POLAR TREC
Learning Resources

Details

Completion Time: Less than a Week
Permission: Download and Share

Playground Profiling–Topographic Profile Mapping

Overview
This lesson was modeled after some of the routine activities that the geologists did on the Kuril Island Expedition.

Complete the following activities:
Day 1 – To measure a simple topographic profile with a level instrument or hand level and stadium rod.
Day 2 – To use the measurements from Day 1 (and/or actual measurements from the Kuril Islands) to create a horizontal topographic profile.

Objectives
Students will continue to become familiar with topography, while practicing skills in data collection, mapping, and graphing.

Preparation
Students will need to be familiar with the concept of topography at a minimum. While it is helpful if they know how to use similar triangles for this activity, it is not essential. If students have not mastered coordinate graphing by hand or with graphing software, that portion of the lesson will need to be increased in length to incorporate this instruction.

Background for Teacher: The surveyor's tripod level uses similar triangles and three measurements to determine both the height and distance to the stadia rod. The center measurement gives the height and the upper and lower measurements, which should be evenly distant from the center measurement,

Materials

- Hand Level – commercial or handmade with a protractor, straw and weighted string
- Surveyor's Tripod Level (if available)
- Stadia Rods (or meter sticks carefully taped to furring strips or 1" by 4" beams)
- 0-50 meter measuring tape
- Calculators and Student Journals
- Graphing software, such as Excel, or graph paper
- Kuril Island profile data sets from Lovtsova and Sernovodsk (attached)

are used to calculate the distance to the rod. Due to the stability of the instrument and its precision, measurements taken this way are more accurate over long distances. The height readings need to be corrected for the eyepiece height by subtraction. The difference between the upper and lower readings is multiplied by 100 to calculate the distance in meters.

For example, if the eyepiece of the instrument is 1.46 m and the readings are 1.119 m (upper), 1.1 m (center) and 0.982 m (lower), then the height at the reading point is 1.46 – 1.1 = -0.36, or 0.36 m LOWER than the tripod, and the distance of the reading point is (1.119 – 0.982) * 100 = 13.7 m away from the tripod.

In this way, a sequence of elevation and distance measurements, relative to the location of the tripod can be measured and then plotted to give a horizontal topography. If a surveyor's tripod level is not available, then there are two other options – a hand level, which gives the same information as tripod level, but is less accurate due to the need to hold the level steady while taking the measurement, or a handmade level, such as a clinometer constructed from a protractor, straw and a weighted string, that can measure the height. If a handmade level is used, then the distance to the rod, must be made manually with a tape measure.

Procedure

Day One

- Set up simple varied topography profile on the school grounds using tables, playground equipment or natural features. Try to make the profile at least 25 meters long, with only 1-2 meters of elevation change so that all of the measurements can be taken from one location.
- Divide the students into groups of 3-4 and then divide the groups into two groups – one that will take measurements with tripod level and one with hand level.
- Illustrate the process on the white board showing how height measurements are taken at various distances with the levels and then used to determine the elevation of the ground.
- Set up data tables in the Student Journals.
- Make measurements – having students rotate through the stations of reading measurements, holding rod, and recording readings.

Day Two

- Do an example set of measurements (perhaps a portion of an actual profile from Kuril Islands) to demonstrate how the calculations are done.
- Use the measurements from Day One to calculate elevations for the "playground profile".
- Actual measurements from Kuril Islands, such as those for Lovtsova on Kunashir, could be used in place of playground measurements. Or these measurements could be used as an assessment, extension, or follow-up activity.

- Once calculations are complete, graphs can be made.
- Differentiation for ability levels: grids with pre-determined scales and intervals could be given to younger students, while older students could use spreadsheet software to do both calculations and graphing.
- Use the graphs to identify "features" in the profile of the playground. Could use graphs of actual data to identify features as an assessment tool.

Assessment
See lesson outline for ideas.

Credits
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National Science Education Standards (NSES):

Content Standard A: Science As Inquiry
a. Abilities necessary to do scientific inquiry
b. Understandings about scientific inquiry

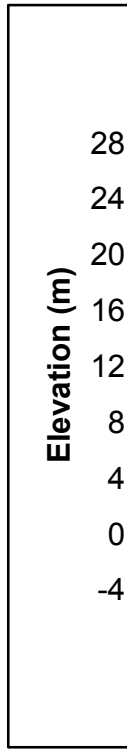
Content Standard D: Earth and Space Science
a. Structure of the earth system

