain "regrouping" on an abacus.
4. Students will be able to recognize patterns found when counting by 2, 5 and 10.

Materials:
1. Personal *s'chyoty*
2. Plastic coins – pennies and dimes

Background:
In order to successfully regroup when adding and subtracting, students need to understand that ten "ones" are equivalent to one "ten" and ten "tens" are equivalent to one "hundred." To illustrate this concept, count beads with students while sliding beads one at a time down along the pipe cleaner. What happens when all the beads are used up? Do you have to stop counting?

Think of money and how that can be exchanged (pennies for dimes, dimes for dollars, etc.). Include a discussion about which method (10 pennies or 1 dime) might be better to buy something that would cost 10 cents. (Is there a correct answer here? Get student ideas…). The important thing is the idea of an "even exchange." Either method would work (1 dime or 10 pennies)…the choice is usually based on individual convenience. Likewise, regrouping in addition or subtraction is based on convenience. Without regrouping, the quantity would be "cluttered" like a change-purse full of pennies.

Using the Russian abacus to regroup during counting, addition, and subtraction involves "exchanging equivalent quantities." Ten beads on the "ones" bar are traded for one bead on the "tens" bar; ten beads on the "tens" bar are traded for one bead on the "hundreds" bar; etc.
In this activity, students will move beads per specific problem, trading ten beads on one bar for one bead on the next bar to the left.

Procedure:
1. Review place value. Discuss how values increase as one moves to the left.
2. Practice counting by "1" to 10, 20, 30… using the abacus. When 10 is reached, all beads in "ones" bar are used, so, in order to continue, exchange those beads for one on the "tens" bar. To do this, simultaneously slide the 10 "ones" beads up and slide one "tens" bead down. Continue counting to 100+, sliding 1 bead at time and exchanging as needed.
3. Next, try moving two beads down at a time (counting by 2's). Record results on a separate paper. Once again, regroup as needed. Are there any patterns to the results?
4. Once counting by 2's is mastered, the next step is to count by 5's. This is aided by the contrasting colors to the beads, but students should see that themselves. Instead of moving two beads at a time, try moving five beads at a time. Once again, record the results. Are there any patterns found when counting by 5's?
5. Finally, slide 10 beads down each time. This requires almost constant regrouping. Record the results on a separate paper. What pattern develops here?

Extensions:
1. Use money to practice counting by 5 and 10.
2. Russian cultural activity (see appendix)
3. Introduce multiplication as repeated addition.

Assessment:
1. Count by 2, 5, and/or 10 to 100.
2. Count nickels and dimes to one dollar.
3. Demonstrate regrouping with explanations while counting by 2's on the abacus.

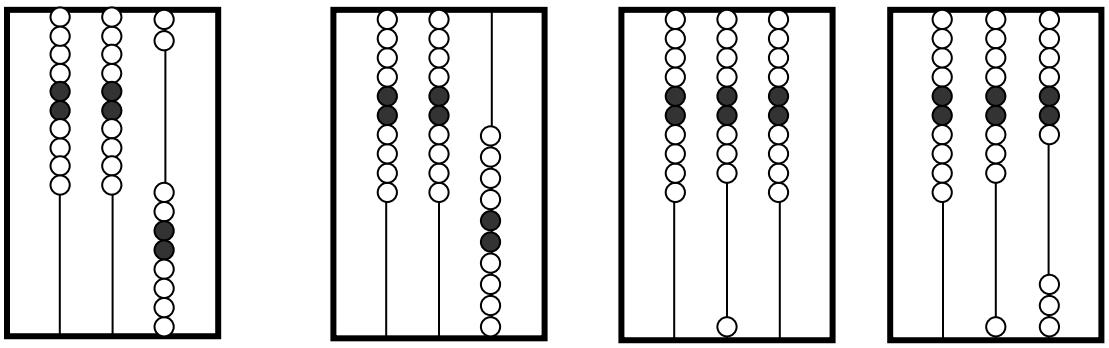
ACTIVITY FIVE

Addition with regrouping (AK Standards M.A.1, M.A.3, M.A.4, M.C.1)

Objectives:
1. Students will be able to model "regrouping" on an abacus.
2. Students will be able to successfully add two quantities with regrouping required.

