

Lesson Plans
DISCRETE MATHEMATICS
THE RUSSIAN TRUCK DRIVER

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Days 1-3(counting principles)

The story begins with a truck driver entering his rig. Before he can open the door, he must unlock it. The lock looks as follows 5 4 3 2 1 (Five buttons numbered 1-5).

1) How many ways can he try to open the lock using each number only once?

In groups of 2-4, students can try to determine a solution.

A) Start with one button and one number. 1 How many ways?

Proceed with two buttons and two numbers. 2 1 How many ways?

** Students may list the different ways or make tree diagrams to determine a solution**

Continue building until all five numbers and five places are reached.

Eventually, students will arrive at the formula of $5 \times 4 \times 3 \times 2 \times 1$ for 120 different ways to number the lock.

2) Now change the lock so that he can use a number more than once. How does that change the amount of ways to program the lock?

Again, begin by looking at simpler examples.

A) Start with one button and one number.

Proceed with two buttons and two numbers. (Remember each number can be used more than once)

Students can list the number of ways or make tree diagrams to arrive at their solutions

Continue building until five numbers and five places are reached.

Eventually, students will arrive at the formula of $5 \times 5 \times 5 \times 5 \times 5$ for 3125 ways.

To further enhance the previous ideas, students may determine the number of ways a license plate can be arranged. They also may be asked to determine how many ways to arrange the lock if it contains 5 numbers and you use only 1 number, then 2 etc.

Days 4-6(Euler paths and circuits)

Now that our truck driver has his rig started, he needs to get started on his route.

See web site for a map of Russia. (a different map may be substituted for Russia) I chose Russia to combine this lesson with a Russian Geography lesson.

Make an overhead copy and draw a vertex-edge graph. Explain what each vertex represents and what each edge represents.

3) Now ask the students if the truck driver can start his route and finish it in the same place. He likes to see the scenery so he would like to travel each road only once. Can it be done on the current map?

The teacher should prepare examples of graphs that will have:

- 1) an Euler circuit(every vertex has an even degree)
- 2) an Euler path(exactly two odd vertices)
- 3) neither an Euler path or circuit(1 odd vertex or 3 or more odd vertices)

Using these examples, students can determine a rule for an Euler circuit and a rule for an Euler path.

Days 7-9

To make our truck driver problem more realistic, construct a weighted graph using the map of Russia. Then ask students to find the shortest route for the driver. Use the student's ideas to develop the Nearest Neighbor and Greedy algorithms. The teacher should change the values of the map to determine how well the students understand the algorithms.

Student Products:

- 1) Using a blank map of Russia, students will use a minimum of 5 cities and 7 edges to create a vertex-edge graph containing an Euler circuit.
- 2) Using a blank map of Russia, students will use a minimum of 5 cities and 7 edges to create a vertex-edge graph containing an Euler path.
- 3) Students should identify the five largest cities on the Russian map and determine the distances between each of these cities.
- 4) Using these cities and distances, students should create a weighted graph.
- 5) Using the above map, students should identify the shortest route or the truck driver using the Nearest Neighbor and Greedy algorithms.
- 6) A student will create a rule for permutations and demonstrate an example of how to use it.

PERFORMANCE PACKAGE TASK 1

(The Russian truck driver)

Content Standard: Discrete Math

Level: Partial(8th grade)

Specific Statement(s) from the Standard: Create and use representations to organize, record, and communicate mathematical ideas.

Product(s): Students will turn in a:

- 1) description of a permutation.***
- 2) map containing an Euler path.***
- 3) map containing an Euler circuit.***
- 4) map containing shortest route using the Nearest Neighbor algorithm.***
- 5) map containing the shortest route using the Greedy algorithm.***

Task Description: Working with a partner, students will use Euler's circuits and paths, Hamilton's circuits and paths to design a route for the Russian truck driver.

Special Notes: For more information about discrete mathematic see the following web sites.

- 1) www.nctm.org***
- 2) www.mctm.org***
- 3) www.mathforum.org***

For more map information, see the following web sites.

- 1) www.infoplease.com/atlas***
- 2) www.lib.utexas.edu/maps***

PERFORMANCE PACKAGE TASK 1
(Title of Package)

FEEDBACK CHECKLIST FOR TASK 1

The purpose of the checklist is to provide feedback to the student about his/her work relative to the content standard. Have the standard available for reference.

Y=Yes

N=Needs Improvement

<u>Student</u>		<u>Teacher</u>
_____	Demonstrate the correct use of an Euler path	_____
_____	Demonstrate the correct use of an Euler circuit	_____
_____	Demonstrate the correct use of a Hamilton circuit	_____
_____	Demonstrate the correct use of a Hamilton path	_____
_____	Write a description of a permutation	_____
_____	Demonstrate using a permutation to solve a real world problem	_____

Overall Comments (information about student progress, quality of the work, next steps for teacher and student, needed adjustments in the teaching and learning processes, and problems to be addressed):