

GPS mathematics puzzle: Holiday in Morocco

Being able to deal with smartphone data is an important skill in the modern world of work. In the following task, you will experience this kind of work as you solve a GPS puzzle.



Photo: P. Bronner

Tags

discipline: mathematics

target group: lower secondary school

age: 10 - 16

duration: depending on class year, 2 lessons (90 min) or 1 lesson (45min)

inquiry-based learning: interpreting and evaluating results, communicating and presenting

world of work: The role of a police detective

Task

1. In your group, first work together to choose a level and then get the pages that correspond to it from the teacher's desk:

Level ☆: Pages 1 – 3

Level ☆☆: Pages 1 – 4

Level ☆☆☆: Pages 1– 4 und page 7

Level ☆☆☆☆: Pages 1 - 3 und pages 5 – 7

2. As homework, cut out all the description cards for your level (text, photo, map, diagram)
3. Please note: For each outing, the GPS data was only recorded for just a few minutes.
4. Work together to match the various cards in a way that makes sense and then make a poster with them.
5. You will be correcting each other's posters during a concluding gallery walk.



Photo: P. Bronner

Homework over the course of one week:

As homework, record GPS data from three, everyday situations and print out the corresponding diagrams. Tips: Record the GPS data with the Android app "My Tracks". To print the smartphone screen, use the app "Screenshot". The app prints offline, so that map background is not loaded into the map view. All photos are taken with the smartphone. You can then make your own GPS mathematics puzzle for your classmates.






Page 1: Text cards: A description of the situation in writing




On the dromedary through the desert over small sand dunes into the sunrise.	With the van on a curvy, mountain road that goes down in serpentines.	Descend by foot from the mountain in the old city part of Aït-Ben-Haddou. At the end, cross a wide river in the new city.
Text 5	Text 9	Text 3




With the van on a long, curvy, poorly surfaced mountain road in down through the High Atlas mountain range.	Pleasant walk on a circular route through the palm garden “Jardin Majorelle” in Marrakesch.	Drive along the Moroccan motorway with the van.
Text 7	Text 1	Text 4

A gorgeous day at the beach: Sunbathing, eating ice cream and swimming in the Atlantic!	Return flight circles six times above Frankfurt due to a storm and a re-fuelling stop in Stuttgart (Smartphone was in flight modus).	Drive home along the German Autobahn from Frankfurt to Freiburg.
Text 2	Text 8	Text 6

