Lesson Title	**Lesson 3 - Mapping the Thalweg**
Time	1 - 50 min class period
Resources	● Quiz – River Anatomy and Age of Rivers ● Mapping the Thalweg Worksheet ● Mapping the Thalweg Activity Map ● Mapping the Thalweg Activity Profiles
Objective	SWBAT analyze data from a river to determine where erosion, deposition, and the thalweg will occur in a river.
Standard	HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
Plan	**Introduction (10 min)** ● River Anatomy and Age Quiz **Activity (30 min)** ● Review what a thalweg is (path of highest velocity), where it is located in a river, and how it affects erosion and deposition. ● Hand out Mapping the Thalweg Activity Worksheet, Map, and Profiles to pairs of students. ● Explain to students how to interpret the Profiles. The longer the arrow and the closer the color is to red, the higher the velocity is. ● Students will match each velocity profile to a location on the river based on what they know about where thalwegs (the paths of highest velocity) occur within a river. **Closing (10 min)** ● Have students check their work with another group and correct mistakes/misunderstandings.
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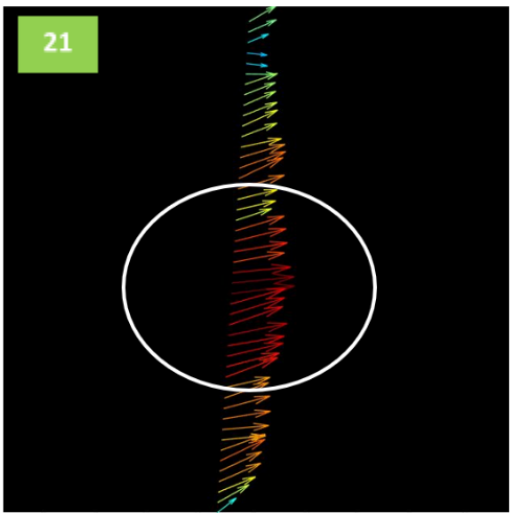
Acknowledgements	The curriculum was developed under National Science Foundation RET grant #1953102. However, these contents do not necessarily represent the policies of the National Science Foundation, and you should not assume endorsement by the federal government.

Mapping the Thalweg

Directions: The thalweg is the path of highest velocity in the river. In this activity you will map the thalweg using cards with velocity profiles across cross sections of the Red River. The cards are divided by the level of difficulty. Green cards are easy, yellow cards are harder, and the red cards are the most challenging. The color of the number on the card matches the color of the letter on the map. Once you match them up, write the number of the card in the table below.



How to read each card:

- The arrows show the direction that the river is flowing.

What direction is the river flowing on the card?

- The larger red arrows show the faster flow, while the smaller blue/green arrows show a slower flow.

Where is this river moving the fastest?

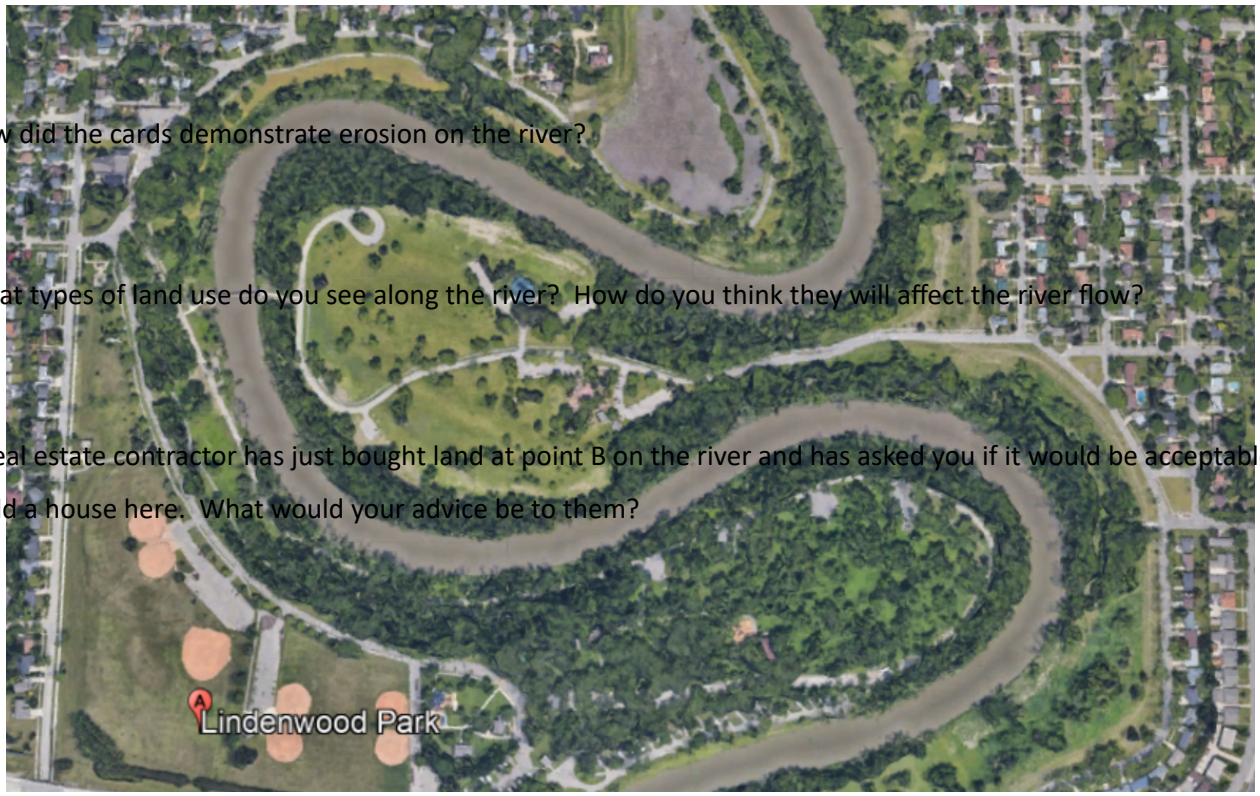
- Looking at this card, would you put this location on a turn of the river or on a straighter section? Why?

You will start with the green cards, once you think you have them figured out, call your teacher over to have them check before you pick up the next set of cards. Hint! Don't forget to look at the color of arrows to find the fastest flow!

GREEN CARDS (EASY)		YELLOW CARDS (HARDER)	
Letter	**Number on Card**	**Letter**	**Number on Card**
A		**B**	
E		**C**	
F		**O**	
K		**P**	
M		**T**	
RED CARDS (THE CHALLENGE!)			
Letter	**Number on Card**	**Letter**	**Number on Card**
D		**L**	
G		**N**	
H		**Q**	
I		**R**	
J		**S**	

Conclusion:

1. How did the arrows on the cards change to show you that the river was turning?
2. How did the cards demonstrate erosion on the river?
3. What types of land use do you see along the river? How do you think they will affect the river flow?
4. A real estate contractor has just bought land at point B on the river and has asked you if it would be acceptable to build a house here. What would your advice be to them?



5. Draw in the thalweg (fastest flowing water) on the map below using the information from the cards.

KEY

GREEN CARDS (EASY)		YELLOW CARDS (HARDER)	
Letter	**Number on Card**	**Letter**	**Number on Card**
A	11	B	2
E	16	C	19
F	4	O	13
K	17	P	6
M	3	T	20
RED CARDS (THE CHALLENGE!)			
Letter	**Number on Card**	**Letter**	**Number on Card**
D	9	L	7
G	1	N	15
H	18	Q	5
I	14	R	8
J	10	S	12

Conclusion:

1. How did the arrows on the cards change to show you that the river was turning?
   The red arrows moved closer to the cutbank side of the river.

