Pedagogická fakulta
Faculty of Education
Jihočeská univerzita v Českých Budějovicích
University of South Bohemia in České Budějovice

Data in run: analysis of various information and data in cross-disciplinary task

Lukáš Rokos

Interdisciplinarity and integration

International Journal of Science Education
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RESEARCH REPORT

Design-based science and real-world problem-solving

David Fortus*,[a], Joseph Krajcik[b], Ralph Charles Dershimer[b], Ronald W. Marx[c] and Rachel Mamlok-Naaman[d]
[a]Michigan State University, USA; [b]University of Michigan, USA; [c]University of Arizona, USA; [d]Weizmann Institute of Science, Israel

Sci Adv. 2017 Aug; 3(8): e1700
Published online 2017 Aug 9.

Interest in STEM is
physics classes

Zahra Hazari,[1,2,3,*] Geoff Potv

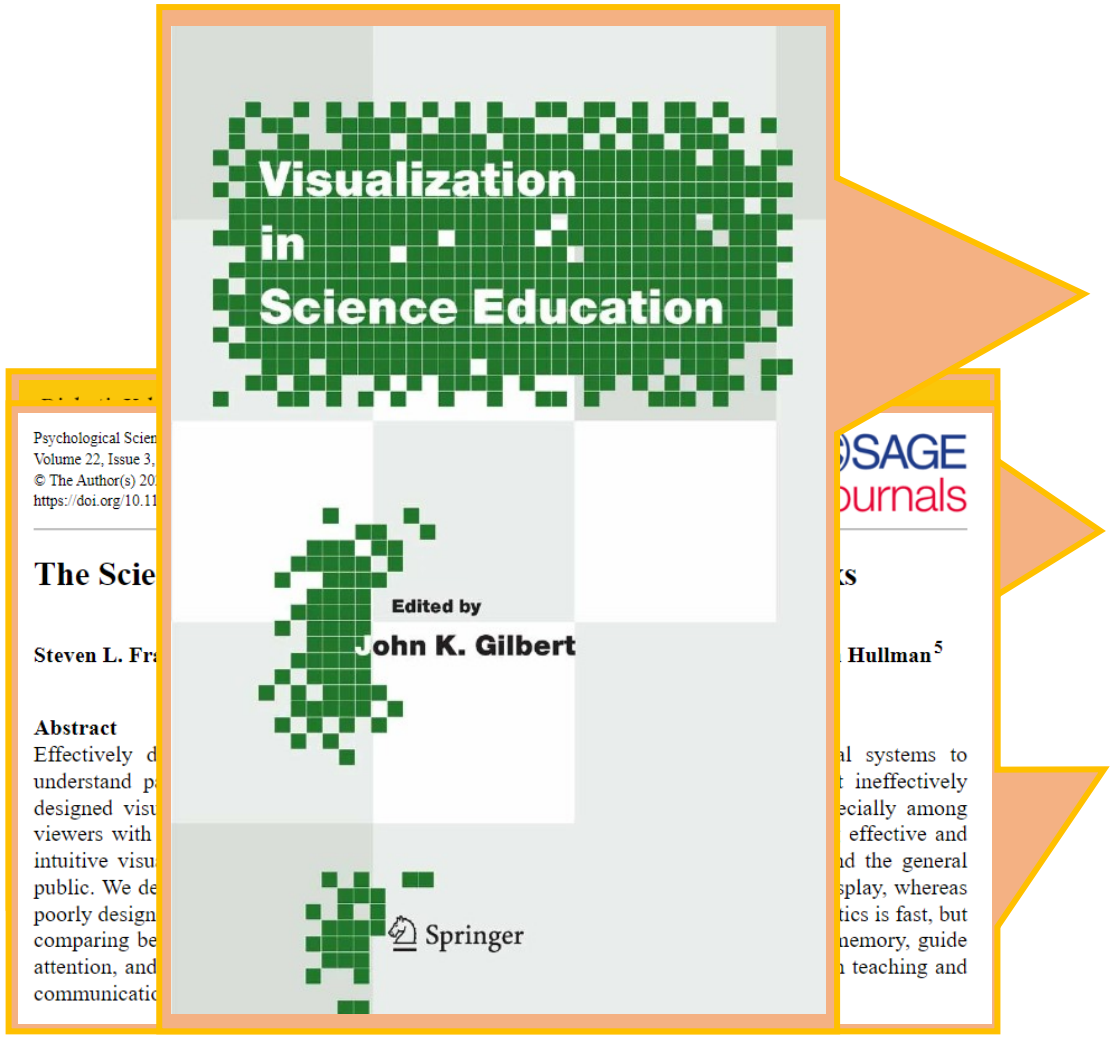
Computers in the Schools, 29:157–173, 2012

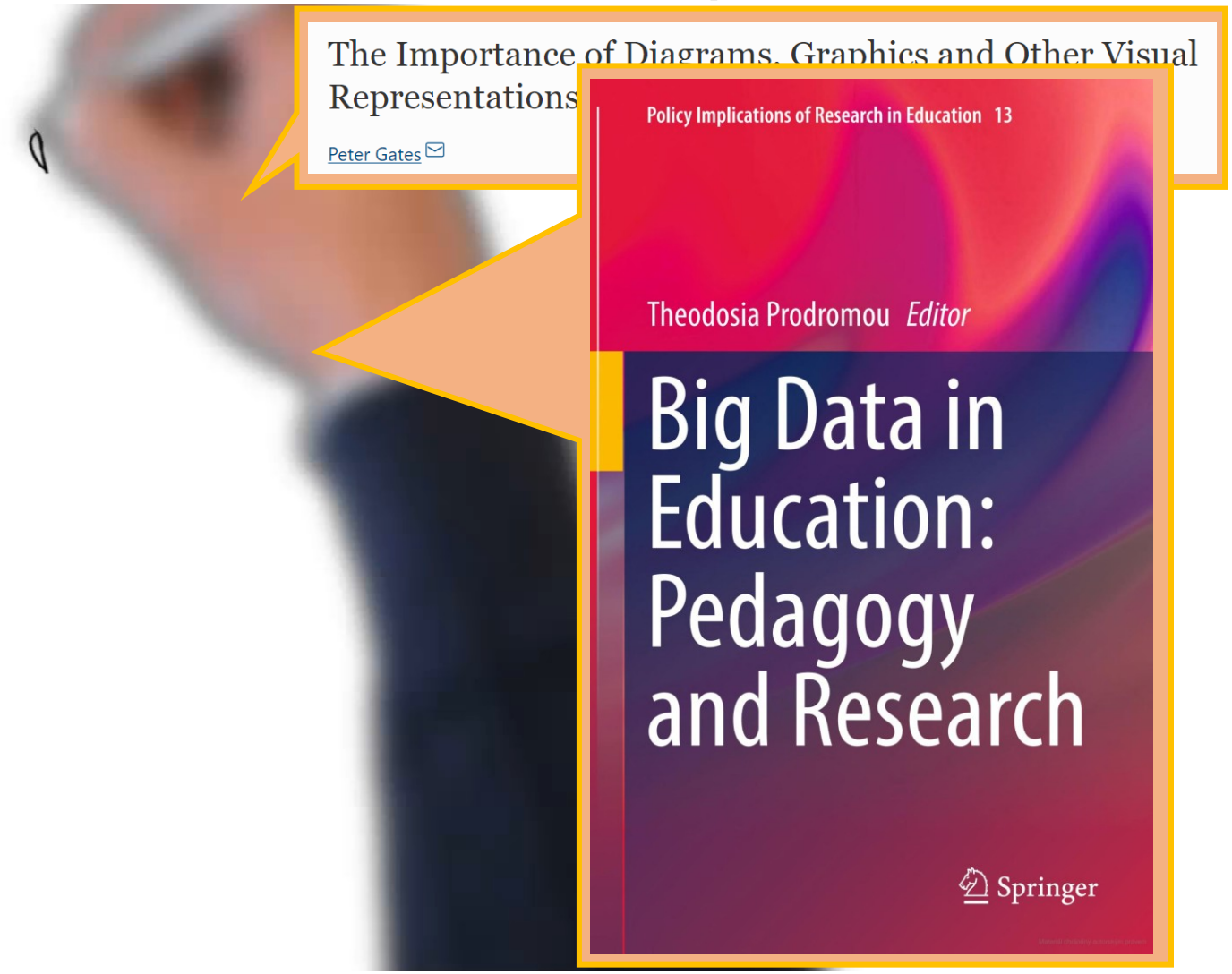
ISSN: 0738-0569 print / 1528-7033 online
DOI: 10.1080/07380569.2012.658733