Page 2: Photo cards: A description of the situation in pictures

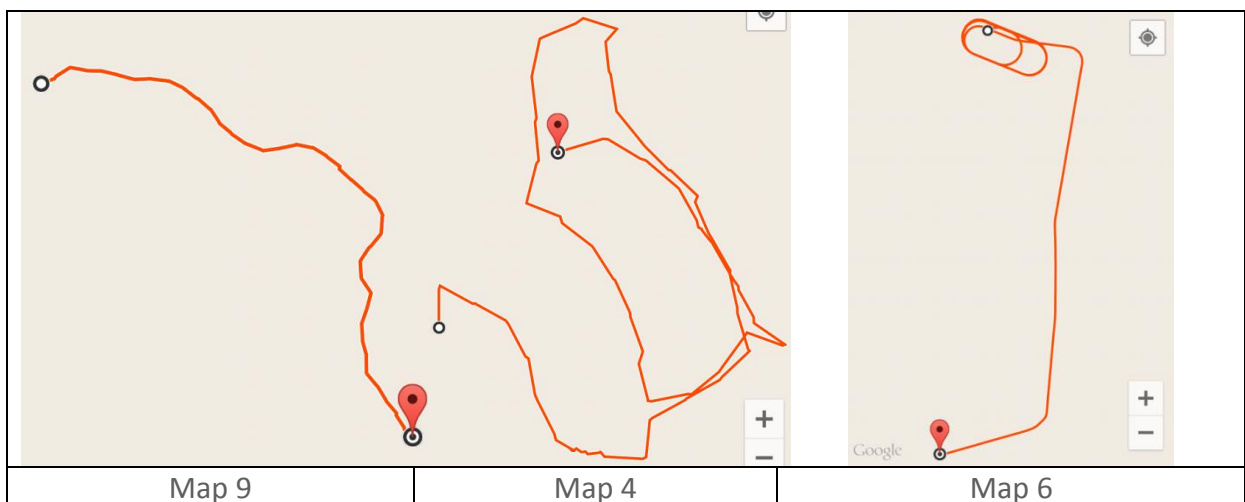
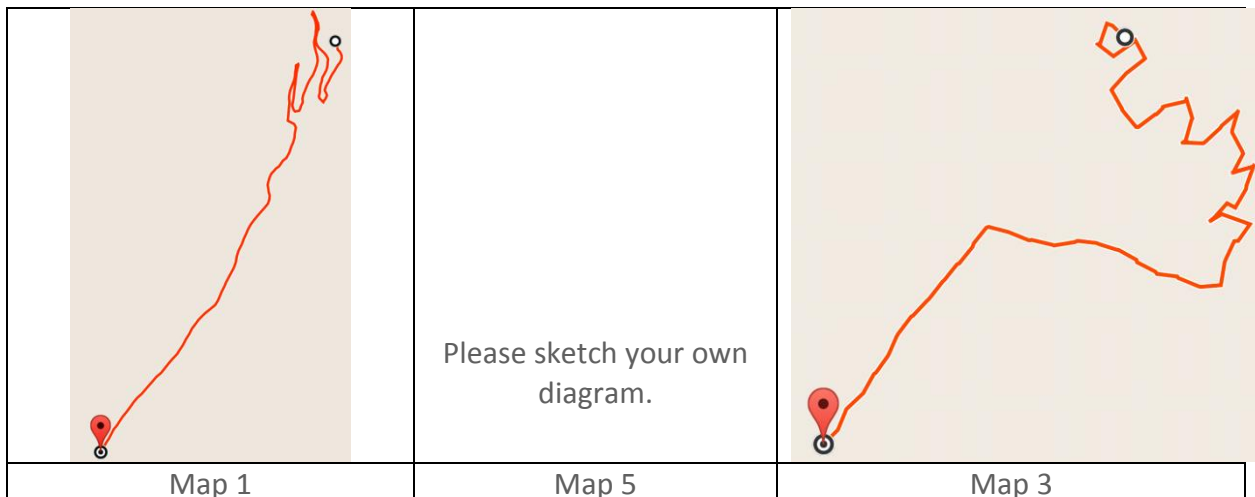
		