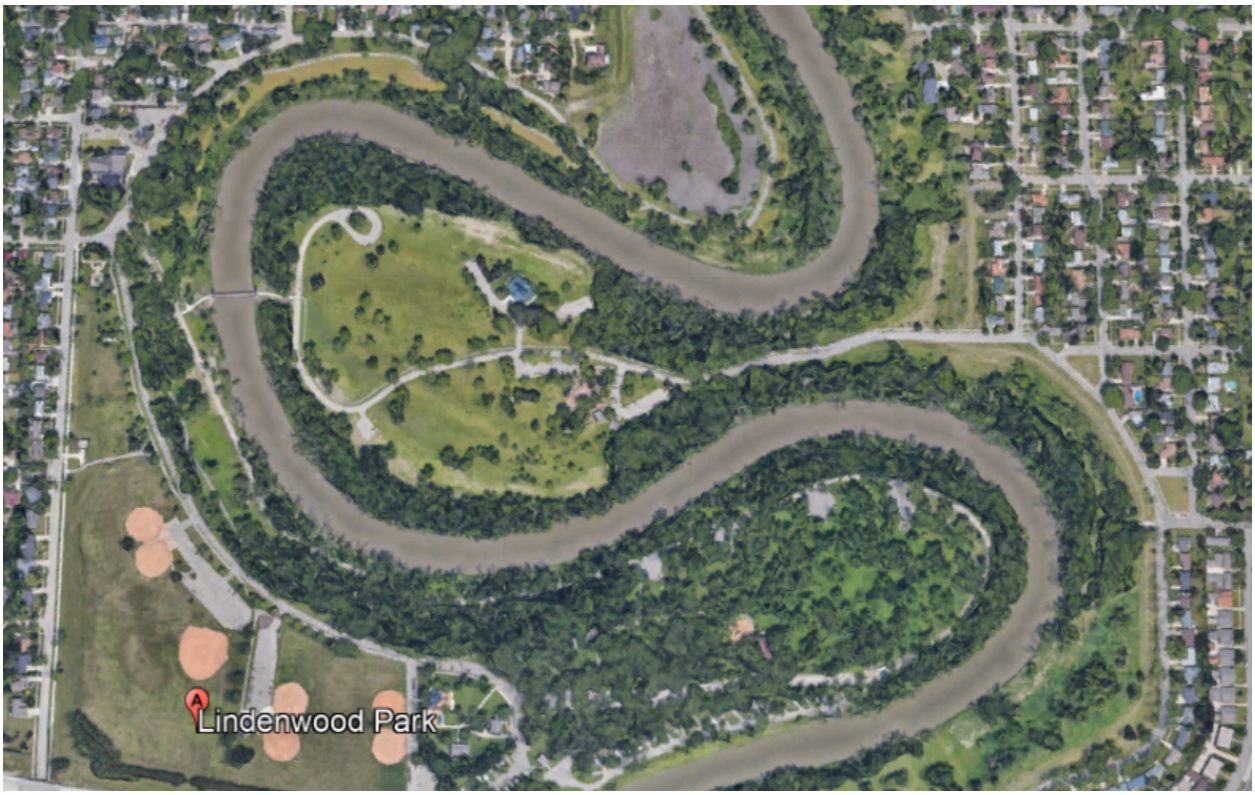
2. How did the cards demonstrate erosion on the river?
   The larger the arrow the faster the flow, so more erosion would occur.

3. What types of land use do you see along the river? How do you think they will affect the river flow?
   Answers will vary – should include parks and residential areas.

4. A real estate contractor has just bought land at point B on the river and has asked you if it would be acceptable to build a house here. What would your advice be to them?
   Students should note that rivers are a natural structure that are meant to meander. After this activity, they can see where the thalweg and where all of the cutbanks are eroding so it would not be a good place to build. Houses built in the floodplain will also have much more insurance costs to pay in case there is a flood. Homeowners would not want to pay that.

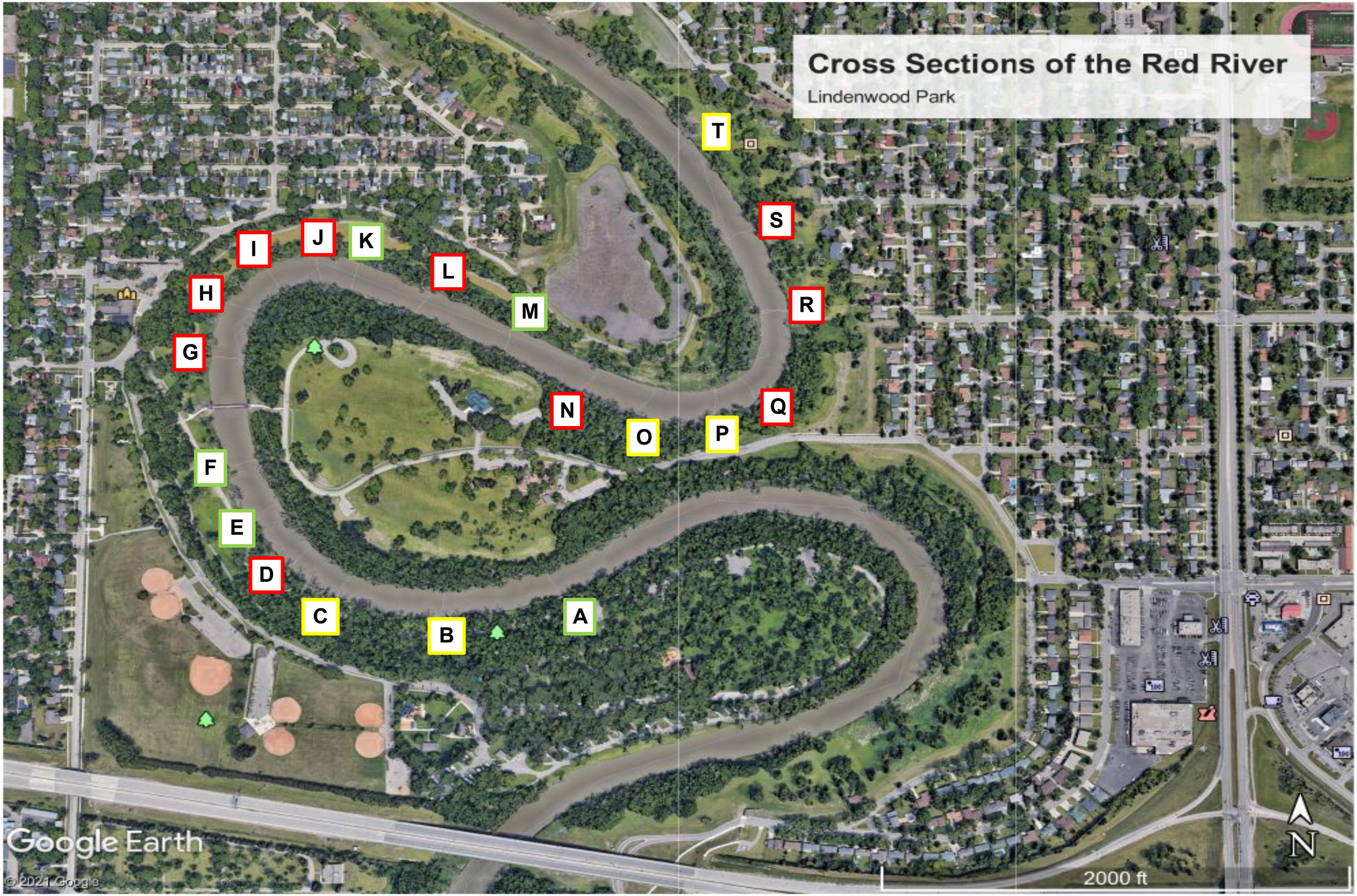
5. Draw in the thalweg (fastest flowing water) on the map below using the information from the cards on the map below.