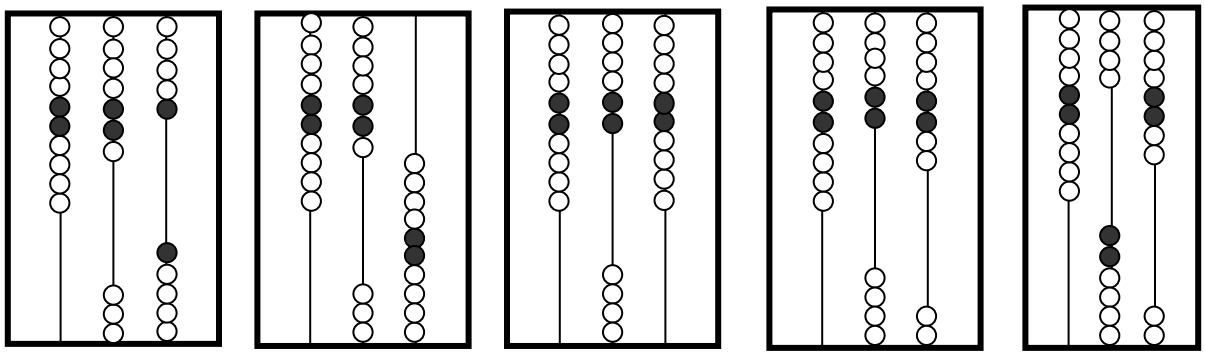
Materials:
1. Personal *s'chyoty*

Procedure:
1. Review skip counting by 2, 5 and 10.
2. Review addition facts using the abacus.
3. For one-digit addition, try adding 8+5. Start with 8 "ones" beads (a) and count five more. But, after only 2, all beads are used (b), so, remembering where you left off counting, slide 1 "tens" bead down while sliding the 10 "ones" beads up (c). Now you have available beads to continue counting. You already counted 2 out of 5, so now finish sliding the other beads while counting 3, 4, and 5 (d). The final result should contain 1 bead on "tens" and 3 beads on "ones" for a sum of 13. 8+5=13.



(a) (b) (c) (d)

4. To add 2-digit numbers, enter the first value onto the abacus. Then add value of 2nd number – "ones" first – using the same process as in #3. Then add the "tens" digit similarly, regrouping as necessary. For example, 35+27…. Represent 35 on the abacus (e). Then count down 7 "ones" beads (f), regrouping after 5 (g). Now the abacus reads 4 "tens" and 2 "ones" (h). Next count down 2 "tens" for a result of 6 "tens" and 2 "ones" (i). Therefore, 35+27=62.



(e) (f) (g) (h) (i)

Extensions:
1. Use examples from text, etc. to demonstrate addition with regrouping.
2. Determine total number of students in your school using the *s'chyoty*.
3. Russian cultural activity (see appendix).

Assessment:
1. Students demonstrate addition with regrouping on the *s'chyoty*, explaining each step.
2. Grocery shopping – add two items from local grocery sale ads, regrouping as needed. Disregard and applicable sales tax and express answer in cents.

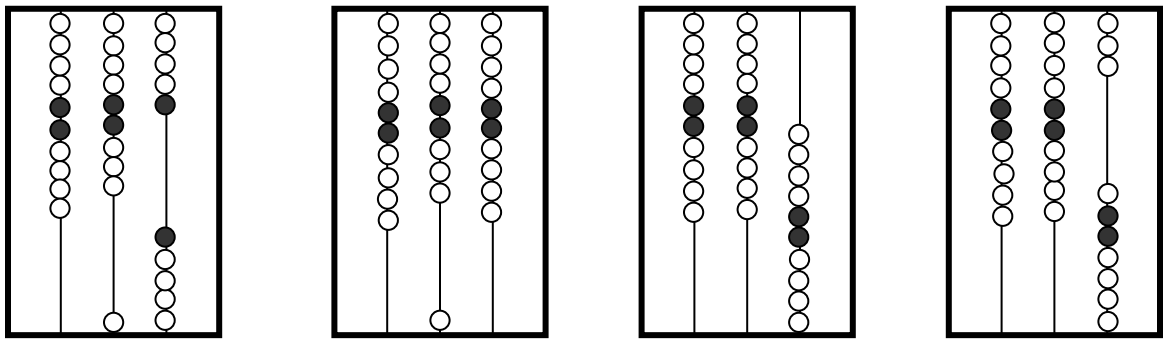
ACTIVITY SIX
Subtraction with regrouping (AK Standards M.A.1, M.A.3, M.A.4, M.C.1).

Objectives:
1. Students will be able to model subtraction "regrouping" on a *s'chyoty.*
2. Students will be able to successfully subtract quantities involving regrouping.

Materials:
1. Personal *s'chyoty*
2. Blackline master of *s'chyoty*

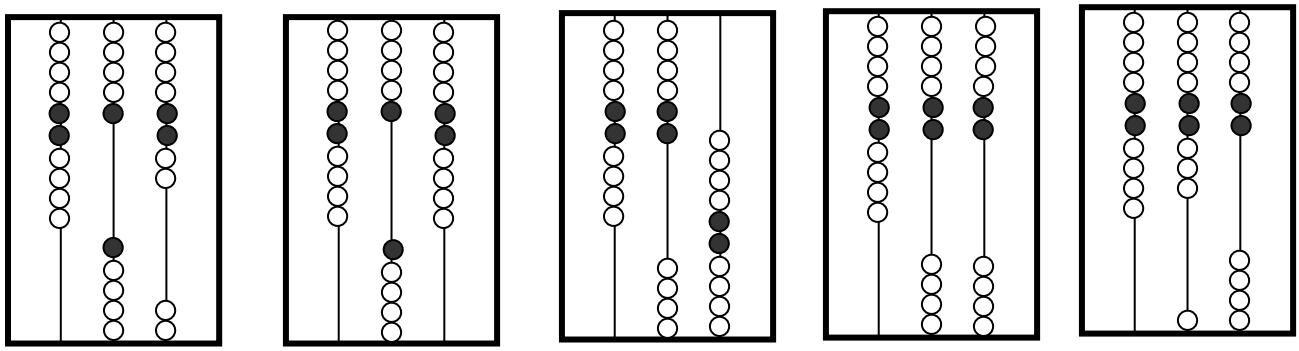
Procedure:
1. Review subtraction on the *s'chyoty.*
2. Regrouping for subtraction involves exchanging equivalent quantities (like addition) – ten "ones" for one "ten" or ten "tens" for one "hundred" – the difference is that the exchange is reversed. For addition, as ten "ones" are pushed up, one "ten" is pushed down. In subtraction, one "ten" is pushed up while ten "ones" are pushed down. Begin with a problem