<p>Photo 3</p>	<p>Photo 4</p>	<p>Photo 9</p>

		
<p>Photo 1</p>	<p>Photo 7</p>	<p>Photo 6</p>

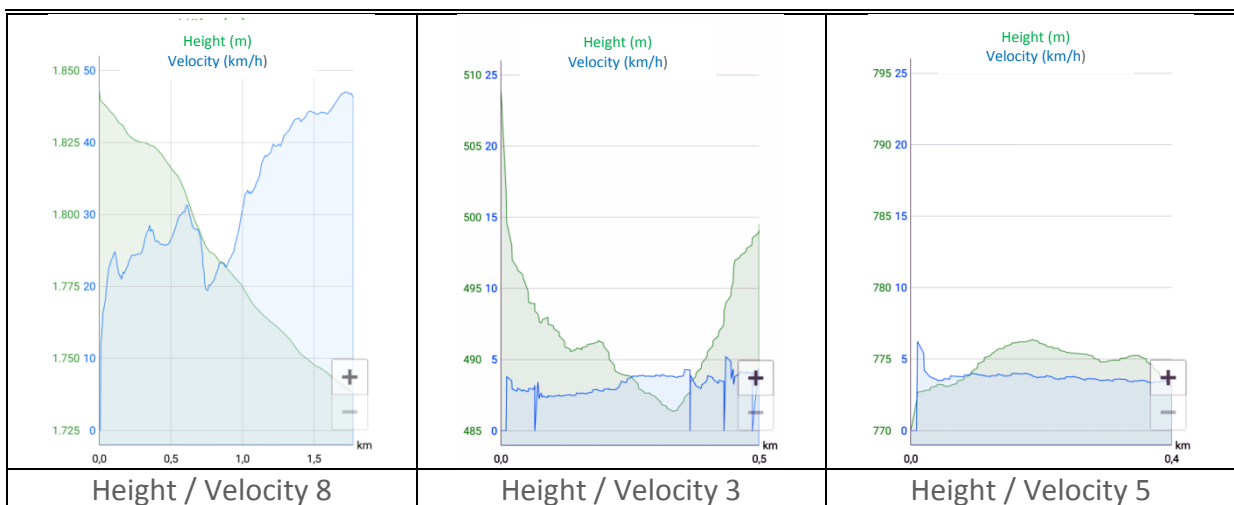
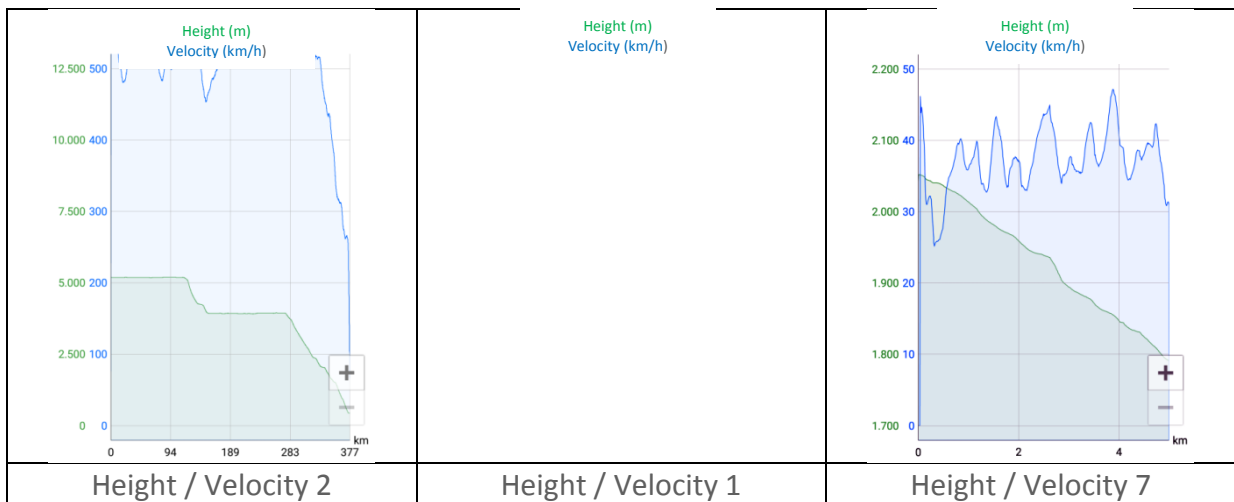
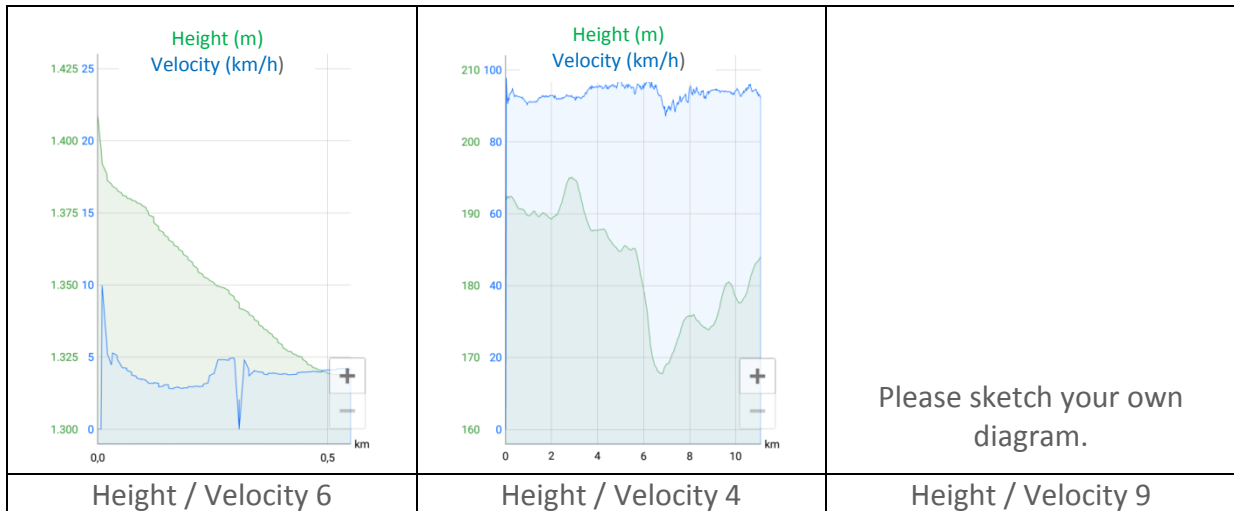
		