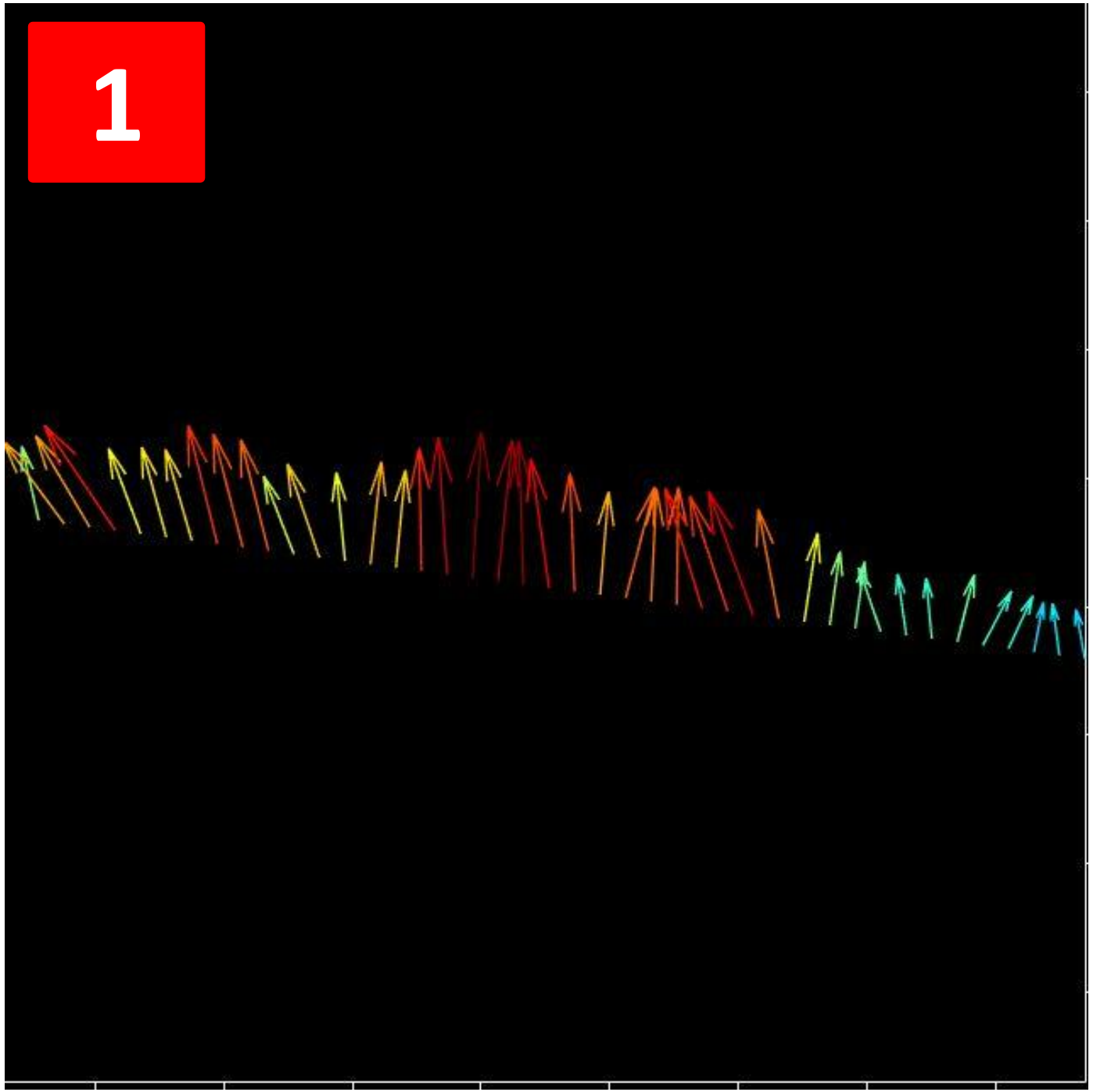
   Students should draw their line closest to each cutbank to show that the fastest flowing water changes as the river meanders.