Scaffolded Inquiry-Based Instruction with Technology: A Signature Pedagogy for STEM Education

KENT J. CRIPPEN
University of Florida, Gainsville, Florida, USA
LEANNA ARCHAMBAULT
Arizona State University, Tempe, Arizona, USA

Importance of data

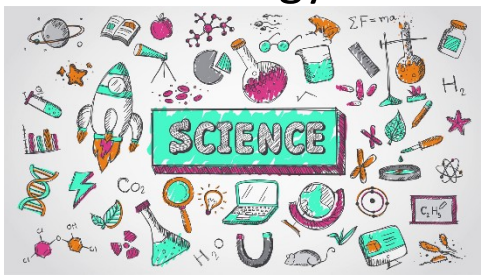




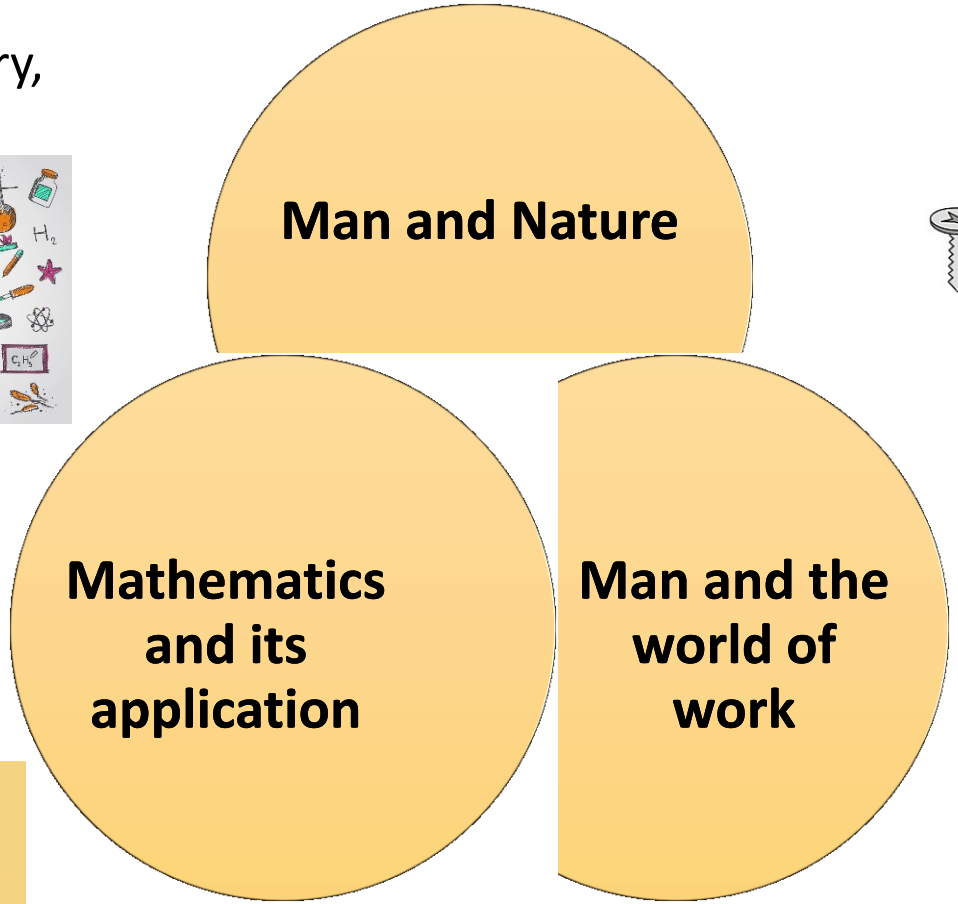
Integration and cross-curricular tasks

- **Czech curricular documents**

Physics, Chemistry, Biology



Mathematics



Work with laboratory equipment,
Use of digital technologies

Work with technical materials,
Design and models

Integration and cross-curricular tasks

Research methods

Quantitative

Qualitative

Mixed methods research

- Case Study
- Ethnography Study
- Grounded Theory Study
- Phenomenological Study
- Content Analysis Study

Task introduction

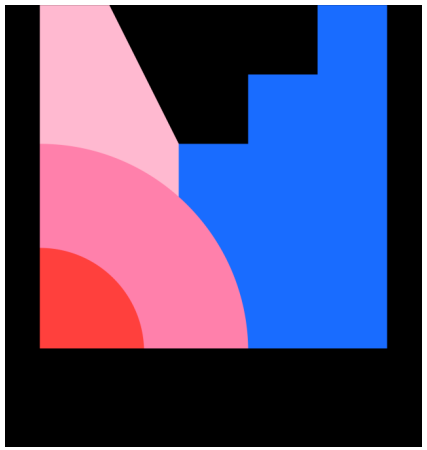
Every runner evaluates his or her results from time to time. A pervasive desire for improvement leads him or her to challenges that not only test physical limits, but also the ability to understand every step, every heartbeat, and every result in training or a race.

This inquiry task consists of tracking the results of three different marathons. This challenge isn't just about running; it's about analyzing, understanding and discovering the deeper meaning of the conditions and other factors that can affect every step of the race. You have three races in front of you, three unique results – and your task is to find the factors that may have affected this runner's overall result.

You are now at the starting line of this inquiry challenge, where you will find that all the data brings important information. And if they are properly visualized, they will help you better understand the various factors that influence the overall results.

Marathon

- How long is exactly a marathon run? Find out why it is this distance.
- Find some other interesting facts about marathon run.
- What information would you need to know about this runner?



Runner's Card

- **Sex:** male
- **Race:** white, europoid
- **Age:** 30 – 33 years
- **Weight:** 65 – 69 kg
- **Height:** 175 cm
- **BMI:** 22,5
- **Professional:** NO
- **Training plan:** YES
  - regular trainings according to the prepared plan
  - alternating between long runs and interval training
- **Injuries:** none
- **Health problems:** none

Runner's Card – equipment

Marathon 1	ADIDAS Adizero Boston 7	
Marathon 2	ADIDAS Adizero Boston 7	
	Montane Via Bite 1	

Marathon 3	Adidas Energy Boost	
	Montane Via Bite 1	

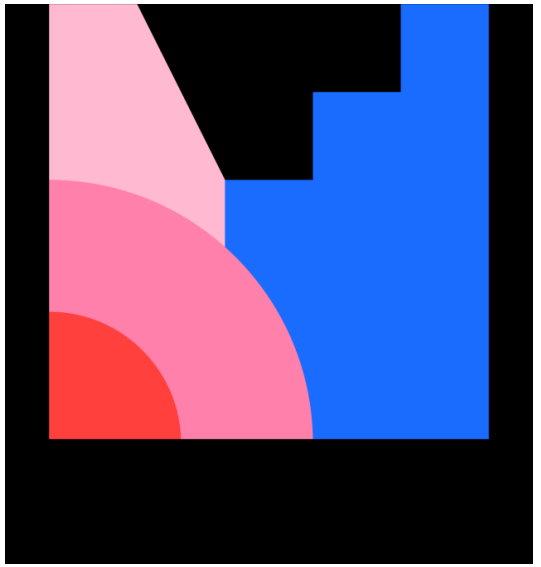
Marathon results

- The aforementioned runner ran three different marathons and achieved the following results.

Marathon 1	Marathon 2	Marathon 3
2:52:27	4:36:40	3:15:15

Marathon results

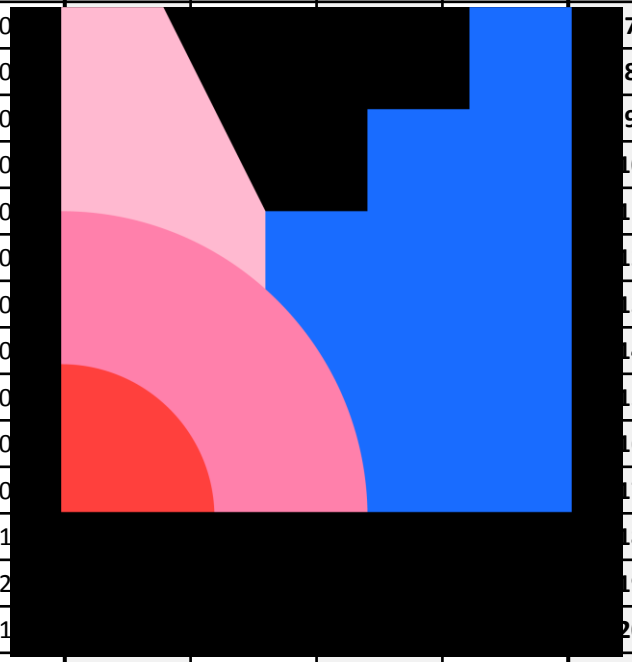
- Try to guess why the total time of each race is different? What could have influenced them?