Content Standard G: History and Nature of Science
a. Science as a human endeavor

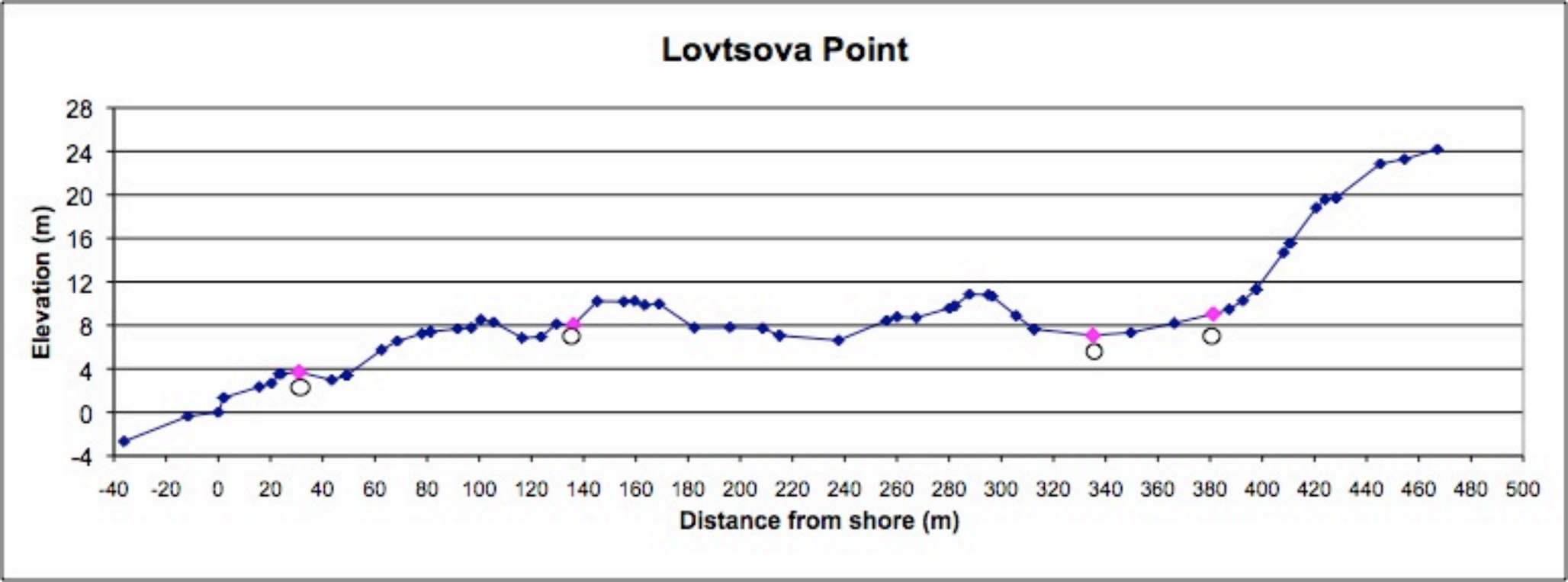
Other Standards:

25-Jul-06
Lovtsova point, Spokoynii

	mid	top	bottom	notes	error	top-bottom	distance	elevation
1	3.78	3.9	3.655	water at 11:55 am	-0.005	24.5	-36.1	-2.68
2	1.46					0	-11.6	-0.36
3	1.1	1.119	0.982	HHT	-0.099	11.6	0	0
4	0.248	0.306	0.19	1st veg	0	13.7	2.1	1.348
4b	3.647	3.729	3.508		-0.057	22.1	2.1	1.348
5	2.659	2.701	2.616		-0.001	8.5	15.7	2.336
6	2.323	2.342	2.304		0	3.8	20.4	2.672
7	1.47			0.9 m away		0	23.3	3.525
8	1.46					0	24.2	3.535
9	1.299	1.333	1.266		0.001	6.7	30.9	3.696
10	2.026	2.122	1.929	trough	-0.001	19.3	43.5	2.969
11	1.596	1.721	1.471		0	25	49.2	3.399
11b	4.482	4.579	4.385		-8.88E-16	19.4	49.2	3.399
12	2.138	2.167	2.107		-0.002	6	62.6	5.743
13	1.33					0	68.6	6.551
14	0.648	0.695	0.601		-1.11E-16	9.4	78	7.233
15	0.47	0.535	0.408		0.003	12.7	81.3	7.411
15b	2.429	2.524	2.331		-0.003	19.3	81.3	7.411
16	2.156	2.201	2.112	dune	0.001	8.9	91.7	7.684
17	2.069	2.087	2.051	dune	4.44E-16	3.6	97	7.771
18	1.315			dune		0	100.6	8.525
19	1.555	1.58	1.531	man made hole betwee	0.001	4.9	105.5	8.285
20	3.003	3.082	2.923		-0.001	15.9	116.5	6.837
21	2.896	3.011	2.78		-0.001	23.1	123.7	6.944
22	1.717	1.861	1.571		-0.002	29	129.6	8.123
23	1.795	1.975	1.62	ex	0.005	35.5	136.1	8.045
23b	3.575	3.69	3.455		-0.005	23.5	136.1	8.045
24	1.405	1.478	1.334		0.002	14.4	145.2	10.215
25	1.438	1.449	1.407		-0.02	4.2	155.4	10.182
26	1.39					0	159.6	10.23
27	1.76	1.779	1.741		0	3.8	163.4	9.86
28	1.643	1.692	1.599	end of ridge	0.005	9.3	168.9	9.977
29	3.845	3.96	3.732		0.002	22.8	182.4	7.775
30	3.81	3.995	3.63		0.005	36.5	196.1	7.81
31	3.88	4.125	3.635		0	49	208.6	7.74