Lindenwood Park

Cross Sections of the Red River

Lindenwood Park

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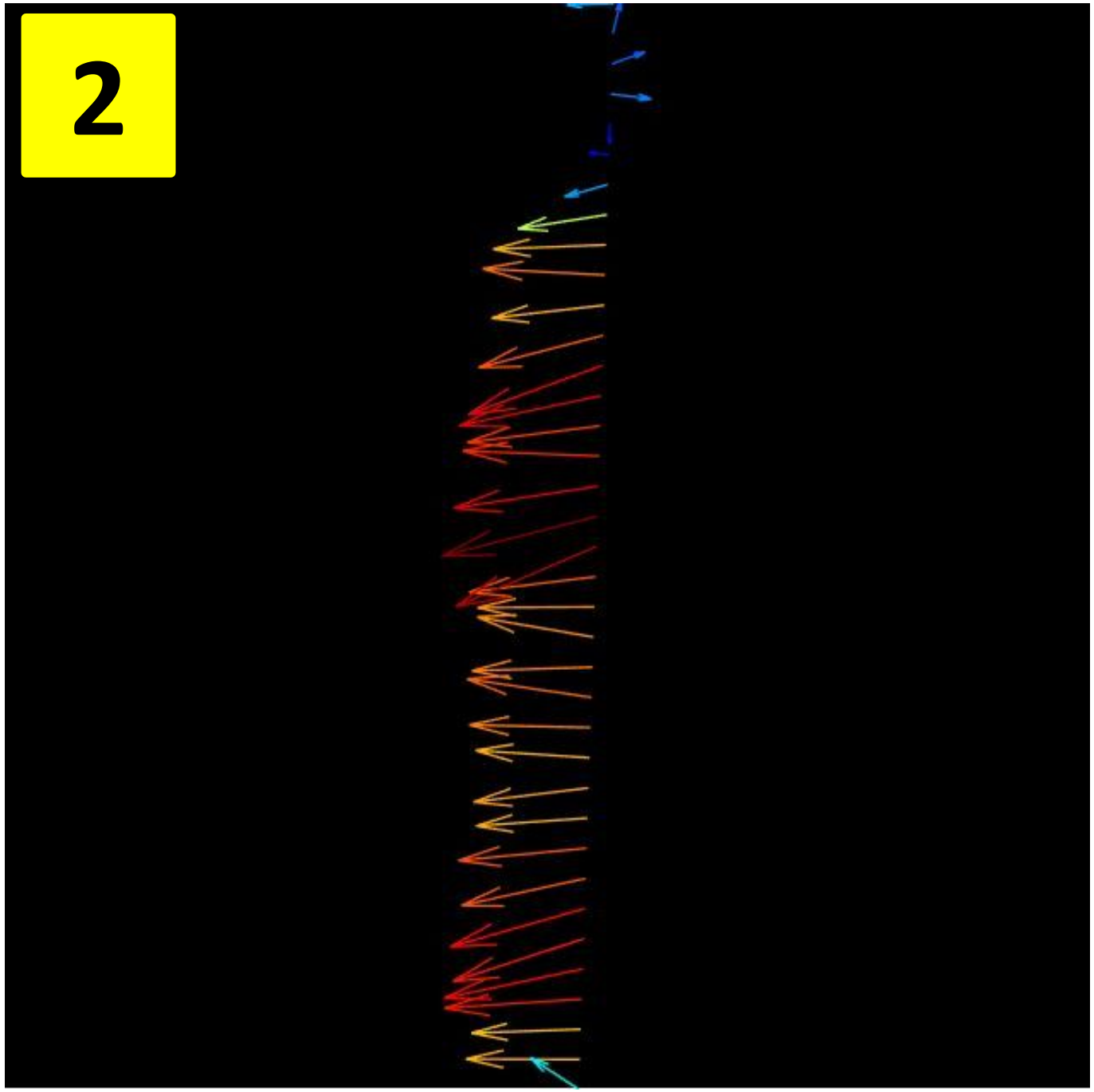
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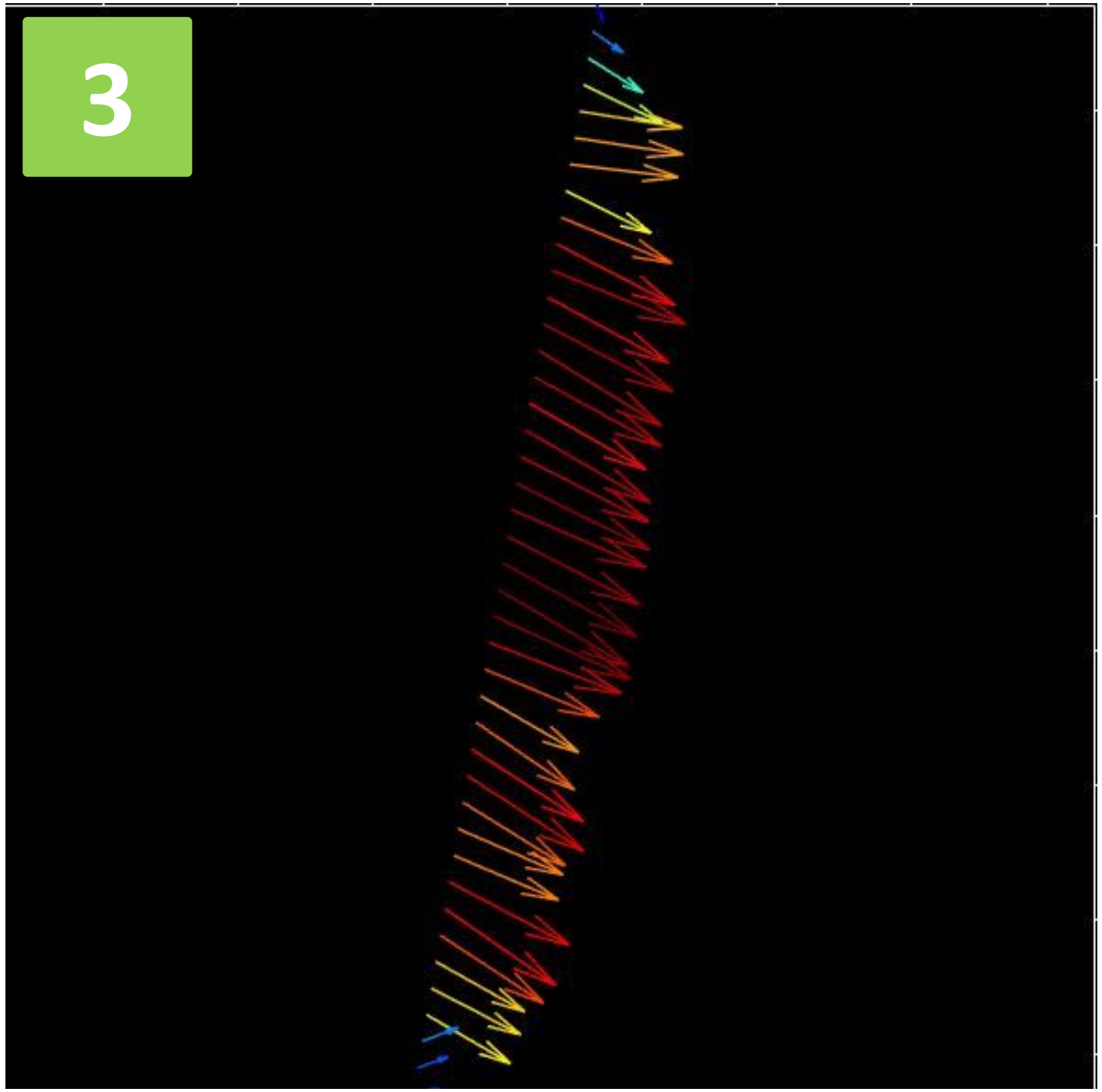