like 15-8. To do this on the abacus, first represent 15 as one "ten" and five "ones" (a). Now begin counting "ones" beads, sliding each one up as it is counted. When the count reaches 5, all "ones" beads are "up" (b). So, since you need to slide more beads up to continue counting to 8, exchange one "ten" bead for ten "ones" beads (c). Now continue counting and sliding "ones" beads up – counting 6 (left off at 5), 7, and 8 (d) for a final answer of 7. Therefore, 15-8=7.



a b c d

3. Next try a 2-digit number minus a 2-digit number, for example 52 minus 38. First, represent 52 on the *s'chyoty* (a). To subtract 38, start with the 8 in the "ones" place and begin counting and sliding beads up. However, after "2," all the "ones" beads are up (b), so exchange one "tens" bead for ten "ones" beads, sliding the "tens" bead up and the "ones" beads down (c). Now continue counting – 3, 4, 5, 6, 7, 8 – sliding beads up for each number counted, leaving 4 beads on the "ones" rod (d). Next, subtract the three tens by sliding 3 "tens" beads up – leaving one bead on the "tens" rod (e). In the end, the *s'chyoty* has one "tens" bead and four "ones" beads for an answer of 14. Therefore, 52-38=14.



(a) (b) (c) (d) (e)

Extensions:

1. Subtract larger digit numbers following the same procedure as above.
2. Determine change for one dollar (represented as 100 cents) when a certain priced item is purchased (disregard sales tax). This may require multiple regrouping. For example, determine the change back from one dollar when a 45-cent item is purchased. To do this, first represent one dollar on *s'chyoty* as 1 "hundreds," 0 "tens," and 0 "ones." Exchange the

one "hundreds" for ten "tens." Then exchange one "tens" for ten "ones." Now you should have 9 "tens" and 10 "ones" to subtract the 4 "tens" and 5 "ones."
3. Russian cultural activity (see appendix).
4. Extend subtraction to paper and pencil method.

Assessment:
2. Randomly select students to demonstrate subtraction regrouping, giving oral explanations.
2. Shopping spree – choose items from local store ads and determine change from a one or five dollar bill, ignoring decimal.

ACTIVITY SEVEN
Rounding and estimating sums and differences (AK Standards M.A.1, M.A.3, M.A.4, M.A.5, M.C.1, M.D.1)

Objectives:
1. Students will be able to round numbers to the nearest tens.
2. Students will be able to round numbers to the nearest hundreds.
3. Students will be able to estimate sums and differences.

Materials:
1. Personal *s'chyoty*

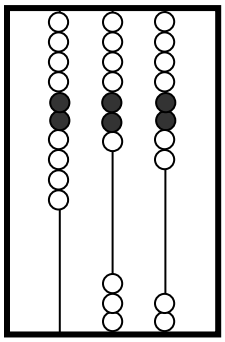
Background
In mathematics, rounding is often used to make computations easier and faster by eliminating "insignificant" digits and converting them to zeroes. It is especially useful when dealing with very large or very small quantities (like populations or the national debt) but can also be used for other quantities like annual precipitation or keeping track of purchase costs. By rounding, mental arithmetic can be done easily (once basic arithmetic facts are learned).

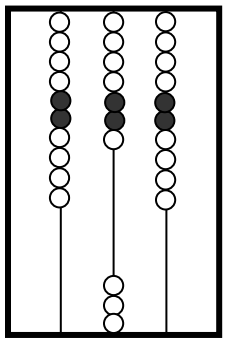
Rounding is typically done to a specific place value – and the result represents a "closest quantity." For example, rounding 17 to the nearest tens place would result in the answer of 20 because 17 is closer to 20 than it is to 10. Likewise, rounding 215 to the nearest hundreds would result in an answer of 200 since 215 is closer to 200 than it is to 300. The significant quantity when rounding is "5." If a specific place value digit is less than five, then the lower value is closer. If that digit is equal to or greater than five, then the higher value is closer. In the first example above, since 7 is greater than five, 1<u>7</u> was rounded up to 20 (the higher value of 10 or 20). In the second example, 215 is rounded down to 200 (the lower value of 200 or 300) because 1 is less than 5.

On the *s'chyoty*, rounding is facilitated by the contrasting colors of the 5^{th} and 6^{th} beads, allowing for quick visual determination of "less than 5," "greater than 5," or "equal to 5."

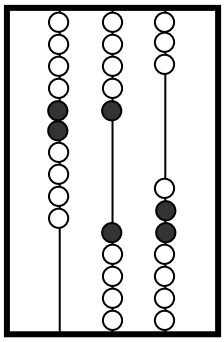
Procedure:

1. Review place value, making sure students understand differences in values of each place value and how to write numbers represented on the *s'chyoty*.
2. To round to the nearest tens – first represent the given value on the *s'chyoty*. Look at the "ones" beads. If there are no contrasting-colored beads in value represented, then slide all beads up. The result is the rounded value. For example, round 32 to the nearest tens. Since there are no contrasting beads on the "ones" rod, slide those beads up leaving zero beads on the "ones" rod and three beads on the "tens" rod, so rounded value is 30.