<p>Photo 2</p>	<p>Photo 5</p>	<p>Photo 8</p>

Page 3: Location cards: A description of the situation in location diagrams

Tips: North is up, the flag designates the end of the stretch. The diagram is created without using Google map material (using the GPS app offline).

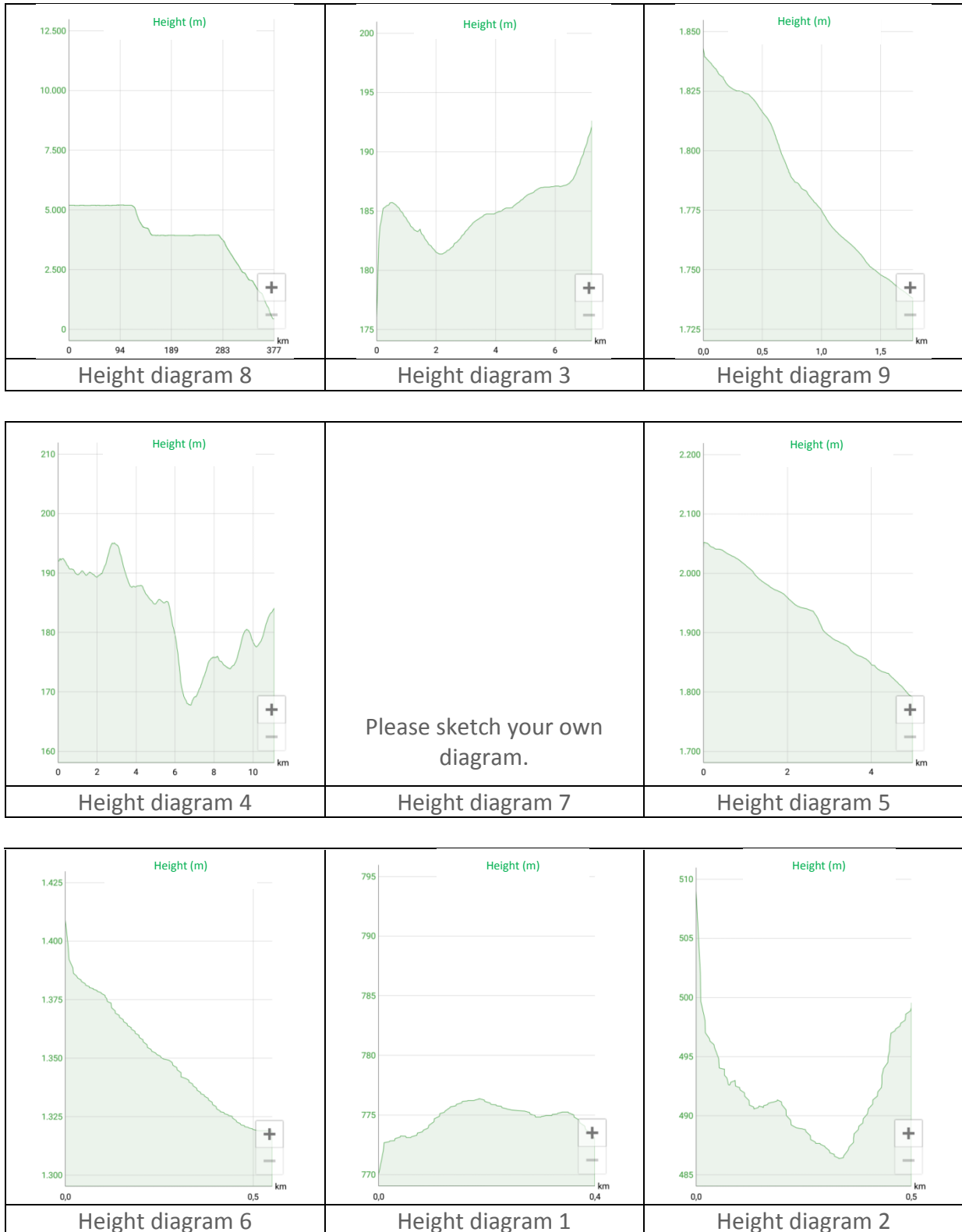


Page 4: Height/velocity cards: A description of the situation with a height/velocity diagram

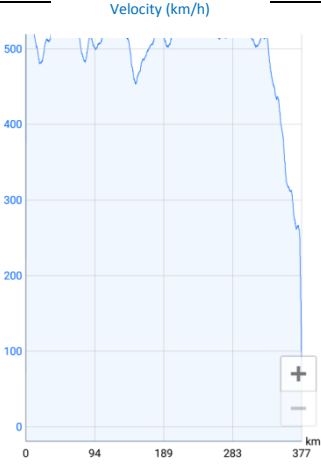





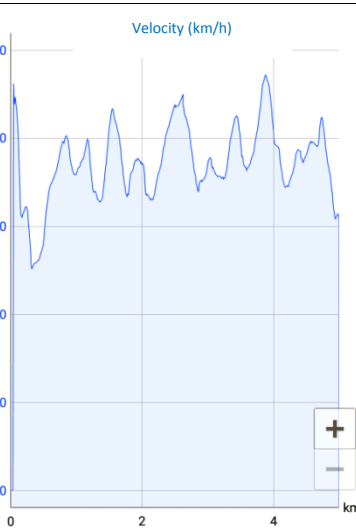
Page 5: Height cards: A description of the situation with a height diagram



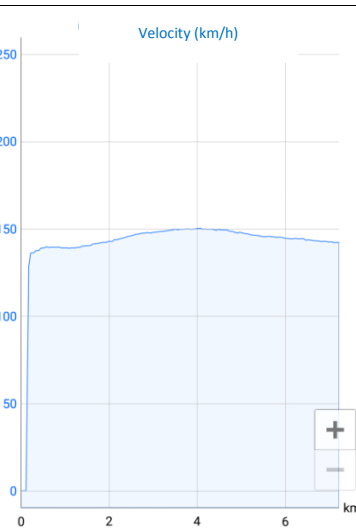
Tip: The height specification with GPS is never particularly exact. A discrepancy of up to 10 metres is possible.