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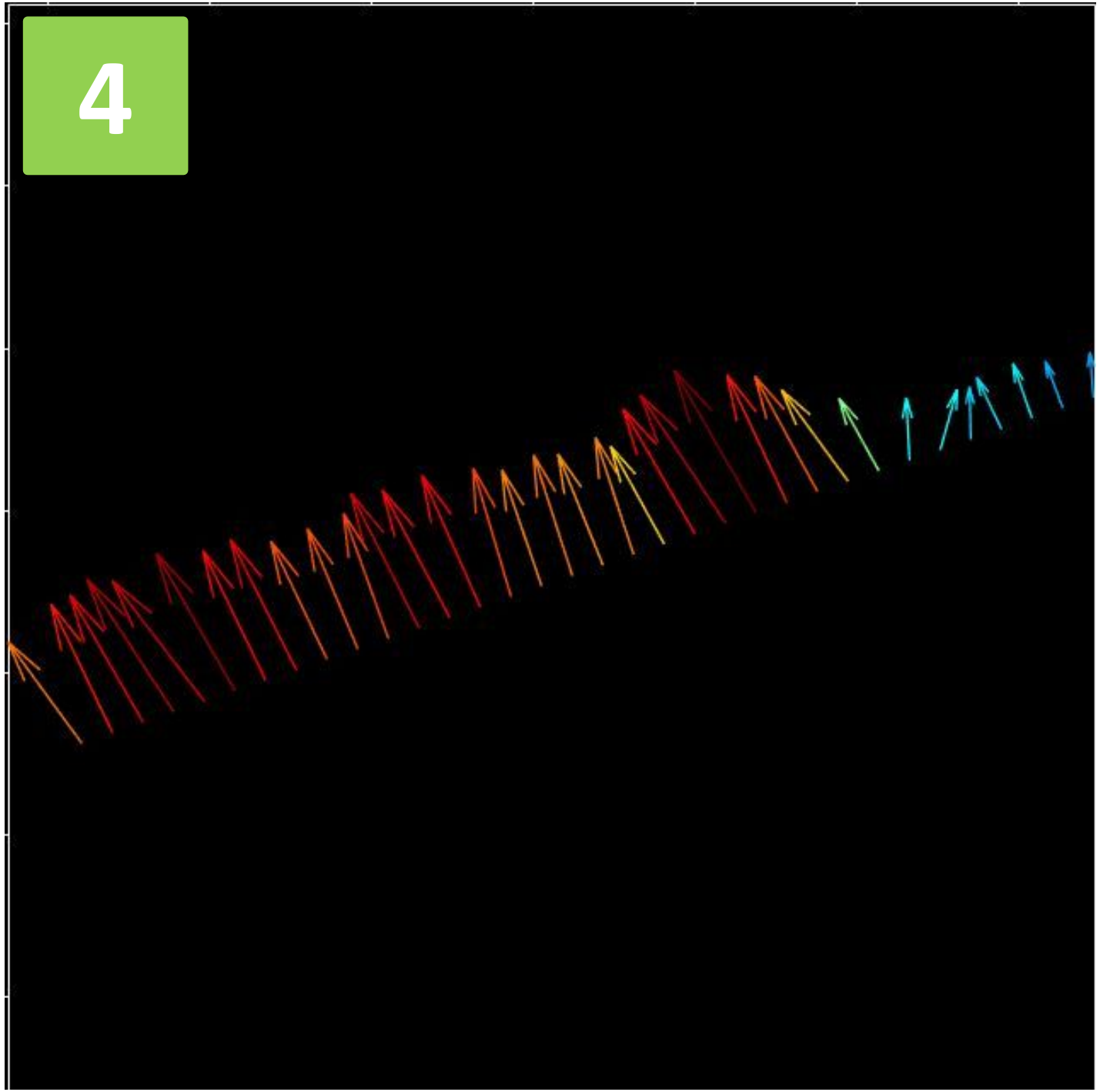
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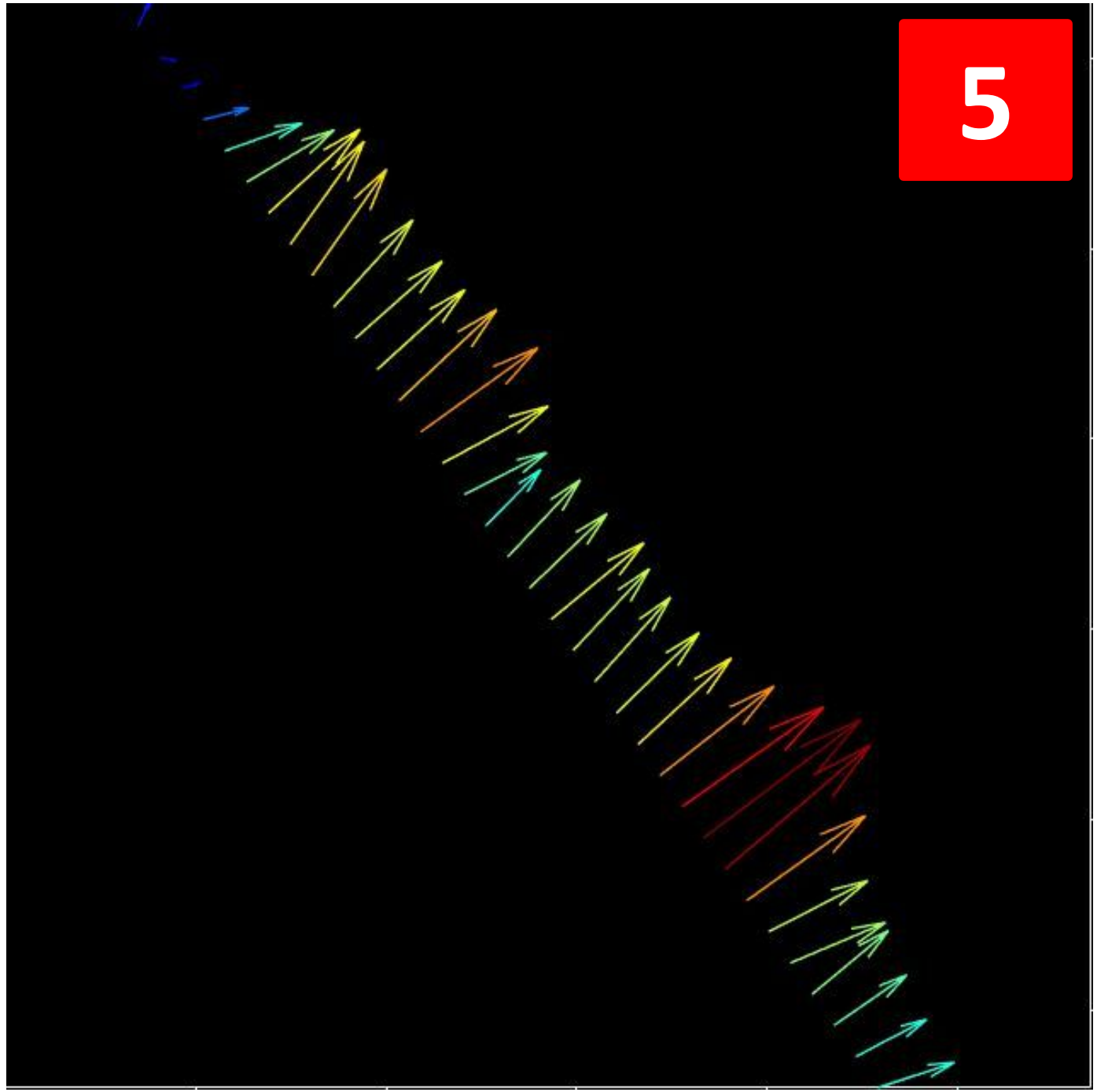