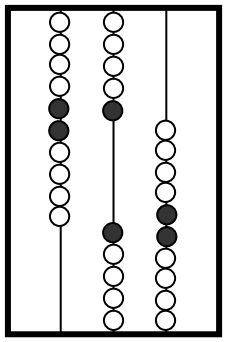




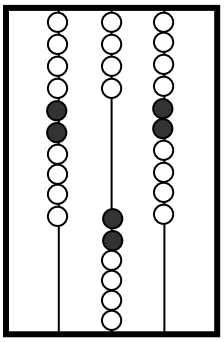
3. If there is a contrasting-colored bead on the "ones" rod, then slide all the other beads down. This basically represents being closer to 10 than 0. Now regroup to simplify the result. For example, round 57 to the nearest tens. Start with 57 represented on the *s'chyoty* (a). Looking at the "ones" rod, the contrasting-colored beads are used, so slide all other beads (10 total) down (b). Next, regroup by sliding the 10 "ones" beads up and 1 "tens" bead down (c). This represents the answer of 6 "tens" and 0 "ones" or 60.



(a)

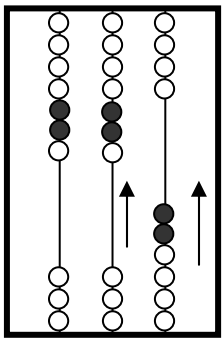


(b)

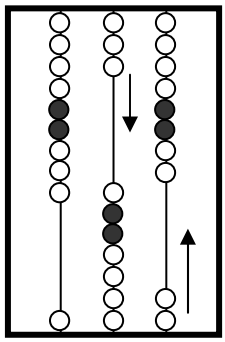


(c)

3. To round to the nearest hundreds, represent the value on the *s'chyoty*. First, slide all "ones" beads up so the value there is zero. Next, look at the beads on the "tens" rod and follow similar process as in #1 or #2 above. If there are less than 5 beads on the "tens" rod, slide all the beads up, and resulting number is rounded value. If there are five or more, slide the remaining "tens" beads down and regroup to simplify.
   Examples:
   <u>Round 336 to the nearest hundreds.</u>
   - Represent 336 on the *s'chyoty.*
   - Slide the 6 "ones" beads up.
   - Look at the "tens" beads – no contrasting-colored beads.
   - Slide the 3 "tens beads up.
   - Left with only 3 "hundreds" beads, so answer to nearest hundreds is 300.



   Round 172 to the nearest hundreds
   - Represent 172 on the *s'chyoty.*
   - Slide the 2 "ones" beads up.
   - Look at the "tens" beads – yes, there are contrasting-colored beads.
   - Slide the remaining "tens" beads down.
   - Regroup sliding one "hundreds" bead down while sliding ten "tens" beads up.
   - Answer is now 200



Extensions:

1. Estimating sums and differences:
   An estimation is a quick and easy <u>solution</u>. Ideally, estimating is a mental process that can be especially handy at the grocery store. By mentally keeping track of purchases, one can insure that the cost won't exceed the available funds. Estimating is done by rounding the numbers to the highest place value <u>before</u> adding and subtracting.

   An important rule for estimating is to round <u>all</u> numbers to the same place value. Then add or subtract the resulting rounded values. For example, to estimate 16+32, round the 16 to 20 and the 32 to 30. Then add 20+30 = 50. The important thing is to emphasize quick and easy. For that to happen, rounding needs to be done <u>first</u>. Similarly, to estimate 324+57: since the number 57 has only two digits, round it to the highest place value (or tens). Round 324 to the nearest tens also. The resulting problem will be 320+60 with an estimated answer of 380. Have students pair up and work with a partner to complete several estimations. One person would round the first value and the other person would round the second value. Once both values are rounded, each student can add or subtract to arrive at the estimated sum or difference, checking each other's work.

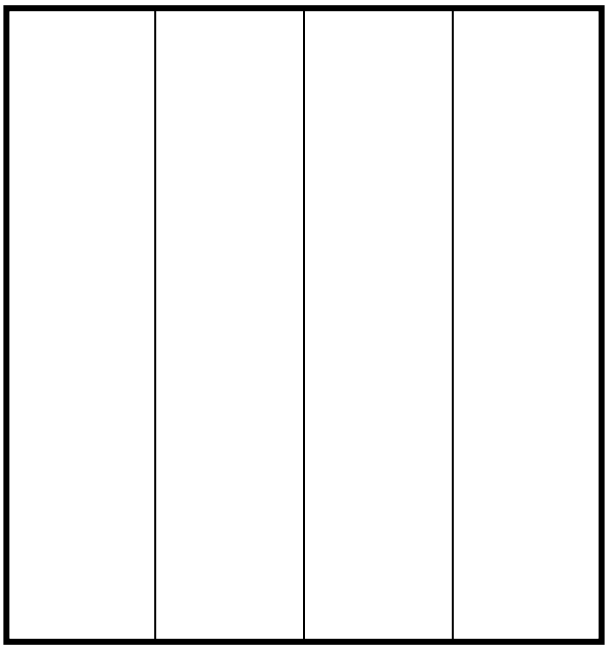
2. Russian Cultural Activity (see appendix).