Pace I.

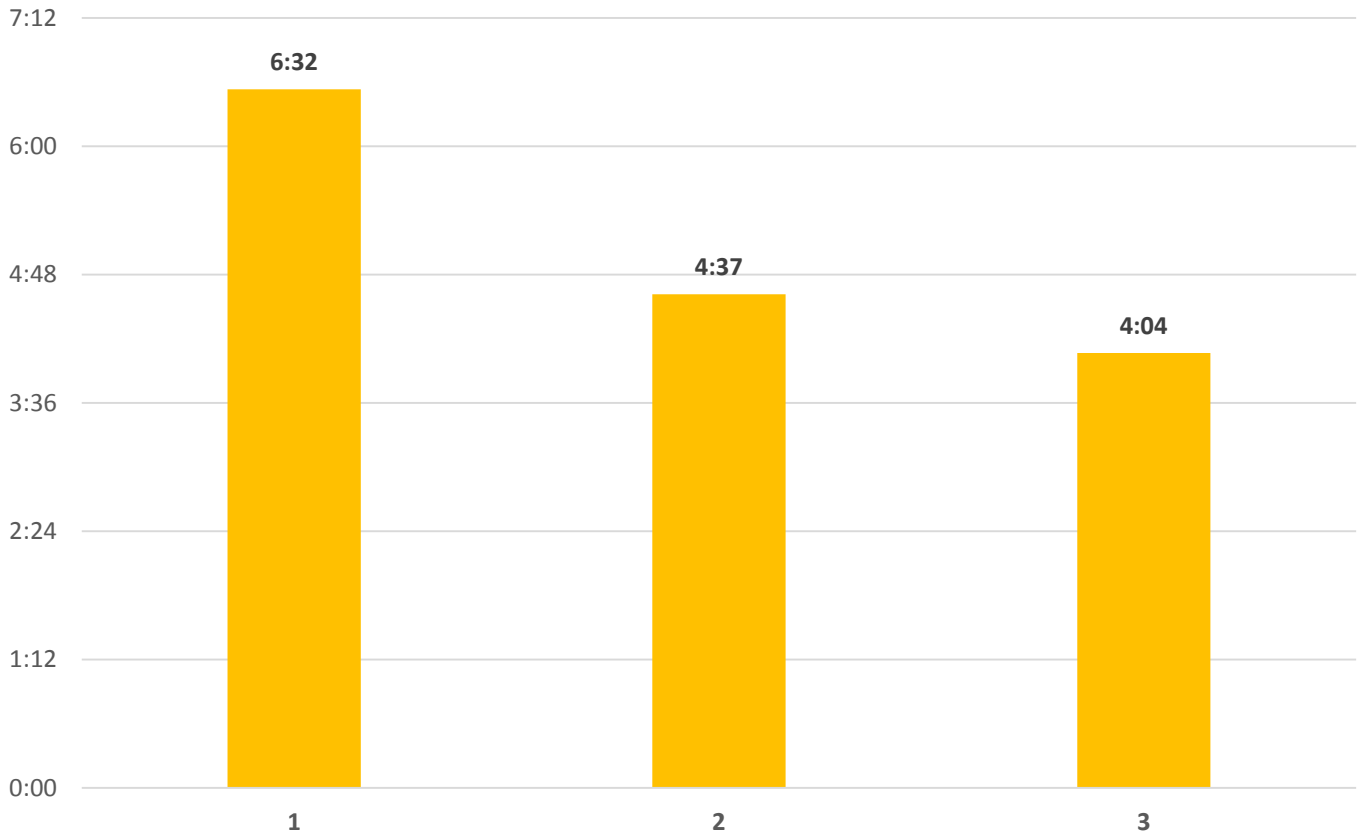
Marathon 1				Marathon 2				Marathon 3			
km	time	22	3:59	km	time	22	4:57	km	time	22	4:30
1	4:02	23	4:00	1	4:28	23	4:57	1	4:33	23	4:42
2	4:05	24	3:59	2	4:24	24	4:53	2	4:26	24	4:47
3	4:04	25	4:04	3	4:29	25	4:47	3	4:21	25	4:42
4	4:02									6	4:32
5	4:07									7	4:30
6	4:02	28	4:01	6	4:28	28	12:22	6	4:22	28	4:31
7	4:07	29	4:0					7	4:26	29	4:41
8	4:07	30	4:0					8	4:32	30	4:38
9	4:02	31	4:0					9	4:22	31	4:41
10	4:09	32	4:0					10	4:32	32	4:33
11	4:10	33	4:0					11	4:35	33	4:26
12	4:05	34	4:0					12	4:33	34	4:44
13	4:01	35	4:0					13	4:28	35	4:50
14	4:07	36	4:0					14	4:24	36	5:07
15	3:59	37	4:0					15	4:29	37	5:17
16	4:01	38	4:0					16	4:30	38	5:17
17	3:59	39	4:0					17	4:28	39	4:58
18	3:58	40	4:1					18	4:27	40	5:07
19	4:02	41	4:2					19	4:35	41	4:50
20	4:02	42	4:1					20	4:36	42	4:47
21	4:02	43	1:16	21	5:00	43	4:06	21	4:27	43	0:59

What caught your eye in the data?



Pace II.

- The following graph shows the average pace within individual races. Rank them from best to worst.



Pace III.

- Which pace will match the specific marathons above? Complete the data in the table below.

	Time	Pace
Marathon 1	2:52:27	4:04
Marathon 2	4:36:40	6:32
Marathon 3	3:15:15	4:37

Routes I.

- Go back to your hypotheses about the factors that may have influenced the results. Do you need to know more data to decide which factors are relevant? If yes, write which factors are involved.

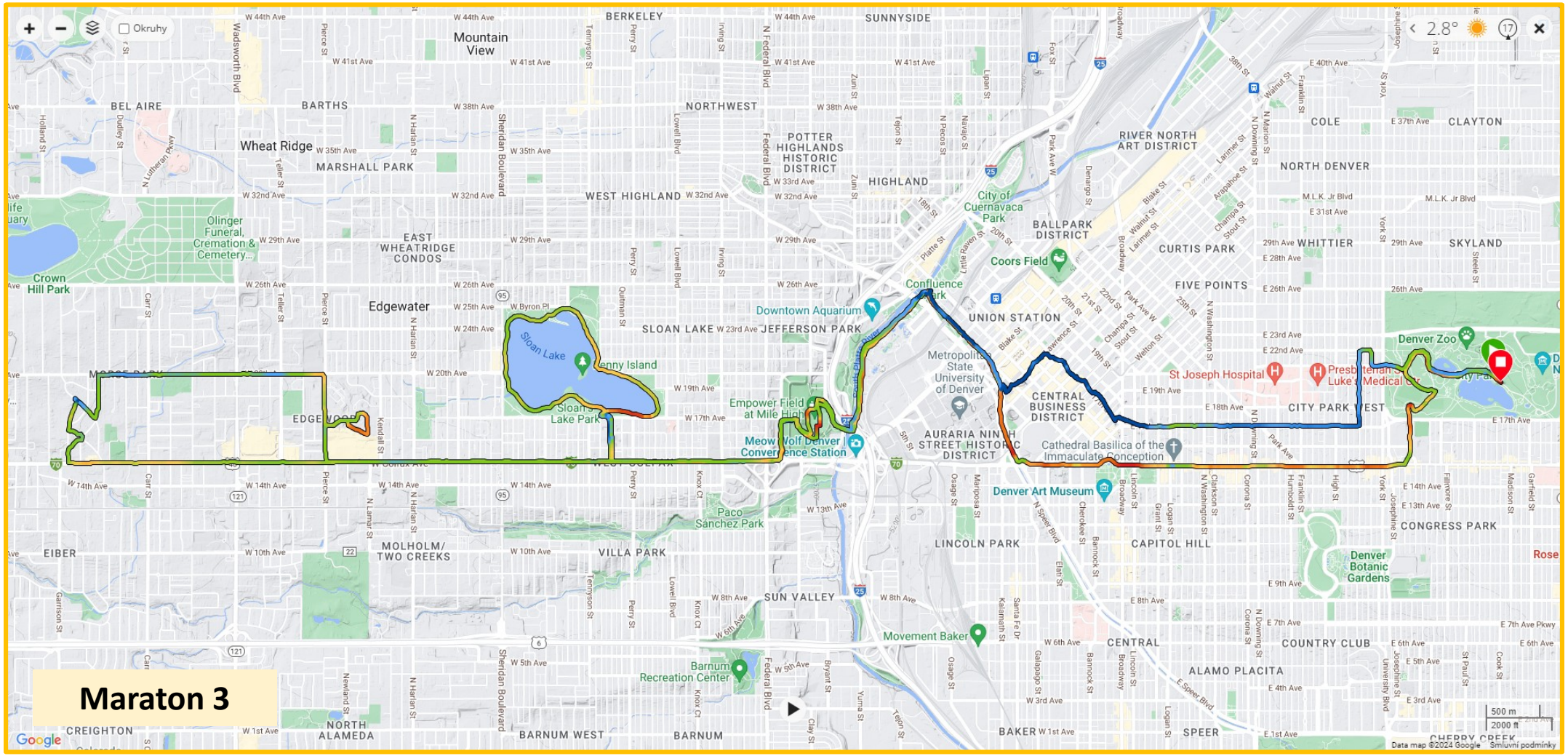
One of the factors that can affect performance is the environment in which the race took place. Look at the route maps and write how they differ.