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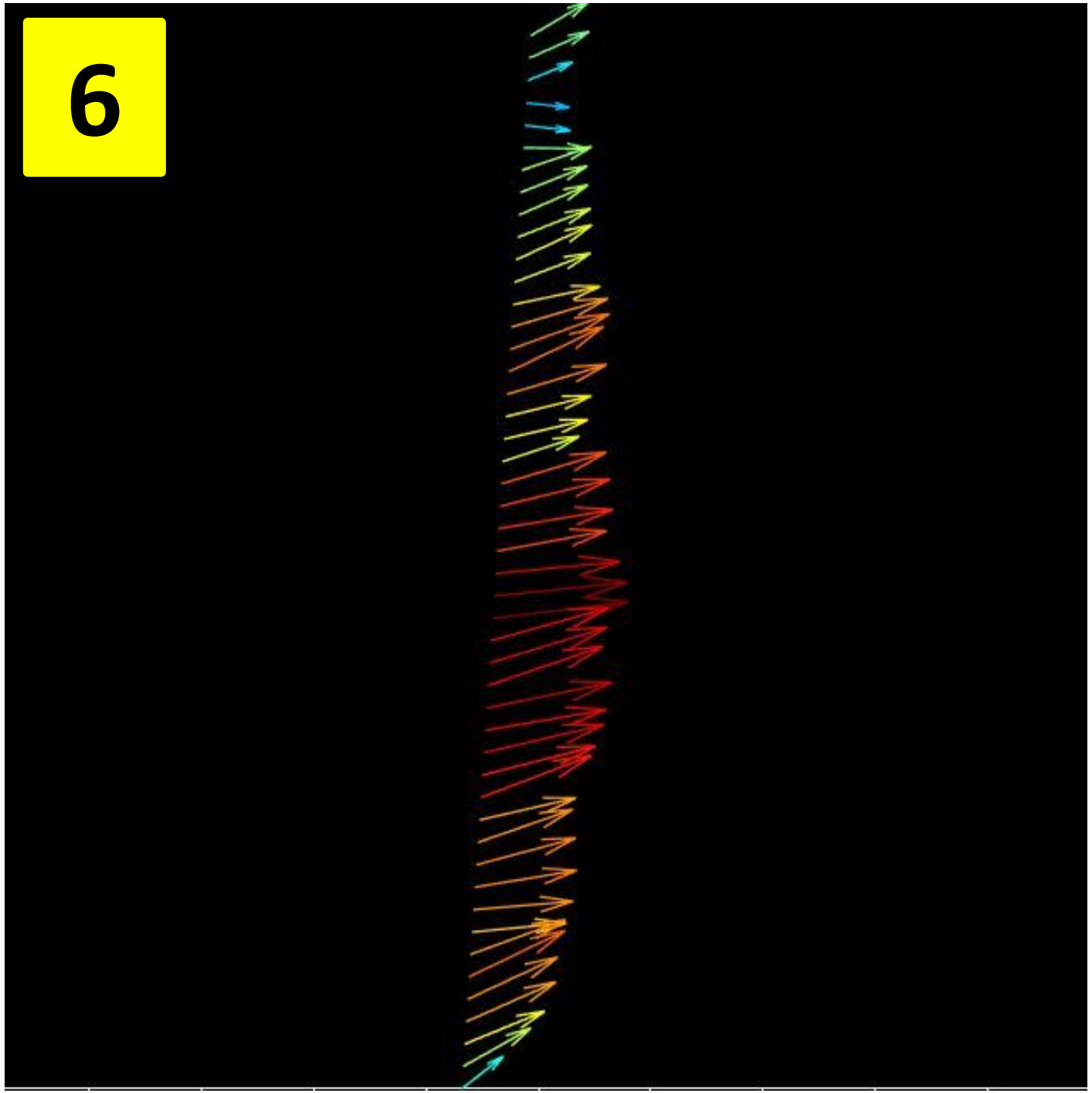
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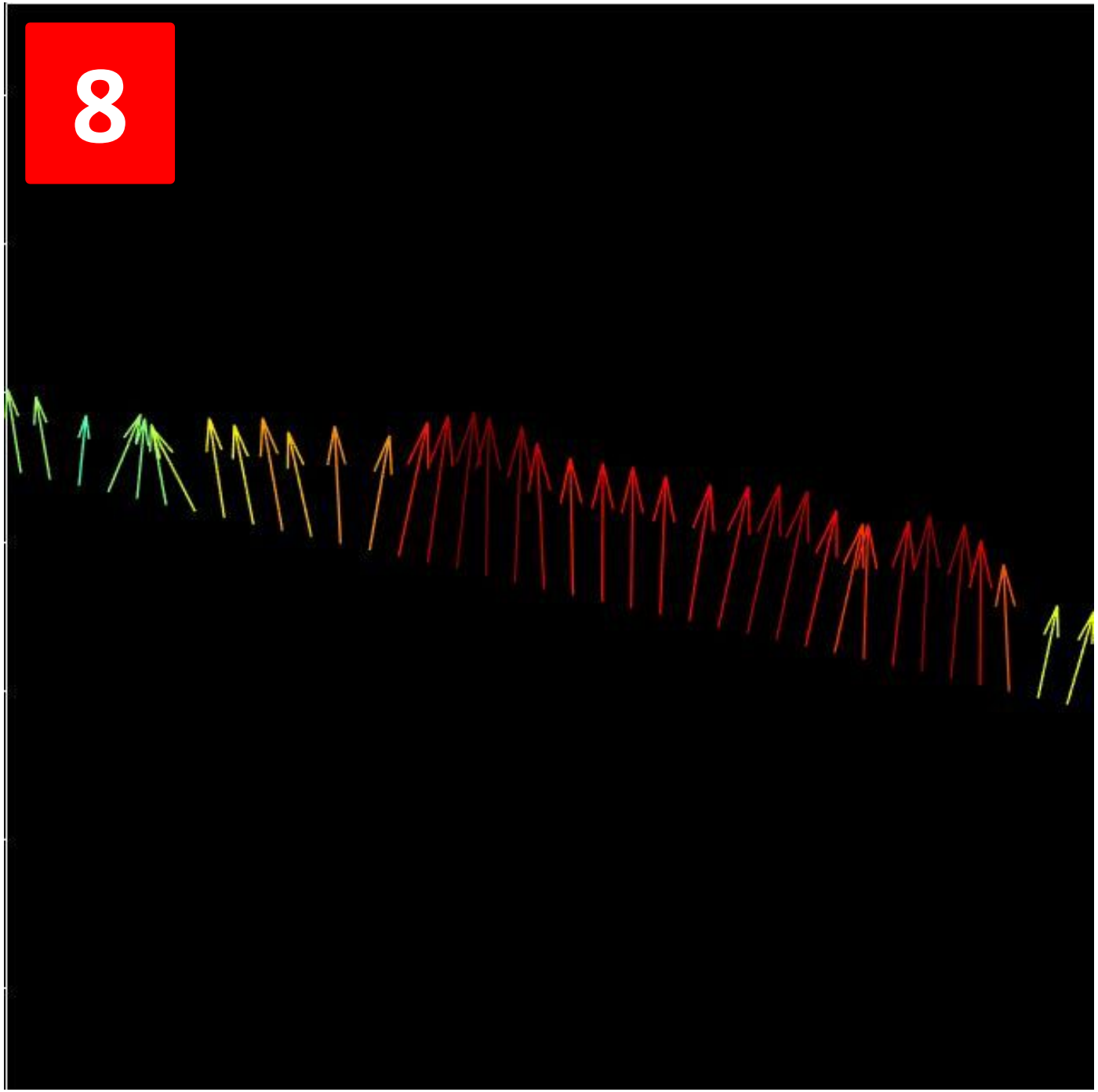
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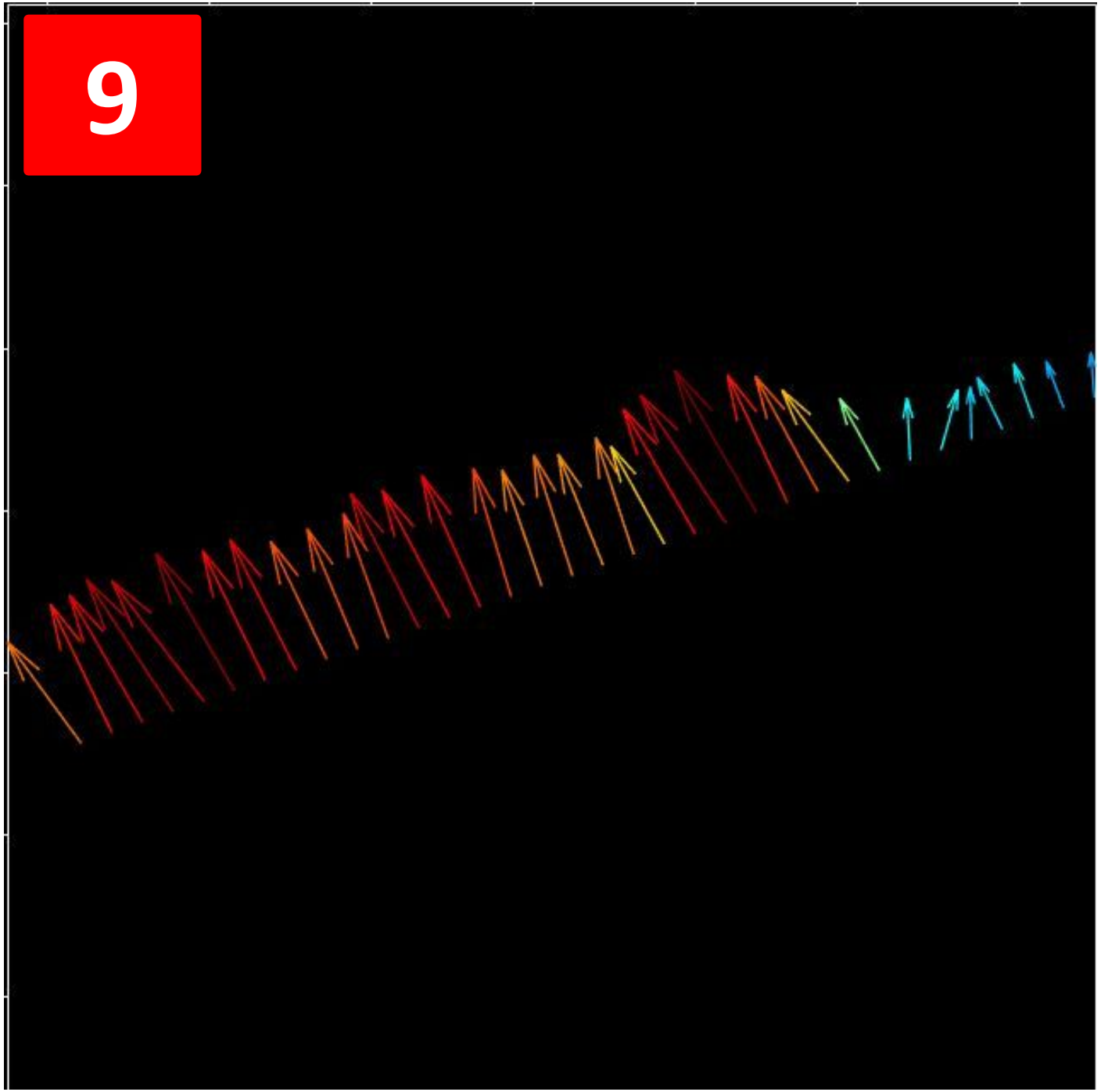