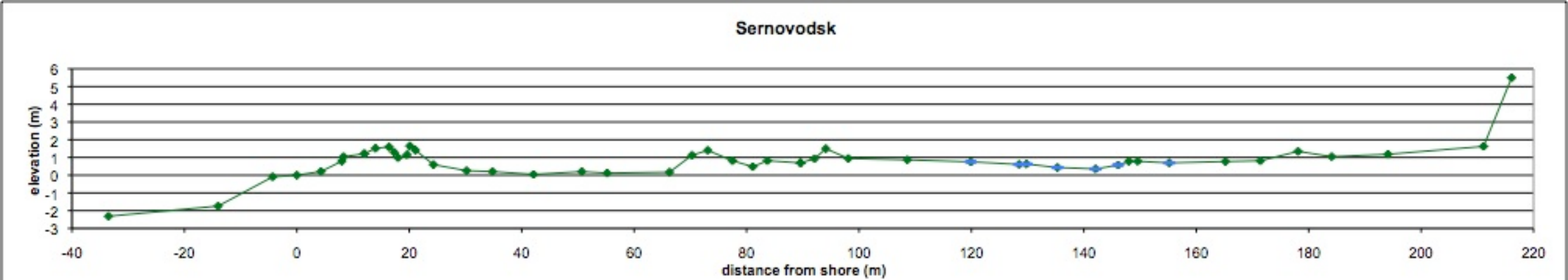
32	4.56	4.835	4.28		-0.005	55.5	215.1	7.06	10.275
32b	3.215	3.44	2.99		4.44E-16	45	215.1	7.06	
33	3.656	3.768	3.544	jody's undescribed ex	-4.44E-16	22.4	237.7	6.619	
34	1.826	1.846	1.806		0	4	256.1	8.449	
35	1.51					0	260.1	8.765	
36	1.572	1.609	1.535		-2.22E-16	7.4	267.5	8.703	
37	0.7	0.8	0.6		1.11E-16	20	280.1	9.575	
38	0.495	0.605	0.385		0	22	282.1	9.78	11.985
38b	2.205	2.278	2.134		0.002	14.4	282.1	9.78	
39	1.132	1.177	1.09	ridge	0.003	8.7	287.8	10.853	
40	1.182	1.189	1.175		2.22E-16	1.4	295.1	10.803	
42	1.32					0	296.5	10.665	
43	3.1	3.146	3.054		-4.44E-16	9.2	305.7	8.885	
44	4.34	4.421	4.26		0.001	16.1	312.6	7.645	11.673
44b	4.028	4.428	3.628		8.88E-16	80	312.6	7.645	
45	4.59	4.875	4.3	ex	-0.005	57.5	335.1	7.083	
46	4.338	4.551	4.122		-0.003	42.9	349.7	7.335	
47	3.478	3.611	3.348		0.003	26.3	366.3	8.195	
48	2.632	2.689	2.575	ex	0	11.4	381.2	9.041	
49	2.192	2.218	2.165		-0.001	5.3	387.3	9.481	
50	1.415					0	392.6	10.258	
51	0.363	0.389	0.338		0.001	5.1	397.7	11.31	16
51b	4.69	4.74	4.635		-0.005	10.5	397.7	11.31	
52	1.31					0	408.2	14.69	
53	0.459	0.471	0.446		-0.001	2.5	410.7	15.541	20.176
53b	4.635	4.685	4.585		0	10	410.7	15.541	
54	1.37					0	420.7	18.806	
55	0.596	0.613	0.579		0	3.4	424.1	19.58	
56	0.455	0.476	0.434		-5.55E-17	4.2	428.3	19.721	24.701
56b	4.98	5.111	4.849		0	26.2	428.3	19.721	
57	1.849	1.896	1.803		0.001	9.3	445.2	22.852	
58	1.425					0	454.5	23.276	
59	0.515	0.578	0.452		0	12.6	467.1	24.186	
				top keeps flat for 30-40m					
				another low area afterwards					


Lovtsova Point
Elevation (m)
28
24
20
16
12
8
4
0
-4
-40 -20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500
Distance from shore (m)