Page 6: Velocity cards: A description of situation with a velocity diagram

<p>Please sketch your own diagram.</p>		
<p>Velocity diagram 7</p>	<p>Velocity diagram 1</p>	<p>Velocity diagram 2</p>

		
<p>Velocity diagram 3</p>	<p>Velocity diagram 4</p>	<p>Velocity diagram 9</p>

		
<p>Velocity diagram 5</p>	<p>Velocity diagram 8</p>	<p>Velocity diagram 6</p>

Page 7: Statistic cards: A description of the situation in statistical form

<p>Think about how to make your own statistic.</p>	<div style="background-color: #333; color: white; padding: 10px;"> <p>ENTFERNUNG KALORIEN</p> <p>7,22 km 0 cal </p> <hr/> <p>GESAMTZEIT BEWEGUNGSZEIT</p> <p>03:03 03:02</p> <hr/> <p style="text-align: center;">DURCHSCHNITTL. GESCHWINDIGKEIT</p> <p style="text-align: center;">141,93 km/h</p> <hr/> <p>HÖCHSTGESCHWINDIGKEIT DURCHSCHNITTL. BEWEGUNGSGESCHWIND.</p> <p>163,76 km/h 142,17 km/h</p> <hr/> <p>GEFÄLLE HÖHE</p> <p>0 % MIN. 11 m ANSTIEG</p> <p>1 % MAX. 176 m MIN.</p> <p style="text-align: right;">193 m MAX.</p> </div>	<div style="background-color: #333; color: white; padding: 10px;"> <p>ENTFERNUNG KALORIEN</p> <p>0,55 km 44 cal </p> <hr/> <p>GESAMTZEIT BEWEGUNGSZEIT</p> <p>12:46 11:48</p> <hr/> <p style="text-align: center;">DURCHSCHNITTL. GESCHWINDIGKEIT</p> <p style="text-align: center;">2,58 km/h</p> <hr/> <p>HÖCHSTGESCHWINDIGKEIT DURCHSCHNITTL. BEWEGUNGSGESCHWIND.</p> <p>22,59 km/h 2,8 km/h</p> <hr/> <p>GEFÄLLE HÖHE</p> <p>-19 % MIN. 0 m ANSTIEG</p> <p>0 % MAX. 1.319 m MIN.</p> <p style="text-align: right;">1.409 m MAX.</p> </div>	
Statistic 4	Statistic 1	Statistic 6	
<div style="background-color: #333; color: white; padding: 10px;"> <p>ENTFERNUNG KALORIEN</p> <p>1,77 km - </p> <hr/> <p>GESAMTZEIT BEWEGUNGSZEIT</p> <p>04:00 03:59</p> <hr/> <p style="text-align: center;">DURCHSCHNITTL. GESCHWINDIGKEIT</p> <p style="text-align: center;">26,57 km/h</p> <hr/> <p>HÖCHSTGESCHWINDIGKEIT DURCHSCHNITTL. BEWEGUNGSGESCHWIND.</p> <p>58,42 km/h 26,65 km/h</p> <hr/> <p>GEFÄLLE HÖHE</p> <p>-12 % MIN. 0 m ANSTIEG</p> <p>-1 % MAX. 1.738 m MIN.</p> <p style="text-align: right;">1.843 m MAX.</p> </div>	<div style="background-color: #333; color: white; padding: 10px;"> <p>ENTFERNUNG KALORIEN</p> <p>4,99 km 0 cal </p> <hr/> <p>GESAMTZEIT BEWEGUNGSZEIT</p> <p>08:18 08:18</p> <hr/> <p style="text-align: center;">DURCHSCHNITTL. GESCHWINDIGKEIT</p> <p style="text-align: center;">36,04 km/h</p> <hr/> <p>HÖCHSTGESCHWINDIGKEIT DURCHSCHNITTL. BEWEGUNGSGESCHWIND.</p> <p>69,29 km/h 36,04 km/h</p> <hr/> <p>GEFÄLLE HÖHE</p> <p>-16 % MIN. 0 m ANSTIEG</p> <p>1 % MAX. 1.791 m MIN.</p> <p style="text-align: right;">2.052 m MAX.