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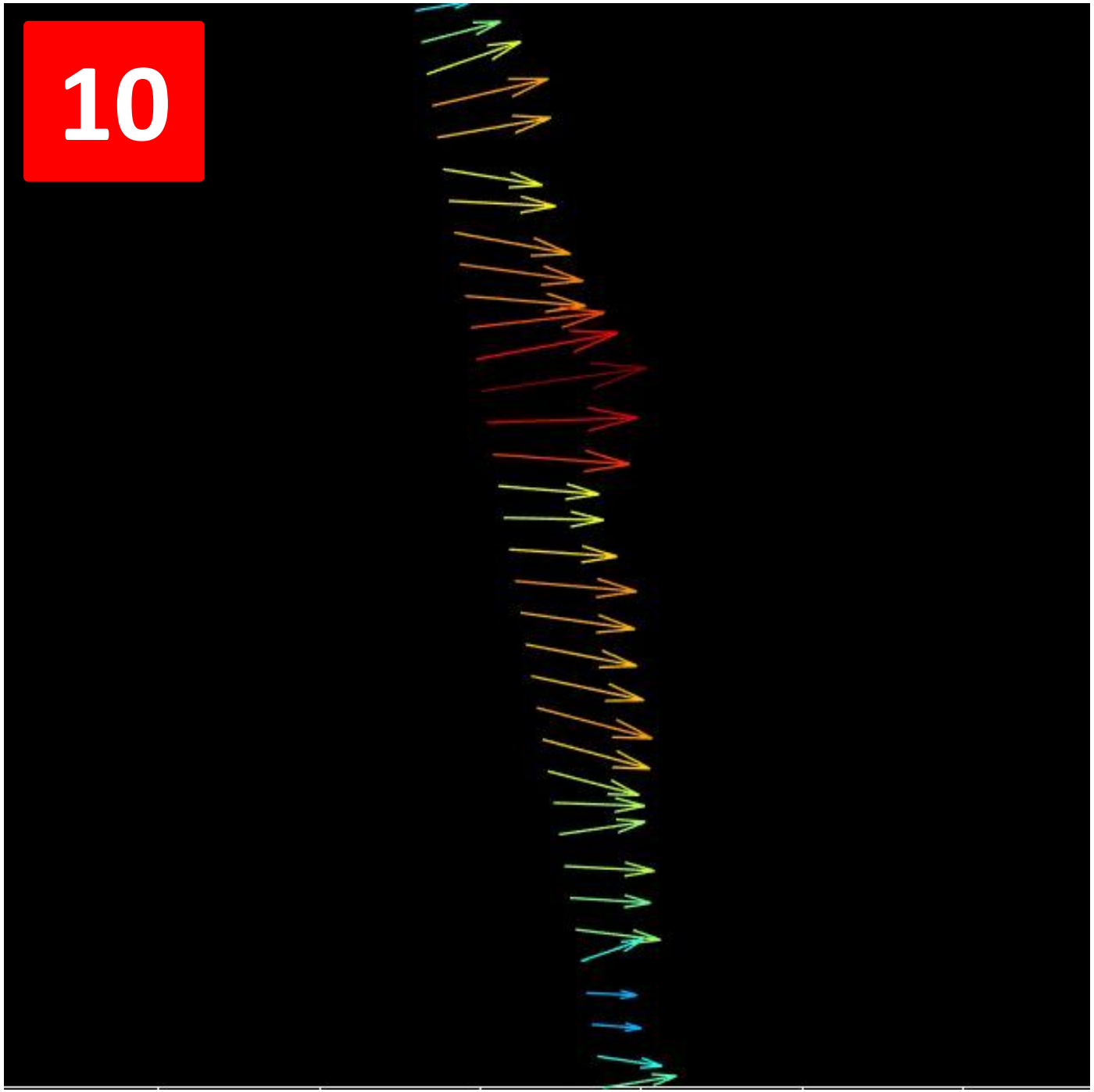
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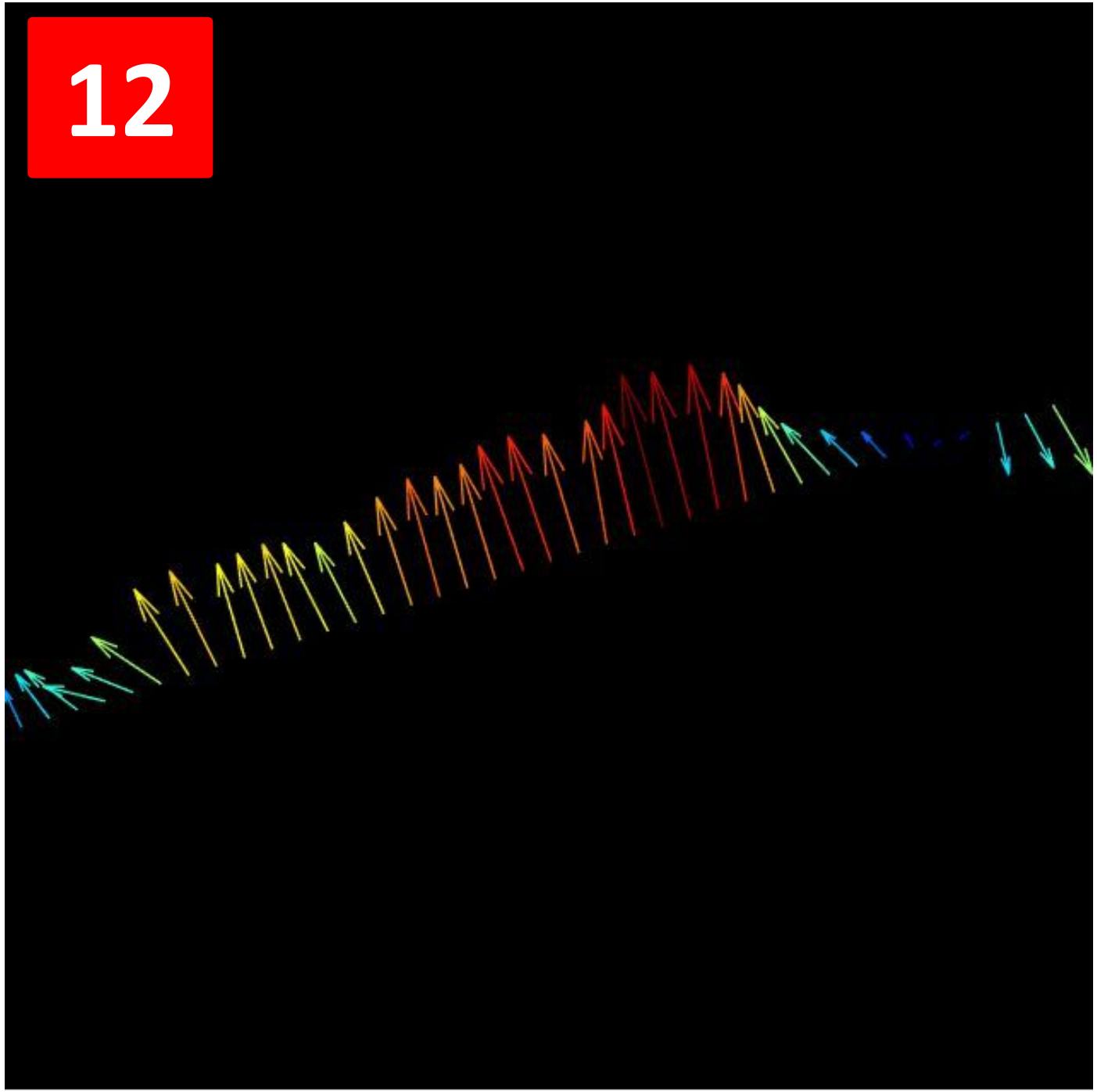