Assessment:

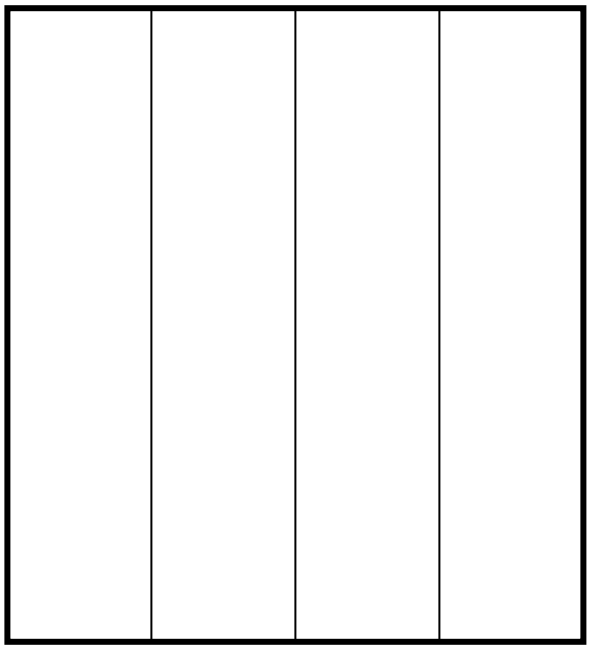
1. In groups of five, estimate a grocery bill. Using a local store ad, choose five items to purchase. Each student then rounds one price each and then total all the costs.

APPENDIX

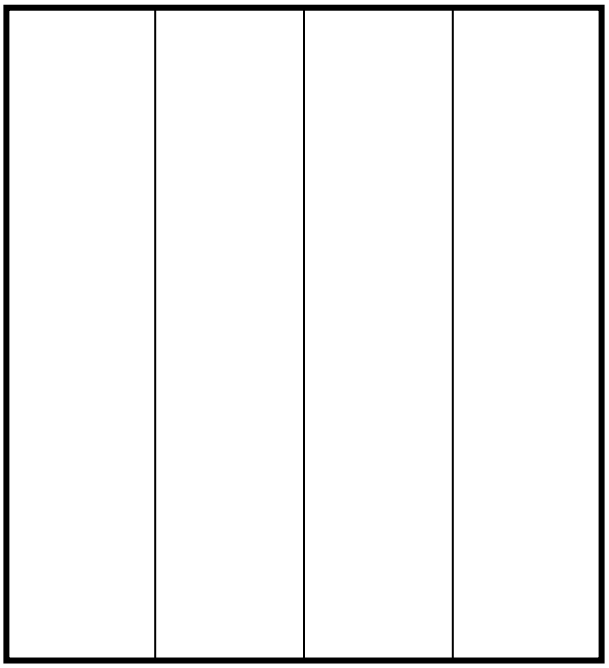
Name_____ Fig 2



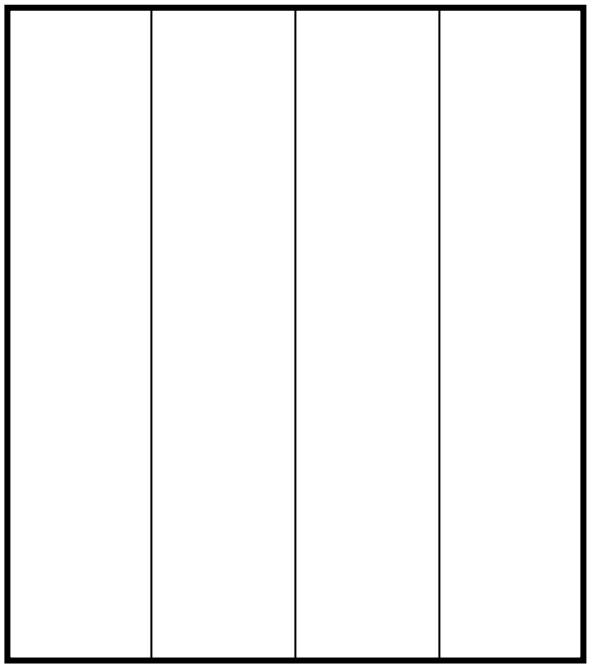
_____



_____



_____



_____

ADDITION FACTS

1+0=1 2+0=2 3+0=3 4+0=4 5+0=5 6+0=6 7+0=7 8+0=8 9+0=9 10+0=10
1+1=2 2+1=3 3+1=4 4+1=5 5+1=6 6+1=7 7+1=8 8+1=9 9+1=10
1+2=3 2+2=4 3+2=5 4+2=6 5+2=7 6+2=8 7+2=9 8+2=10
1+3=4 2+3=5 3+3=6 4+3=7 5+3=8 6+3=9 7+3=10
1+4=5 2+4=6 3+4=7 4+4=8 5+4=9 6+4=10
1+5=6 2+5=7 3+5=8 4+5=9 5+5=10
1+6=7 2+6=8 3+6=9 4+6=10
1+7=8 2+7=9 3+7=10
1+8=9 2+8=10
1+9=10