</p> </div>	<div style="background-color: #333; color: white; padding: 10px;"> <p>ENTFERNUNG KALORIEN</p> <p>487 m 0 cal </p> <hr/> <p>GESAMTZEIT BEWEGUNGSZEIT</p> <p>13:38 11:30</p> <hr/> <p style="text-align: center;">DURCHSCHNITTL. GESCHWINDIGKEIT</p> <p style="text-align: center;">2,14 km/h</p> <hr/> <p>HÖCHSTGESCHWINDIGKEIT DURCHSCHNITTL. BEWEGUNGSGESCHWIND.</p> <p>12,26 km/h 2,54 km/h</p> <hr/> <p>GEFÄLLE HÖHE</p> <p>-9 % MIN. 14 m ANSTIEG</p> <p>9 % MAX. 486 m MIN.</p> <p style="text-align: right;">509 m MAX.</p> </div>	
Statistic 7	Statistic 9	Statistic 3	
<div style="background-color: #333; color: white; padding: 10px;"> <p>ENTFERNUNG KALORIEN</p> <p>11,09 km - </p> <hr/> <p>GESAMTZEIT BEWEGUNGSZEIT</p> <p>07:09 07:08</p> <hr/> <p style="text-align: center;">DURCHSCHNITTL. GESCHWINDIGKEIT</p> <p style="text-align: center;">93,02 km/h</p> <hr/> <p>HÖCHSTGESCHWINDIGKEIT DURCHSCHNITTL. BEWEGUNGSGESCHWIND.</p> <p>146,34 km/h 93,14 km/h</p> <hr/> <p>GEFÄLLE HÖHE</p> <p>-3 % MIN. 30 m ANSTIEG</p> <p>1 % MAX. 168 m MIN.</p> <p style="text-align: right;">195 m MAX.</p> </div>	<div style="background-color: #333; color: white; padding: 10px;"> <p>ENTFERNUNG KALORIEN</p> <p>377,17 km 0 cal </p> <hr/> <p>GESAMTZEIT BEWEGUNGSZEIT</p> <p>47:45 47:45</p> <hr/> <p style="text-align: center;">DURCHSCHNITTL. GESCHWINDIGKEIT</p> <p style="text-align: center;">473,82 km/h</p> <hr/> <p>HÖCHSTGESCHWINDIGKEIT DURCHSCHNITTL. BEWEGUNGSGESCHWIND.</p> <p>660,03 km/h 473,82 km/h</p> <hr/> <p>GEFÄLLE HÖHE</p> <p>-8 % MIN. 169 m ANSTIEG</p> <p>1 % MAX. 428 m MIN.</p> <p style="text-align: right;">5.200 m MAX.</p> </div>	<div style="background-color: #333; color: white; padding: 10px;"> <p>ENTFERNUNG KALORIEN</p> <p>413 m 0 cal </p> <hr/> <p>GESAMTZEIT BEWEGUNGSZEIT</p> <p>08:03 08:03</p> <hr/> <p style="text-align: center;">DURCHSCHNITTL. GESCHWINDIGKEIT</p> <p style="text-align: center;">3,07 km/h</p> <hr/> <p>HÖCHSTGESCHWINDIGKEIT DURCHSCHNITTL. BEWEGUNGSGESCHWIND.</p> <p>6,37 km/h 3,07 km/h</p> <hr/> <p>GEFÄLLE HÖHE</p> <p>-5 % MIN. 2 m ANSTIEG</p> <p>5 % MAX. 770 m MIN.</p> <p style="text-align: right;">776 m MAX.</p> </div>	
Statistic 8	Statistic 2	Statistic 5	
Entfernung = distance	Kalorien = Calories	Gesamtzeit = total amount of time	Bewegungszeit = time of movement
durchschnittliche Geschwindigkeit = average velocity	Höhe = Height	Höchstgeschwindigkeit = maximum velocity	Gefälle = descent
Durchschnittliche Bewegungszeit = average velocity of the movement			Anstieg = rise

Pedagogical Issues

Potential challenges might occur with the use of the smartphone apps and with obtaining parental approval for app instalment and usage.