Marathon 1

Marathon 2

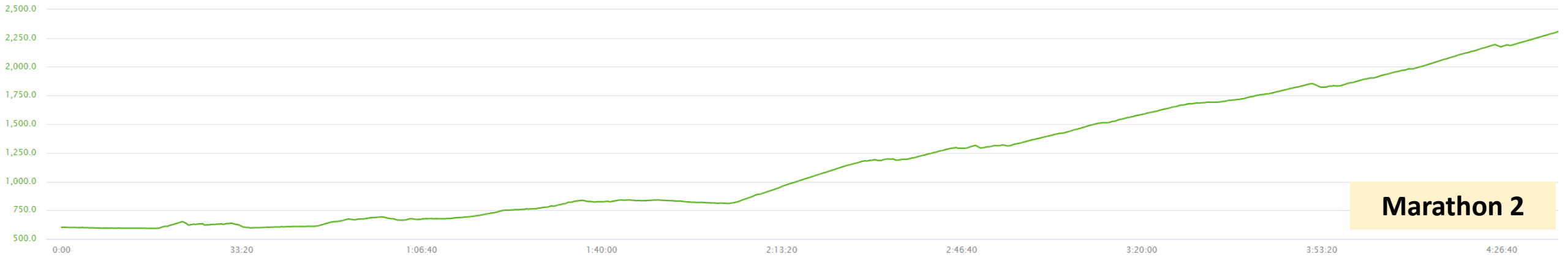
Marathon 3

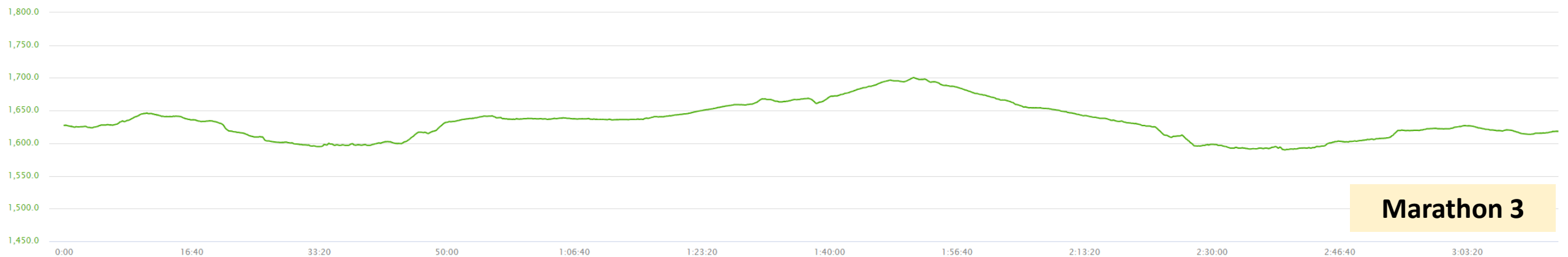
Routes II.


Maraton 3
Mountain View
BERKELEY
SUNNYSIDE
BEL AIRE
BARTHS
NORTHWEST
Wheat Ridge
MARSHALL PARK
POTTER HIGHLANDS HISTORIC DISTRICT
HIGHLAND
RIVER NORTH ART DISTRICT
COLE
CLAYTON
NORTH DENVER
WEST HIGHLAND
City of Cuernavaca Park
BALLPARK DISTRICT
CURTIS PARK
WHITTIER
SKYLAND
Olinger Funeral, Cremation & Cemetery...
EAST WHEATRIDGE CONDOS
Coors Field
Crown Hill Park
Confluence Park
FIVE POINTS
Edgewater
Downtown Aquarium
UNION STATION
SLOAN LAKE
JEFFERSON PARK
Sloan Lake
Denny Island
Denver Zoo
St Joseph Hospital
Metropolitan State University of Denver
CENTRAL BUSINESS DISTRICT
CITY PARK WEST
Sloan's Lake Park
Empower Field at Mile High
AURARIA NINTH STREET HISTORIC DISTRICT
Cathedral Basilica of the Immaculate Conception
Denver Art Museum
Paco Sánchez Park
CONGRESS PARK
EIBER
MOLHOLM/ TWO CREEKS
VILLA PARK
LINCOLN PARK
CAPITOL HILL
Denver Botanic Gardens
SUN VALLEY
Movement Baker
CENTRAL
COUNTRY CLUB
ALAMO PLACITA
Barnum Recreation Center
CREIGHTON
NORTH ALAMEDA
BARNUM WEST
BARNUM
BAKER
SPEER
CHERRY CREEK
Google
Data map ©2024 Google
Smluvní podmínky

- Let's go back to our runner's results. The following table provides a detailed description of the routes in relation to the ascent and descent on individual kilometers.


350.0
300.0
250.0
200.0
150.0
100.0
50.0
0
0:00
16:40
33:20
50:00
1:06:40
1:23:20
1:40:00
1:56:40
2:13:20
2:30:00
2:46:40
Marathon 1


2,500.0
2,250.0
2,000.0
1,750.0
1,500.0
1,250.0
1,000.0
750.0
500.0
0:00
33:20
1:06:40
1:40:00
2:13:20
2:46:40
3:20:00
3:53:20
4:26:40
Marathon 2


1,800.0
1,750.0
1,700.0
1,650.0
1,600.0
1,550.0
1,500.0
1,450.0
0:00
16:40
33:20
50:00
1:06:40
1:23:20
1:40:00
1:56:40
2:13:20
2:30:00
2:46:40
3:03:20
Marathon 3

Races and records I.

- Match specific race names to their routes. Find the fastest men's and women's times on these routes.

DENVER COLFAX MARATHON®

jungfrau marathon
schweiz switzerland
www.jungfrau-marathon.ch

PIM PRAGUE INTERNATIONAL MARATHON

Races and records II.

- Match specific race names to their routes. Find the fastest men's and women's times on these routes.

PIM PRAGUE INTERNATIONAL MARATHON

Men's: Eliud Kiptanui – 2:05:39 (2010, KEN)
Women's: Lonah Salpeterová – 2:19:46 (2019, ISR)

jungfrau marathon schweiz switzerland
www.jungfrau-marathon.ch

Men's: Jonathan Wyatt - 2:49:01 (2003, NZ)
Women's: Maude Mathys - 3:12:56 (2017, CH)

DENVER COLFAX MARATHON

Men's: Tyler McCandless – 2:21:08 (2022, US)
Women's: Brittany Lee Charboneau – 2:52:56 (2017, US)

World records

- Find out the world records in the men's and women's category. Where were these times performed? Calculate the pace of the world record holders during their performances. How do you proceed with the calculation? Record your calculation and add the results to the table.

	Time	Pace	Place
Men's	2:00:35	2:51	Chicago, 2023
Women's	2:11:53	3:07	Berlin, 2023

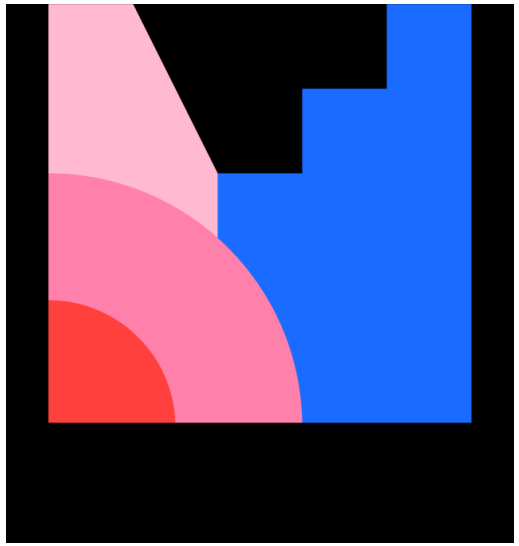
Calories

- If you use a sporttester, you know that another value you get for individual exercises is calorie consumption. Can you find any relationship from the data below?