SUBTRACTION FACTS

10-10=0 9-9=0 8-8=0 7-7=0 6-6=0 5-5=0 4-4=0 3-3=0 2-2=0 1-1=0
10-9=1 9-8=1 8-7=1 7-6=1 6-5=1 5-4=1 4-3=1 3-2=1 2-1=1 1-0=1
10-8=2 9-7=2 8-6=2 7-5=2 6-4=2 5-3=2 4-2=2 3-1=2 2-0=2
10-7=3 9-6=3 8-5=3 7-4=3 6-3=3 5-2=3 4-1=3 3-0=3
10-6=4 9-5=4 8-4=4 7-3=4 6-2=4 5-1=4 4-0=4
10-5=5 9-4=5 8-3=5 7-2=5 6-1=5 5-0=5
10-4=6 9-3=6 8-2=6 7-1=6 6-0=6
10-3=7 9-2=7 8-1=7 7-0=7
10-2=8 9-1=8 8-0=8
10-1=9 9-0=9
10-0=10

SAMPLE FACT FAMILIES

3+4=7	5+1=6	4+6=10	7+2=9	4+4=8	2+3=5
7-4=3	6-1=5	10-6=4	9-2=7	8-4=4	5-2=3
7-3=4	6-5=1	10-4=6	9-7=2		5-3=2

PLACE VALUE TABLE

Fig. 5

millions			thousands			(ones)			.	decimal		
H	T	O	H	T	O	H	T	O	.	t	h	th
									.			
									.			
									.			
									.			
									.			
									.			
									.			
									.			
									.			
									.			
									.			
									.			
									.			
									.			
									.			
									.			
									.			
									.			
									.			
									.			
									.			
									.			
									.			
									.			

RUSSIAN CULTURAL AND HISTORICAL ACTIVITIES

1. **Counting in Russian**

English	Cyrillic	Pronunciation
• (1) one	(1) раз	*raaz*
• (2) two	(2) два	*dva*
• (3) three	(3) три	*tree*
• (4) four	(4) четыре	*chetíree*
• (5) five	(5) пять	*pyaat*
• (6) six	(6) шесть	*shest*
• (7) seven	(7) семь	*syem*
• (8) eight	(8) восемь	*vóesyem*
• (9) nine	(9) девять	*dévyaat*
• (10) ten	(10) десять	*désyaat*
• (100) one hundred	(100) сто	*stoe*
• (1,000) one thousand	(1,000) тысяча	*tíesyacha*

2. **Russian Alphabet (in order)**

English	Cyrillic	Letter Name & Pronunciation
• Aa	Аа	*aa*
• Bb	Бб	*baa*
• Vv	Вв	*vaa*
• Gg	Гг	*gaa*
• Dd	Дд	*daa*
• YEye	Ее	*ye*
• YOyo	Ёё	*yoe*
• ZHzh	Жж	*dje*
• Zz	Зз	*zaa*
• Ii	Ии	*ee*
• Ieie	Йй	*ee kraatkoye* – ie sound
• Kk	Кк	*kaa*
• Ll	Лл	*laa*
• Mm	Мм	*maa*
• Nn	Нн	*naa*
• Oo	Оо	*oe*
• Pp	Пп	*paa*
• Rr	Рр	*raa*
• Ss	Сс	*saa*
• Tt	Тт	*taa*
• Uu	Уу	*oo*
• Ff	Фф	*faa*
• KHkh	Хх	*khaa* (soft, back of throat)
• TSts	Цц	*tsaa*
• CHch	Чч	*chaa*

• SHsh	Шш	*shaa*
• S'CHs'ch	Щщ	*s'chaa*
• "Hard Sign"	ъ	*tvyórdiy znaak* - no sound
• IYiy	Ыы	*uiy*
• "Soft Sign"	ь	*myágkie znaak* - no sound
• Ee	Ээ	*e*
• YUyu	Юю	*yoo*
• YAya	Яя	*yaa*

3. **Vocabulary**

• Russian abacus	счёты	*s'chyotuiy*
• Mathematics	математика	*maatemáteeka*
• Bead	бусина	*búeseenaa*
• Wire	проволока	*próevoeloekaa*
• Bishop's house	Архиерейское подворье	*Aarkheeryéskoye poedvoerye*
• school	школа	*shkoela*
• sea otter	калан	*kaalán*
• New Archangel	Ново-Архангельскъ	*Nóvo Arkhángels'k*
• America	Америка	*Amyéreekaa*
• Russia	Россия	*Roesíya*
• Pacific Ocean	Тихий океан	*Tíekhee oekeyán*
• children's games	детские игры	*dyétskeeye eégruiy*

4. **Tea Party**

Chinese tea was a vital part of Russian culture during the nineteenth century and still today. *Stash Tea Company* http://www.stashtea.com/ sells authentic reproduction Chinese tea bricks for less than $20.00 (search for "tea brick" on the site). These reproduction bricks can be used to teach students about the economy and social life of Russian America. Chinese tea was the primary trade item for the sea otter and fur seal pelts for which the Russians (using their Aleut and Tlingit hunters) were in the Americas. The furs were sold to the Chinese who made fine fur clothing out of them.

Russians made their tea using a *samovar*. Here are some examples of *samovars*.