Solutions

Text 5	Ph. 4	Loc. 9	H/V 5	H 1	V 8	Stat 5
Text 9	Ph. 8	Loc. 1	H/V 8	H 9	V 3	Stat 7
Text 3	Ph. 2	Loc. 3	H/V 6	H 6	V 4	Stat 6
Text 7	Ph. 3	Loc. 2	H/V 7	H 5	V 9	Stat 9
Text 1	Ph. 9	Loc. 4	H/V 3	H 2	V 2	Stat 3
Text 4	Ph. 1	Loc. 8	H/V 4	H 4	V 5	Stat 8
Text 2	Ph. 7	Loc. 5	H/V 9	H7	V 7	Stat 4
Text 8	Ph. 5	Loc. 6	H/V 2	H 8	V 1	Stat 2
Text 6	Ph. 6	Loc. 7	H/V 1	H 3	V 6	Stat 1

Student solution

Student group solution with two mistakes on the poster.

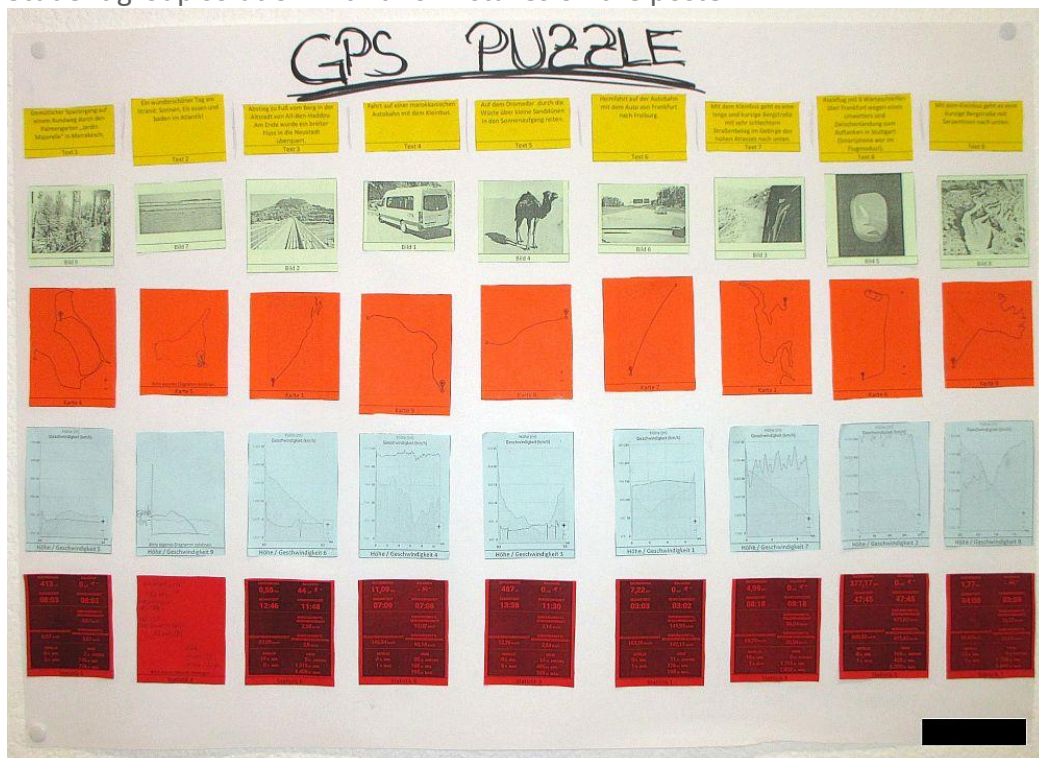


Photo: P. Bronner