	Time	Pace	Ascent	Calories
Marathon 1	2:52:27	4:04	241	2 576
Marathon 2	4:36:40	6:32	2 024	3 846
Marathon 3	3:15:15	4:37	207	2 892

Running in higher altitude I.

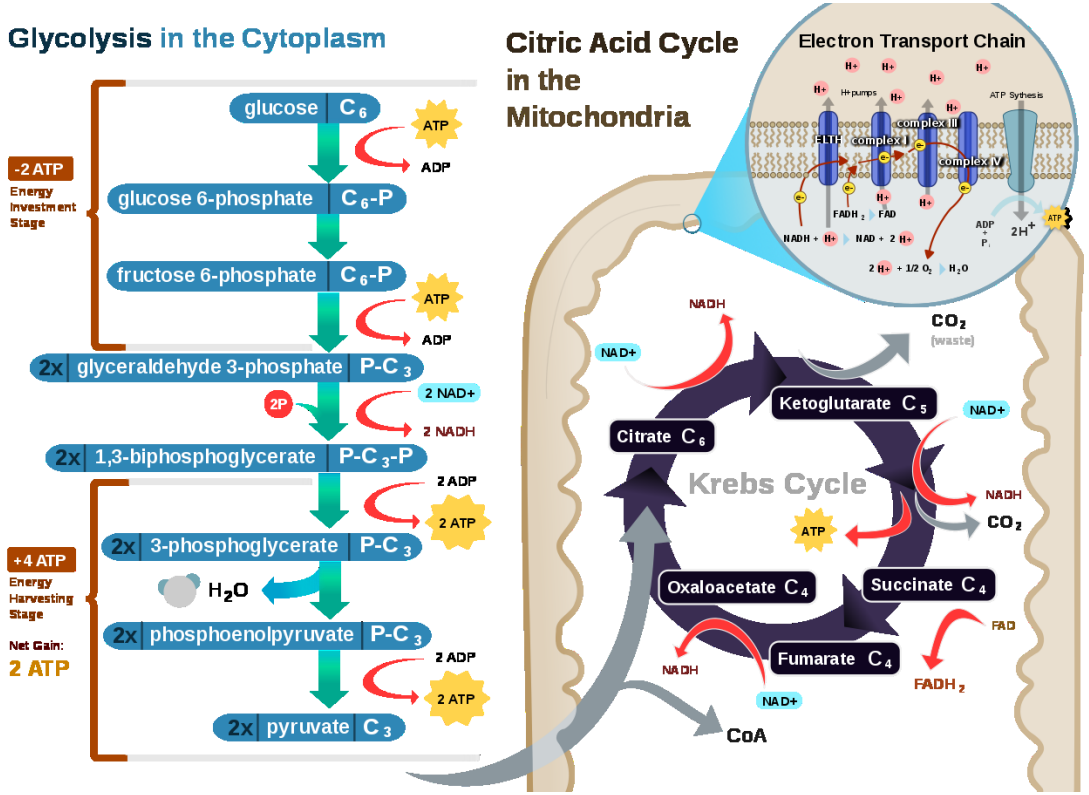
- Let’s focus on a marathon at a higher altitude and explore the role of altitude in influencing results. Discuss the effect that lower oxygen content has on the physical performance of runners.



Running in higher altitude III.

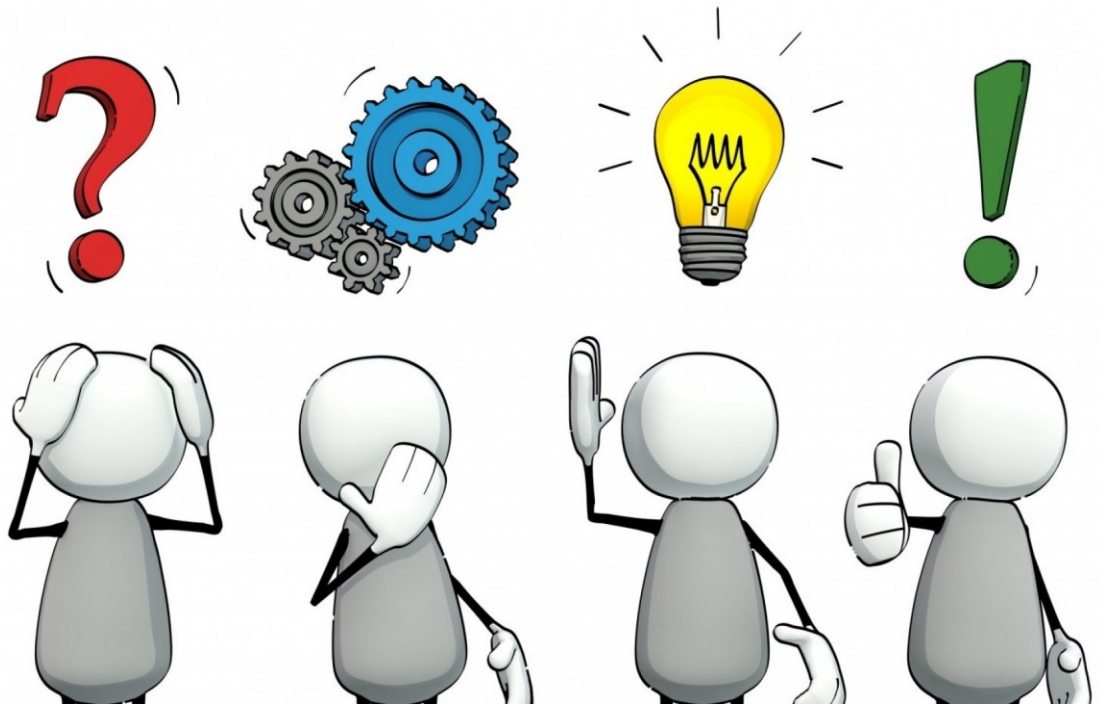
- cellular respiration

$$C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O + energy$$



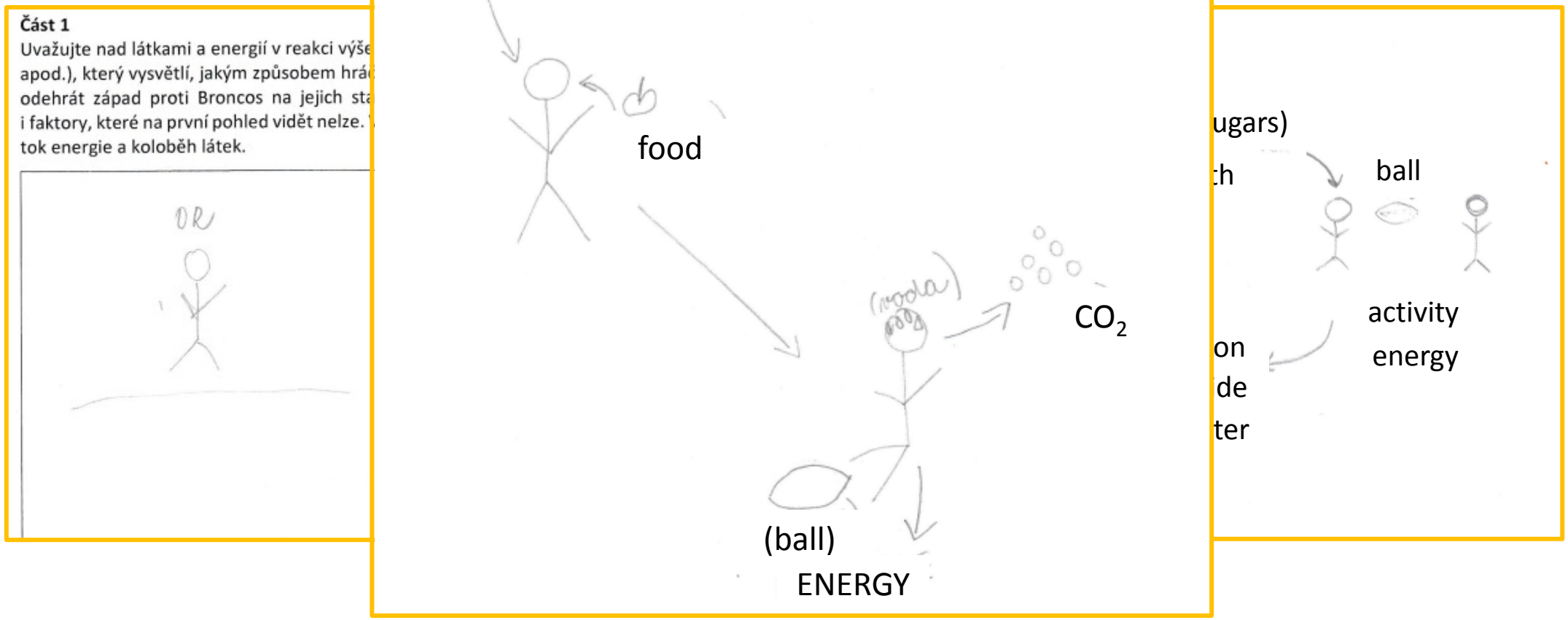
Running in higher altitude III.