Sernovodsk (town name)
26-Jul-06
Kunashir

	mid	top	btm	notes	vege	error	top-bottom	distance	elevation		
1	4.005	4.21	3.8	.35 m water		0	41	-33.5	-2.317		
2	3.43	3.595	3.26	water line at 10:58		-0.005	33.5	-14	-1.742		
3	1.78	1.85	1.71			0	14	-4.3	-0.092		
4	1.688	1.71	1.667	HHT		0.001	4.3	0	0		water
5	1.48				very patchy vege		0	4.3	0.208		
6	0.897	0.916	0.879		dense vege (grasses)	0.001	3.7	8	0.791		
7	0.646	0.666	0.626			0	4	8.3	1.042		
8	0.479	0.518	0.441			0.001	7.7	12	1.209	2.891	
8b	1.682	1.727	1.636			-0.001	9.1	12	1.209		
9	1.374	1.409	1.338			-0.001	7.1	14	1.517		
10	1.294	1.318	1.271	edge of bunker		0.001	4.7	16.4	1.597		
11	1.592	1.611	1.573			-2.22E-16	3.8	17.3	1.299		
12	1.903	1.918	1.887	btm of trench (debris inside trench)		-0.001	3.1	18	0.988		
13	1.744	1.752	1.737			0.001	1.5	19.6	1.147		
14	1.241	1 meter away		high point	roses			20.1	1.65		
15	1.48				roses		0	21.1	1.411		
16	2.293	2.304	2.272	btm	roses	-0.01	3.2	24.3	0.598		
17	2.637	2.683	2.592	road edge	roses	0.001	9.1	30.2	0.254		
18	2.688	2.756	2.619	road edge	carex	-0.001	13.7	34.8	0.203		
19	2.847	2.952	2.742		carex	0	21	42.1	0.044		
20	2.689	2.837	2.541		carex	0	29.6	50.7	0.202		
21	2.772	2.94	2.599	EX (Jesse)	carex	-0.005	34.1	55.2	0.119		
22	2.72	2.948	2.496		carex	0.004	45.2	66.3	0.171		
23	1.763	2.01	1.518		rose, less grass, bambo	0.002	49.2	70.3	1.128		
24	1.49	1.75	1.23	ridge	rose, less grass, bambo	0	52	73.1	1.401		
25	2.075	2.357	1.793		rose, less grass, bambo	0	56.4	77.5	0.816		
26	2.413	2.713	2.113	EX 2	carexy	4.44E-16	60	81.1	0.478		
27	2.073	2.388	1.762		irises	0.004	62.6	83.7	0.818		
28	2.198	2.542	1.857			0.003	68.5	89.6	0.693	2.985	
28b	2.292	2.314	2.269			-0.001	4.5	89.6	0.693		
29	2.053	2.063	2.043			4.44E-16	2	92.1	0.932		
30	1.49			top (continu	roses		0	94.1	1.495		
31	2.042	2.062	2.022		potentilla, iris	0	4	98.1	0.943		
32	2.119	2.193	2.048			0.003	14.5	108.6	0.866		
33	2.231	2.359	2.101	boggy		-0.002	25.8	119.9	0.754		
34	2.378	2.55	2.206	water at 6 cm		-4.44E-16	34.4	128.5	0.607		
35	2.355	2.534	2.177	water at 6 cm		0.001	35.7	129.8	0.63		

	2.073	2.253	1.893		tufted grass elevation	2.22E-16	36	129.8	0.912
36	2.552	2.757	2.345	water at 25	cm	-0.002	41.2	135.3	0.433
	2.055	2.26	1.852		tufted grass elevation	0.002	40.8	135.3	0.93
37	2.632	2.872	2.392	water at 33	cm	-4.44E-16	48	142.1	0.353
	2.155	2.397	1.918		tufted grass elevation	0.005	47.9	142.1	0.83
38	2.413	2.673	2.153	water at 11	cm	4.44E-16	52	146.1	0.572
39	2.202	2.472	1.933	not boggy		0.001	53.9	148	0.783
40	2.2	2.48	1.925	PEAT CORE		0.005	55.5	149.6	0.785
41	2.292	2.598	1.987	boggy		0.001	61.1	155.2	0.693
42	2.213	2.567	1.856	not boggy		-0.003	71.1	165.2	0.772
43	2.172	2.558	1.785			-0.001	77.3	171.4	0.813
44	1.64	2.06	1.22	high point		0	84	178.1	1.345
45	1.94	2.39	1.49	low point		0	90	184.1	1.045
46	1.805	2.305	1.305	EX 1		0	100	194.1	1.18
47	1.36	1.94	0.77	base of road		-0.01	117	211.1	1.625
48	3.87 m high	5 m distance		road				216.1	5.495


Sernovodsk
elevation (m)
6
5
4
3
2
1
0
-1
-2
-3
-40
-20
0
20
40
60
80
100
120
140
160
180
200
220
distance from shore (m)