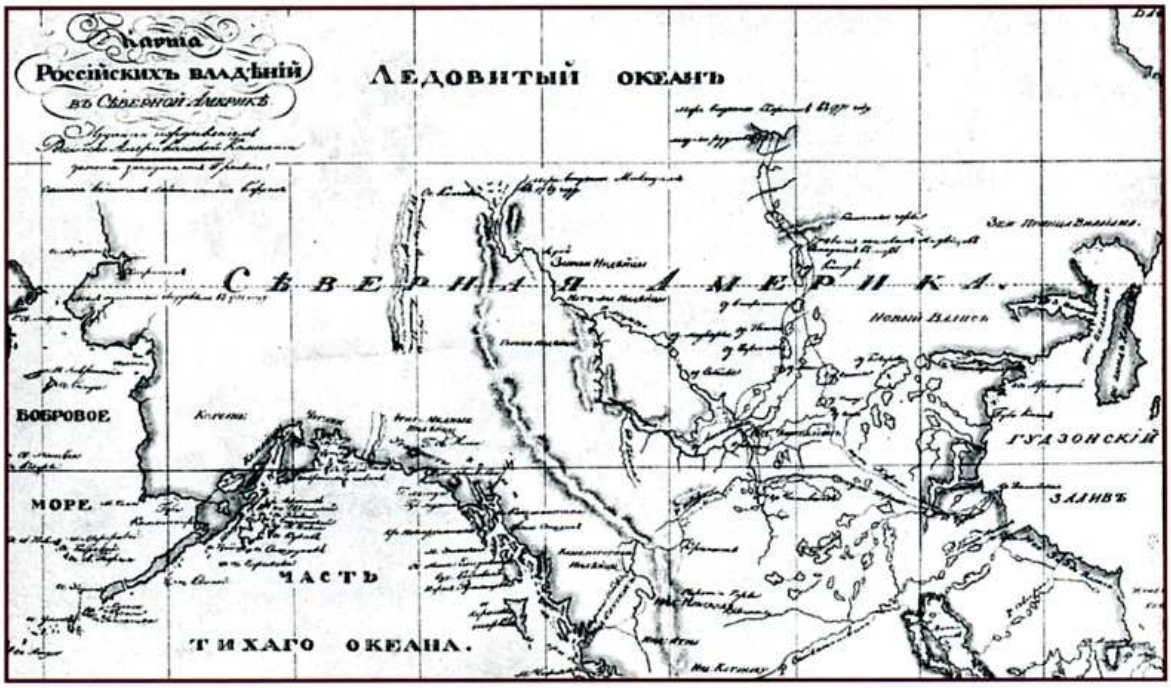


Samovars work much like today's coffee makers, with a charcoal or wood fire made in the center surrounded by a vat of water to heat up. Tea leaves were chipped off the tea brick and made with hot water into a thick sludge. The teapot holding this thick tea sat on top of the *samovar* to keep warm. When someone wanted tea, they would put some thick tea in the bottom of their cup and use the tap on the front of the *samovar* to thin the tea with hot water. This tea was very bitter, so people would drink it with jam or other sweets to cut the bitterness (when possible). *Samovars* were the most precious objects owned in a household, and even the poorest households had the fanciest one they could afford. Through your tea party, the children can learn about life in Russian America.