- Consider the substances and energy in the reaction above and try to draw a simple model (picture, diagram etc.) that explains how a runner can obtain and use energy before and/or during a race. Try to include all the factors you have already discussed in this assignment in the diagram. Use arrows and labels in the model to show the flow of energy and the cycle of matter.



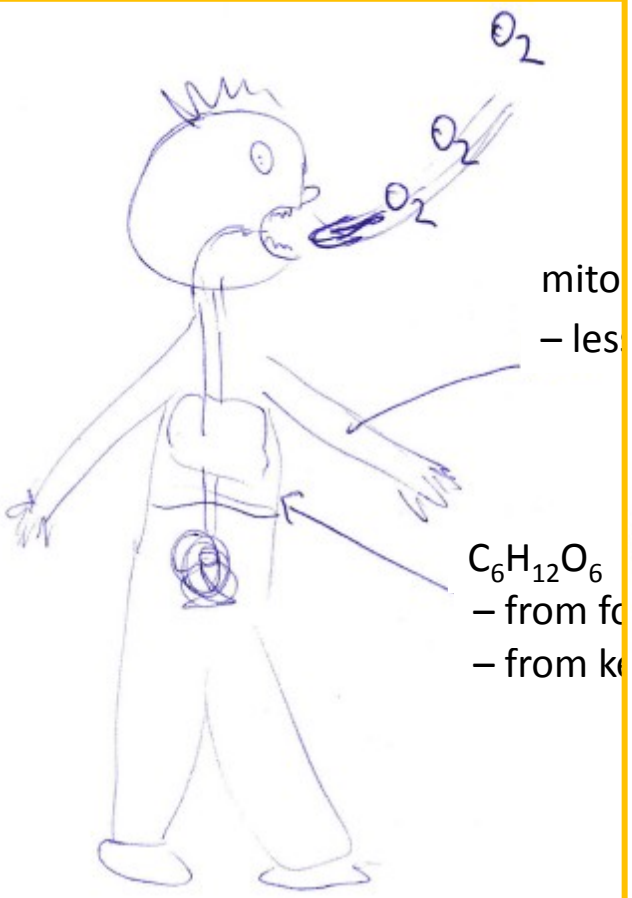
Running in higher altitude IV.

- example of visual mode



Running in higher altitude IV.

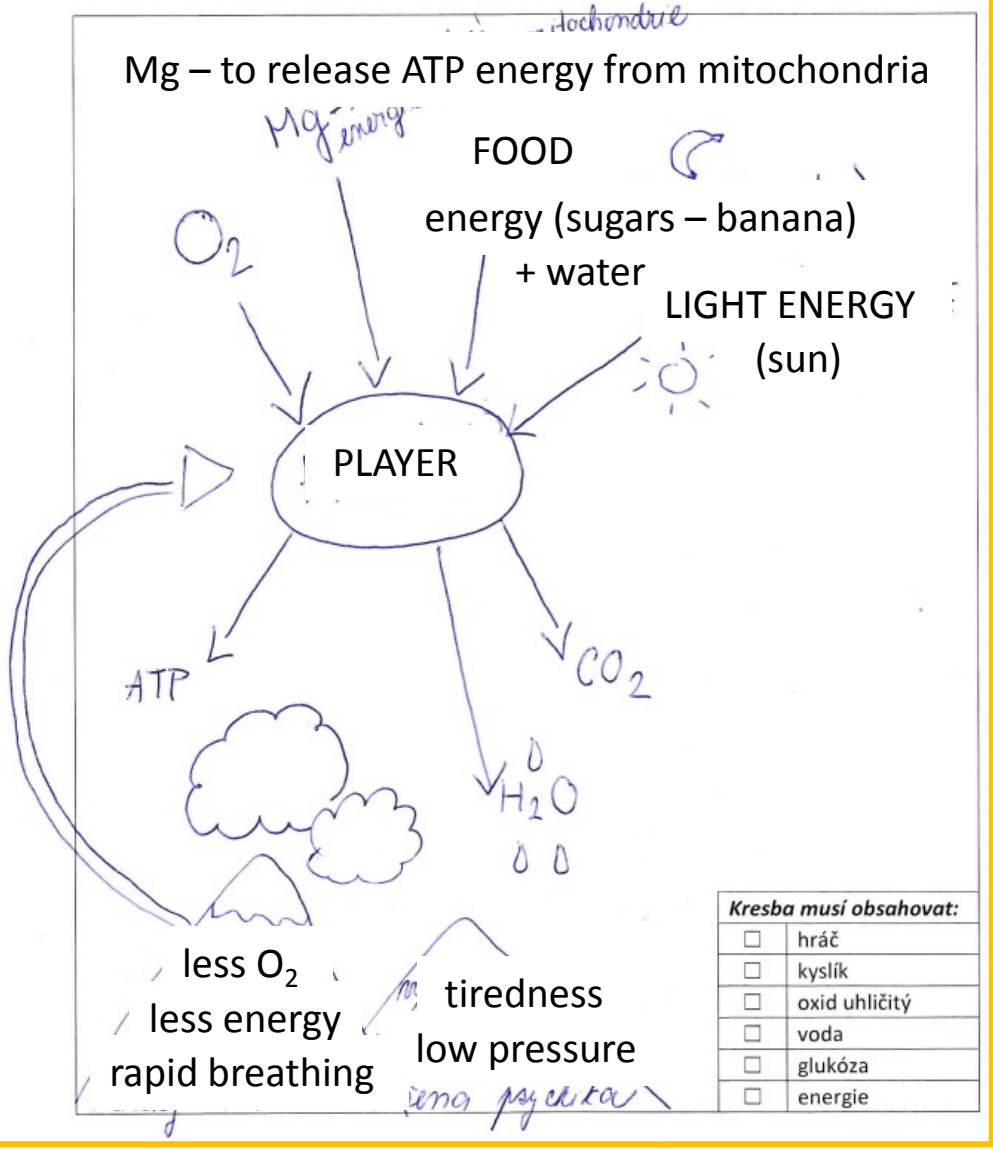
- more examples of model c



mito
– les

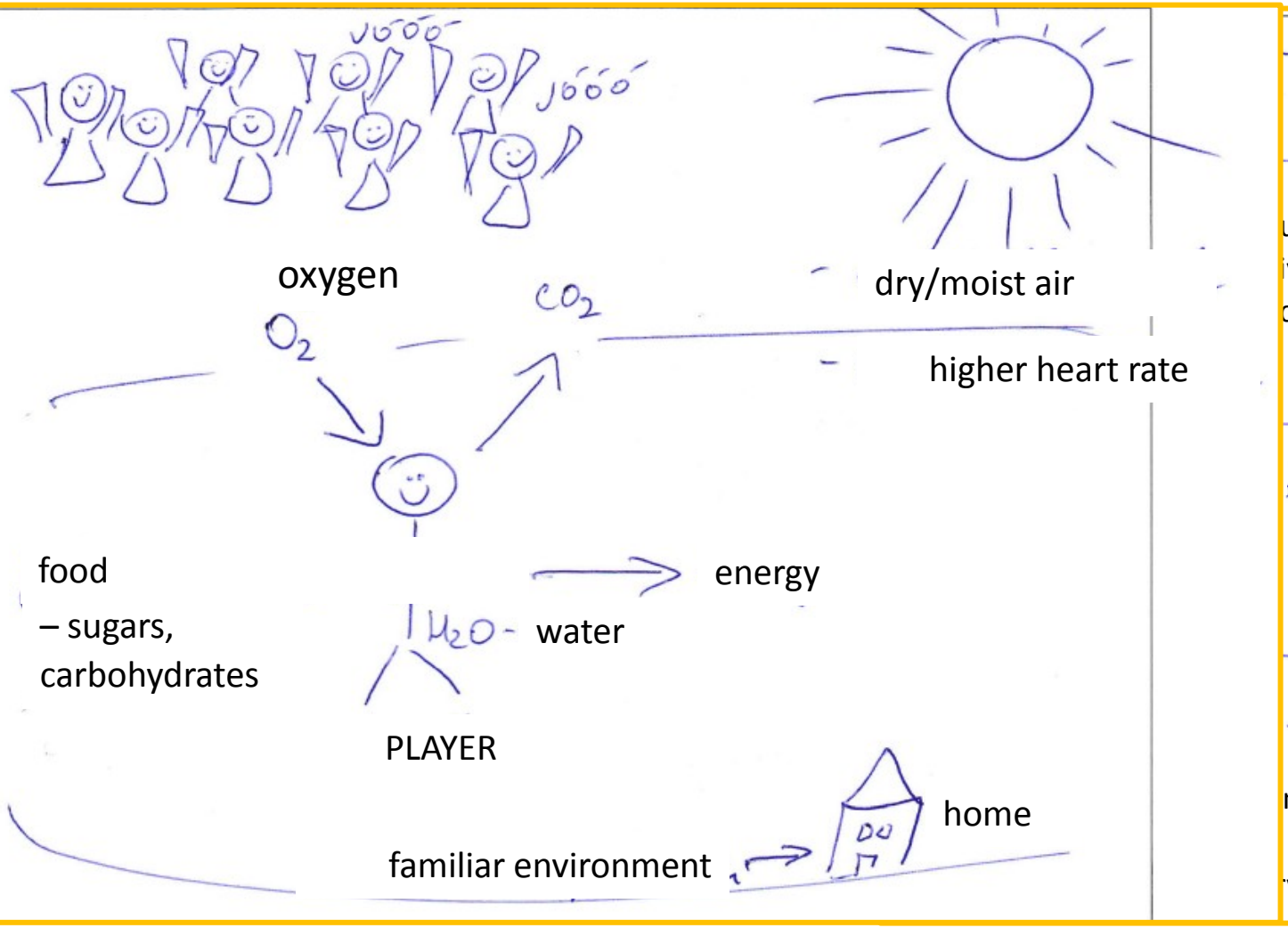
$C_6H_{12}O_6$
– from fo
– from k

Mg – to release ATP energy from mitochondria



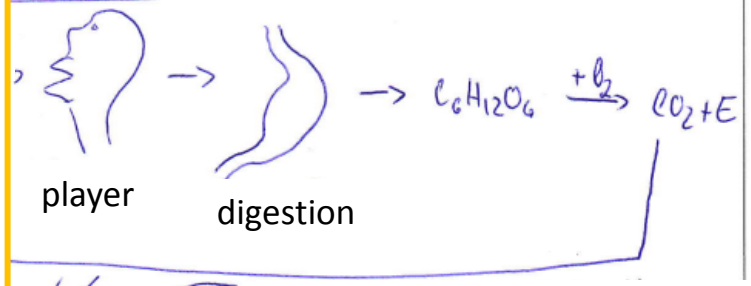
Kresba musí obsahovat:	
☐	hráč
☐	kyslík
☐	oxid uhličitý
☐	voda
☐	glukóza
☐	energie

Running in higher altitude IV.



digestion of food
– split into simple substances, subsequent absorption

during physical activity, energy for muscle work is taken sugars – glucose → during long-term activity, after period of time, fats are burned