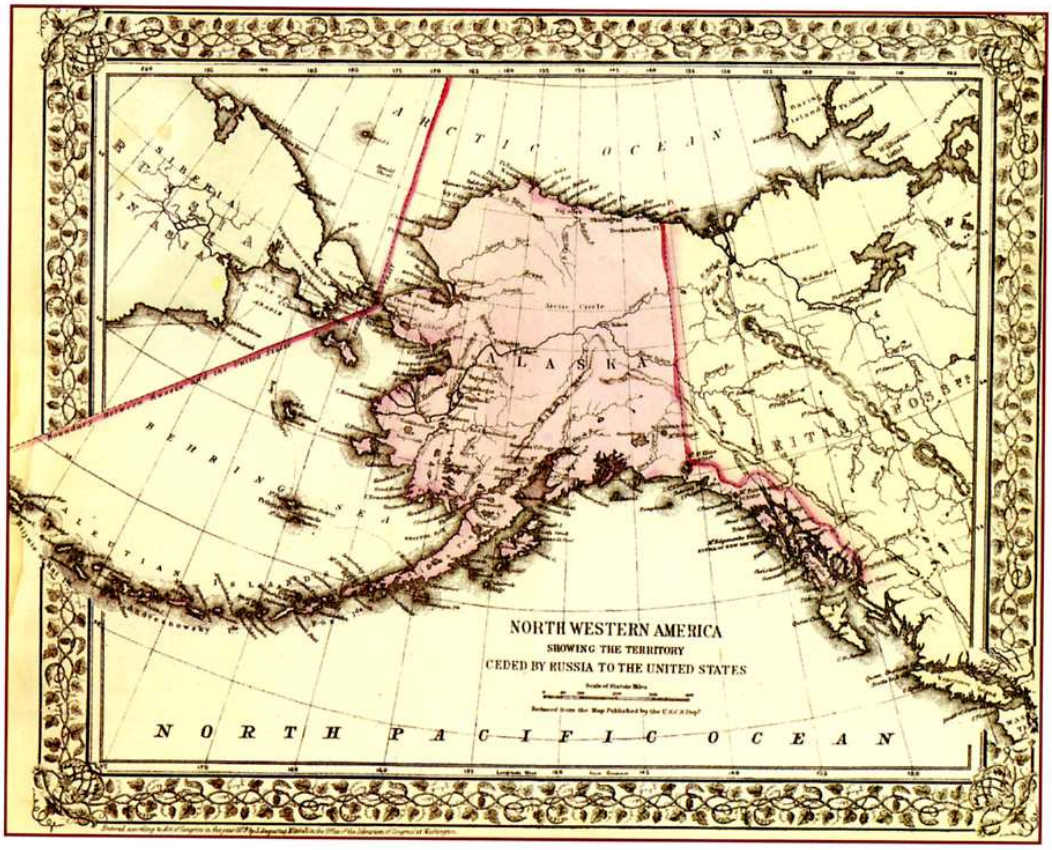
5. **Map Skills**

Maps have changed dramatically from the time that Russia first reached the Pacific northwest of the United States to today. Here are some maps with their dates that can be compared to contemporary maps to teach students about how knowledge of the world and its boundaries have changed over time.

Early 1700's map of the world. Ask your students what's missing here?



1821 map of the part of the world claimed by Russia at that time.



1867 "Transfer Map" used by the United States when Russia sold Alaska to us.

6. **Russian Bishop's House Tour**
   - *Virtual* – A virtual tour of the 1843 historic Russian Bishop's House can be found on Sitka National Historical Park's extended website: http://www.nps.gov/sitk/Cultural%20Resources/rbhtour/rbhmap.htm.
     A Park Ranger will take your students back in time as you visit the historically furnished center of the Russian Orthodox Church in Russian America.

   - *Live* – Any class interested in touring the Russian Bishop's House with a Park Ranger can contact the park's Education Specialist at (907) 747-0110 or by email at sitk_interpretation@nps.gov.

7. **Children's Games**
   - *Protyag (proetyaág or Протяг)*

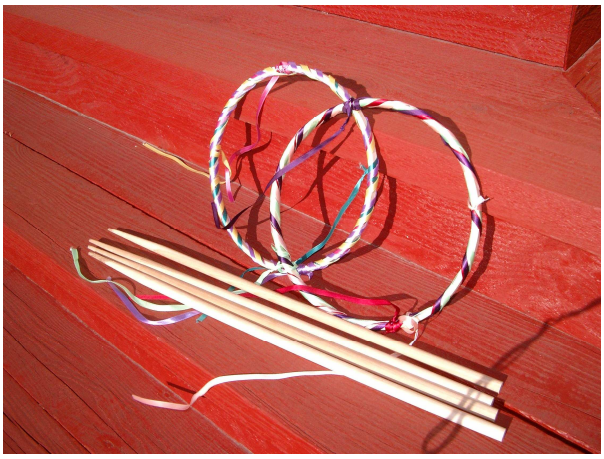
   For the game of protyag, an active tug of war game, find an open grassy area or spot in the gym. Divide the class into two even teams, and draw a line in the dirt or tape a line to the floor. Each player links arms at the elbows and faces sideways. The two team captains (or first in line) join elbows also. When all of the players are locked together and signal they are ready, the tug of war begins. Each team tries to pull the opposite team across the center line

without breaking their side of the chain. If one side pulls the other side across the line, but the chain breaks, they lose.

- *Russian Game of Graces* or *Flying Circle*

The Game of Graces was considered both proper and beneficial exercise for young ladies in the early 1800's, and it was proper as well for boys to join the game. In this game children send colorful ribboned hoops whirling toward each other to be caught on the tips of slender wands.

Materials for this game can be found at any craft store. For one complete game set, you will need four strong wooden spindles (about 24" long) that each narrow at one end. You will also need two wooden hoops with a diameter of about 12" and multiple long ribbons to wrap around the hoop, leaving ends as streamers when knotted off. A photograph of these materials is shown below to provide assistance with making them.



Opponents stand across from each other, each with two wands and one hoop. Each child holds the wands crossed like open scissors with the hoop hanging from the pointed ends. When the child draws the wands quickly apart, the hoop flies toward his or her opponent. The arc of the hoop's flight is determined by the upswing given to the it is given as it leaves the wand tips. The air speed is determined by how quickly the sticks are drawn apart, the arc of flight, and the number and pattern of ribbon streamers hanging from the hoop. It takes some practice to get the hoop flying off in the proper direction!

The object of the game is to catch the opponent's hoop on the tips of the wands followed by returning it to the opponent as fast as possible.

Thank you for using this curriculum!

Please note the evaluation form on the next page to help us improve this for future classrooms. If you have any questions, thoughts, or suggestions about this curriculum or other park education programs, please contact the park's Education Specialist at (907) 747-0110 or by email at: sitk_interpretation@nps.gov.

Sitka National Historical Park Education Program Evaluation

Thank you for participating in Sitka National Historical Park's education program. Please complete this evaluation and return it to the park after completing the lessons. These evaluations help us to improve and expand programs.

Name of Program _____

Teacher _____ **Grade level** _____

School _____ **Number of Students** _____

Did the program meet your expectations? _____

Were objectives met? _____

Please list any improvements we can make to better meet the needs of your students/curriculum:

Suggestions for future program needs:

Comments (continue on back if necessary):

Please return this evaluation by mail to:
Education Specialist
Sitka National Historical Park
103 Monastery Street
Sitka, AK 99835

Or by email to:
Sitk_interpretation@nps.gov