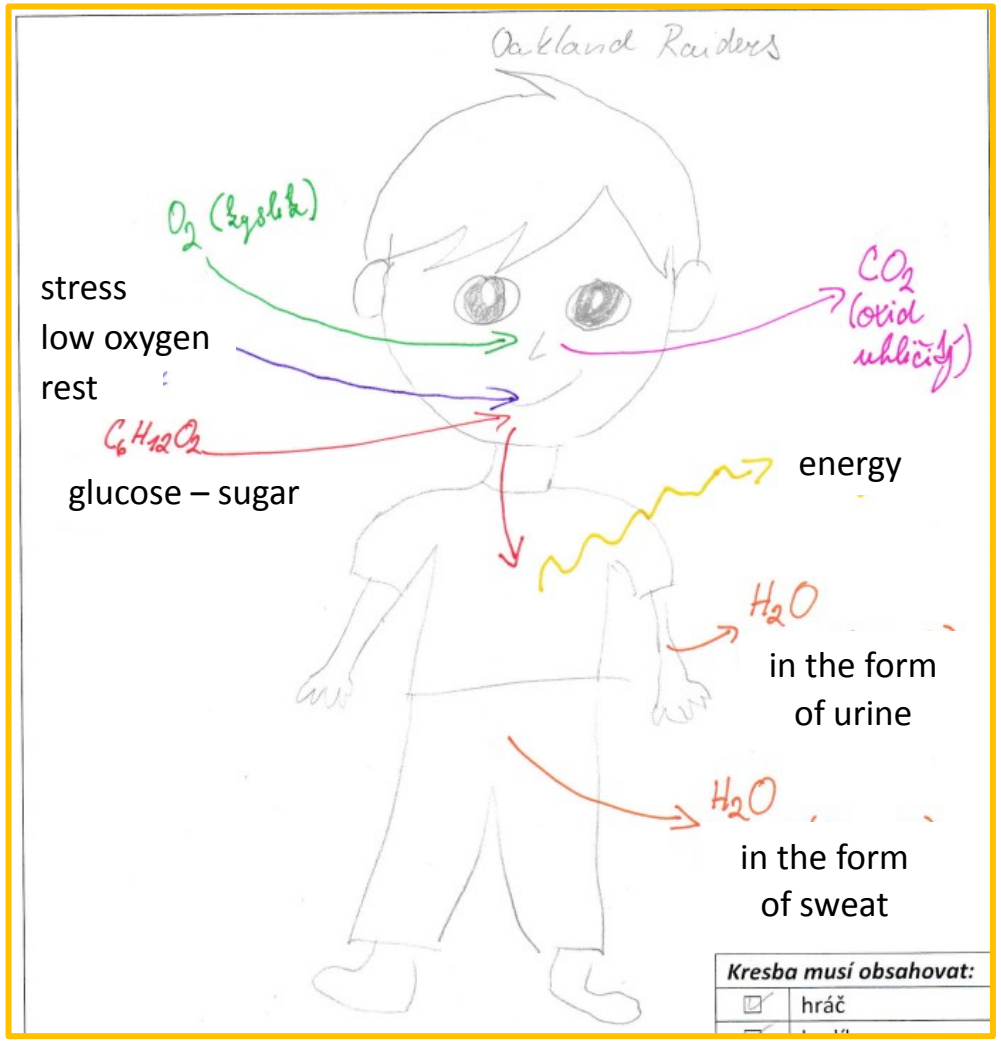


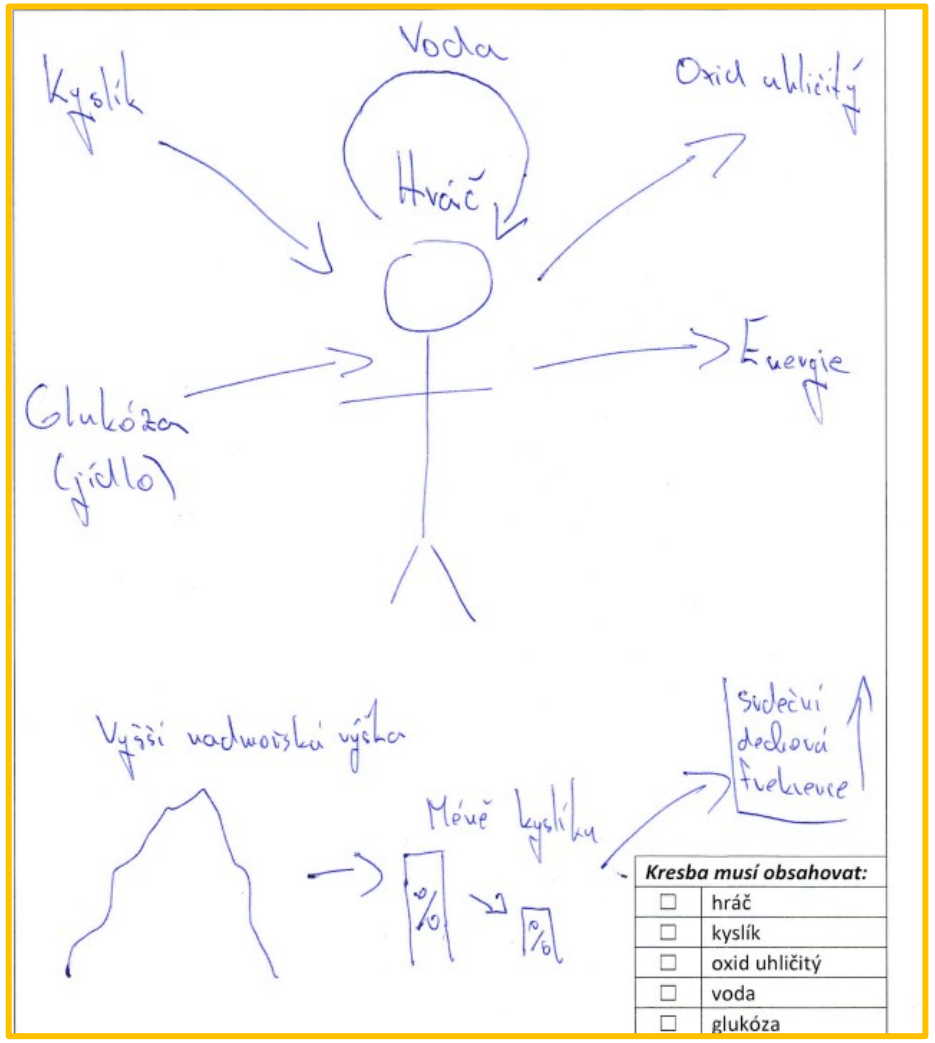
muscle work

it is necessary to have a supply of energy from which it is possible to obtain energy by splitting a chemical substance and use it for muscle work

y to have a sufficient amount of O_2 – aerobic work occurs

Running in higher altitude IV.





Running in higher altitude IV.

PFLEGUNG

SPONSER SPORT FOOD

Long Energy Fruitmix	Cola	Bouillon Soup	Energy Riegel Energy Bar	Bananen Bananas	LIQUID ENERGY PLUS Gel	LIQUID ENERGY SALTY Gel	Wasser Water	Schwämme Sponges
●							●	
●			●	●			●	
●			●				●	
●		●		●	■		●	●
●			●		■		●	
●		●	●	●			●	
							●	
●		●	●	●		■	●	●
●	●	●	●	●		■	●	
							●	
	●	●	●	●	■		●	
●	●		●	●	■		●	●
	●						●	
	●						●	
	●						●	

uct presentation in above order!
Teilnehmenden abgegeben. / Self-service for the runners.

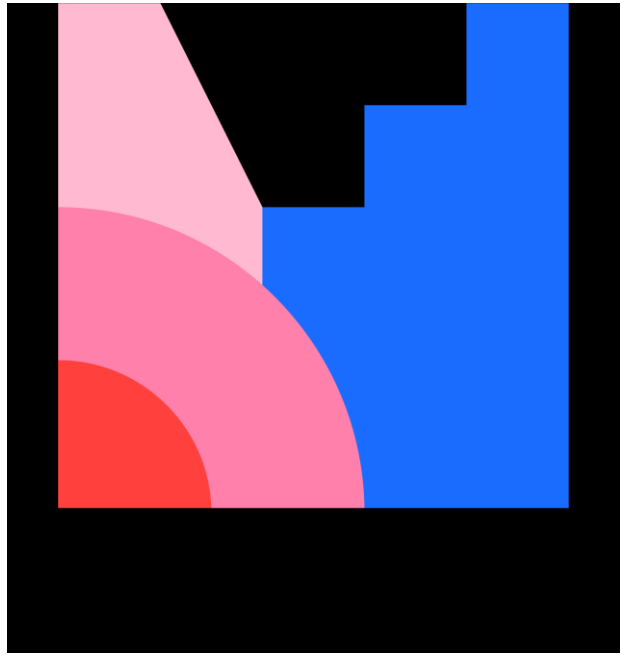
ARRIVAL

ibräu alkoholfreies Bier, «Linzertörtli»
ibräu non alcoholic beer, Linzer tartlet

Bitte Abfall nur bei den Verpflegungsposten entsorgen. Schütze die Natur, damit du sie auch weiterhin geniessen kannst.
Please dispose of waste only at the food stations / feeding areas.

Conclusions

- You are on the finish line of this inquiry activity. Write the main conclusions you reached. Focus mainly on which data helped you identify some of the factors affecting the runner's performance. What other factors have you discovered?



Conclusions

- **Let's return to the beginning…**

Research methods

Quantitative

Qualitative

Mixed methods research

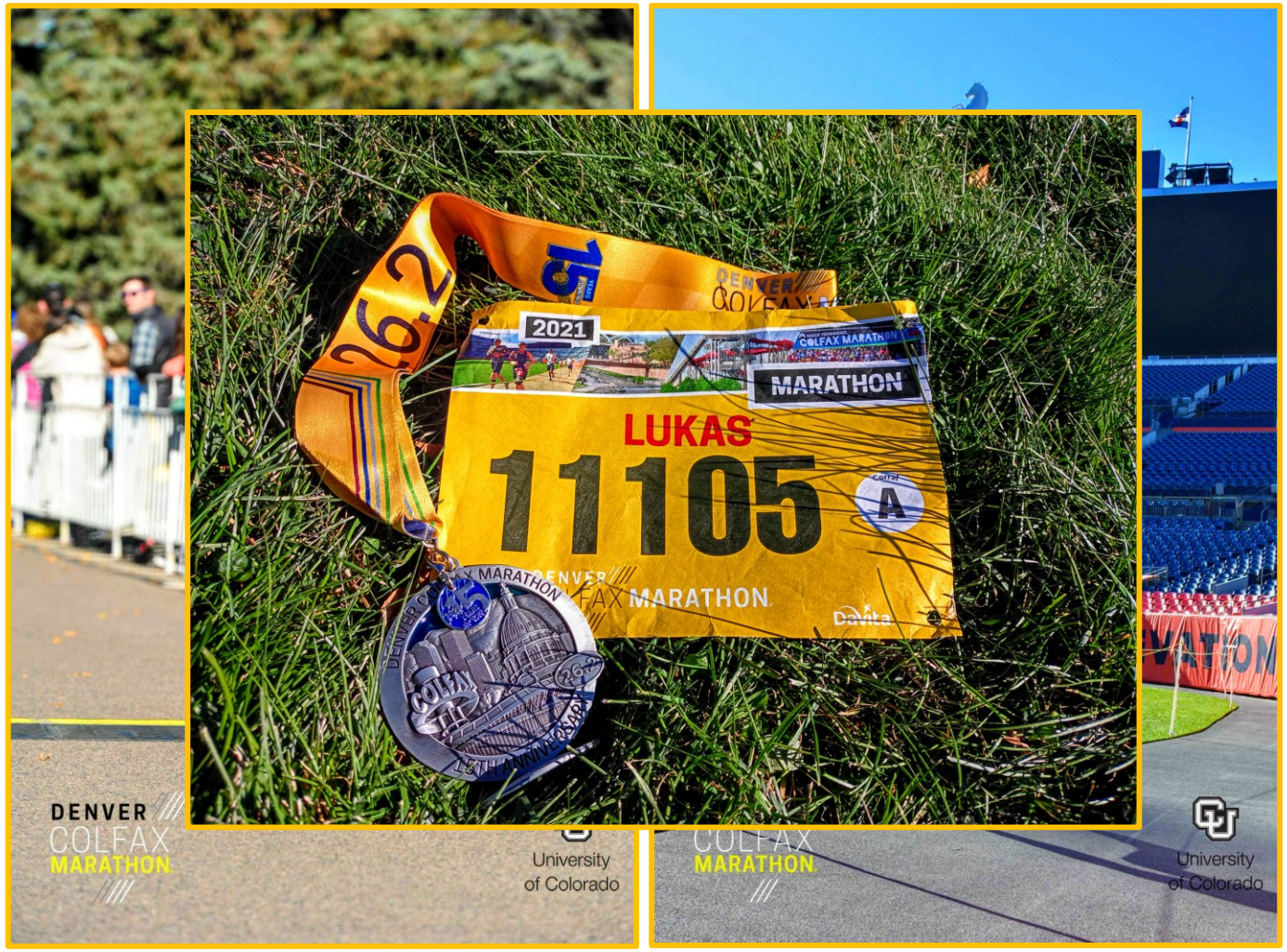
Conclusions I.

- **How would you use and analyse the data?**

Conclusions II.

Conclusions III.

Conclusions IV.



Thank you for your attention!

Lukáš Rokos