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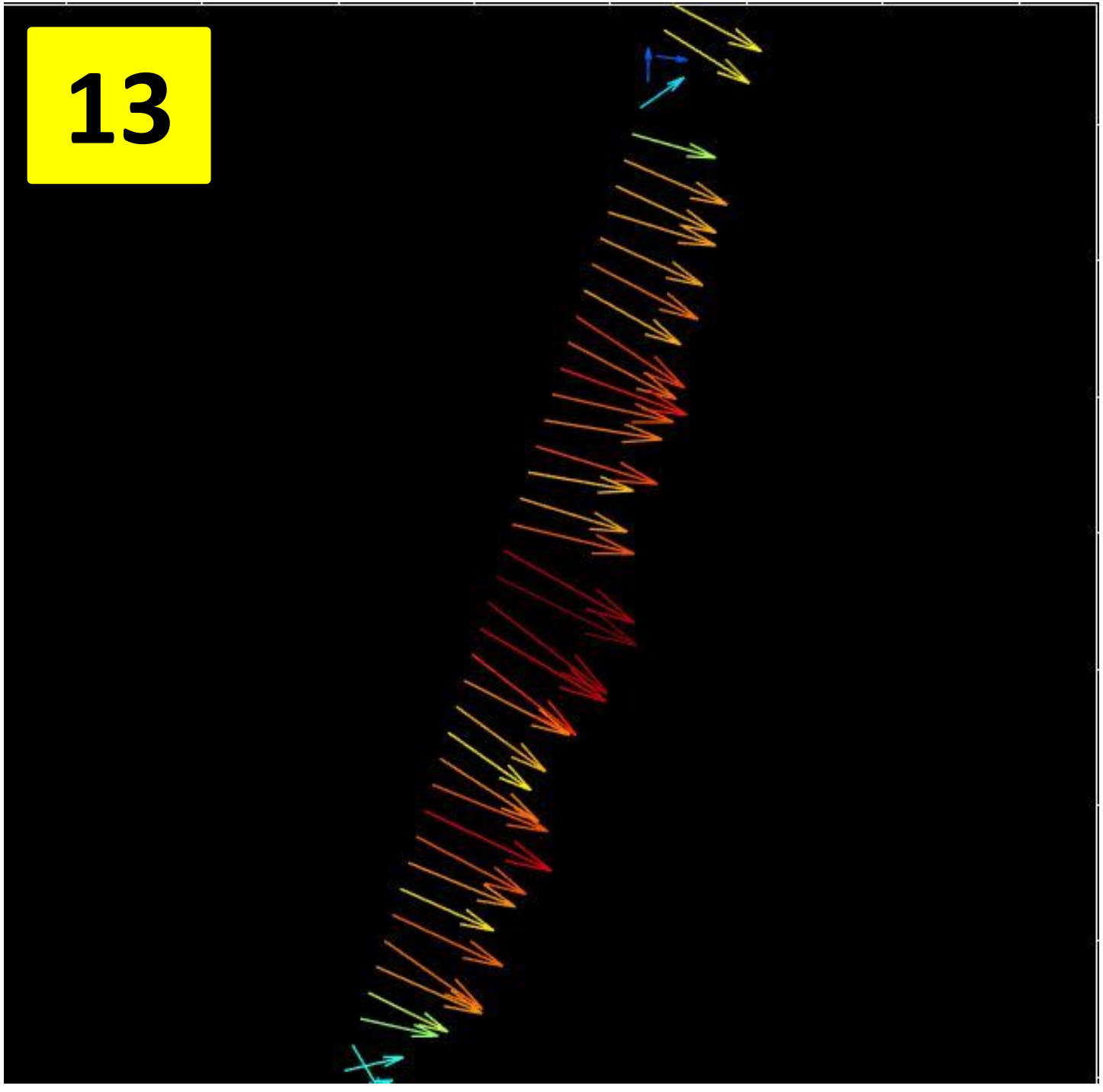
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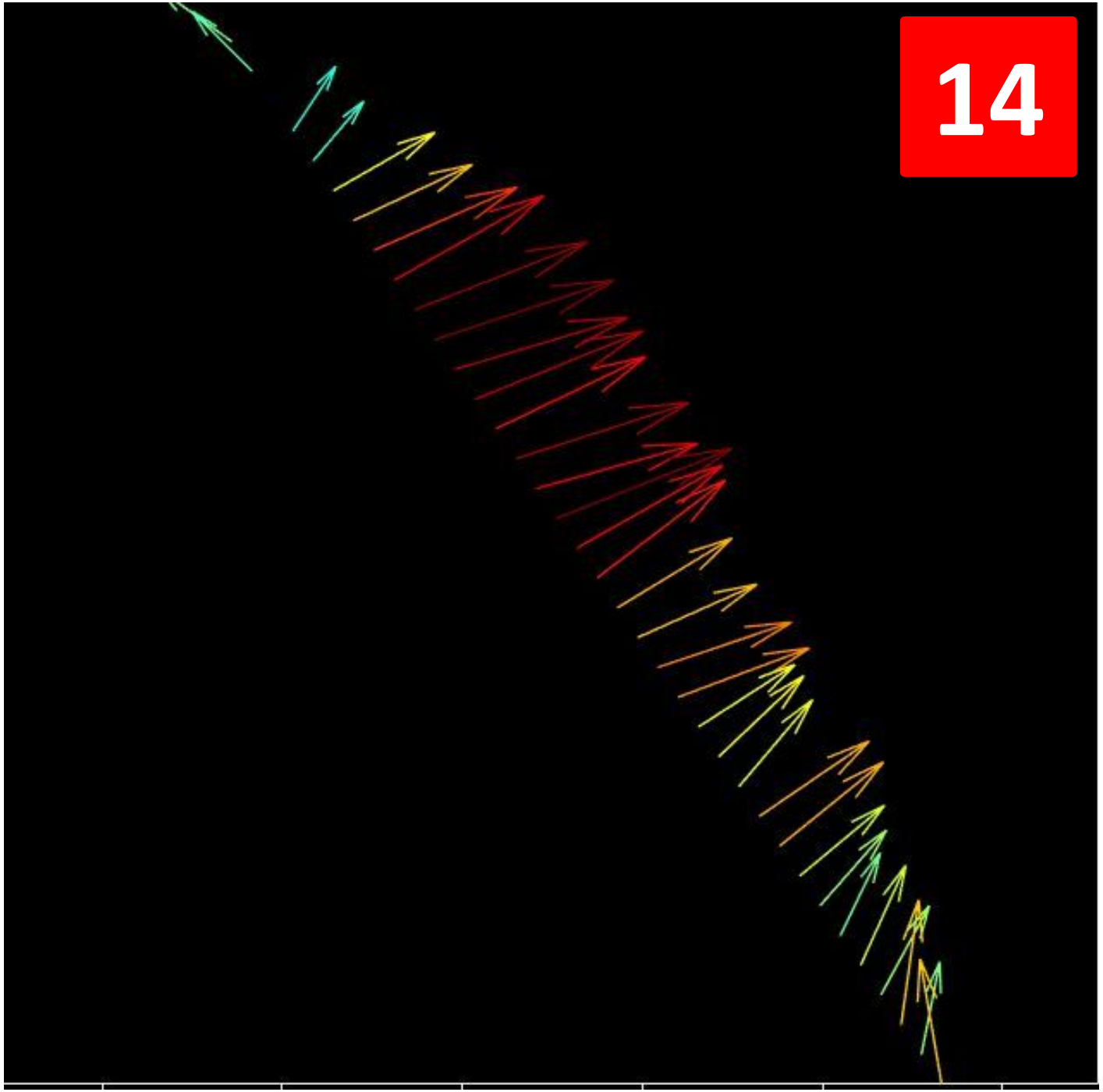
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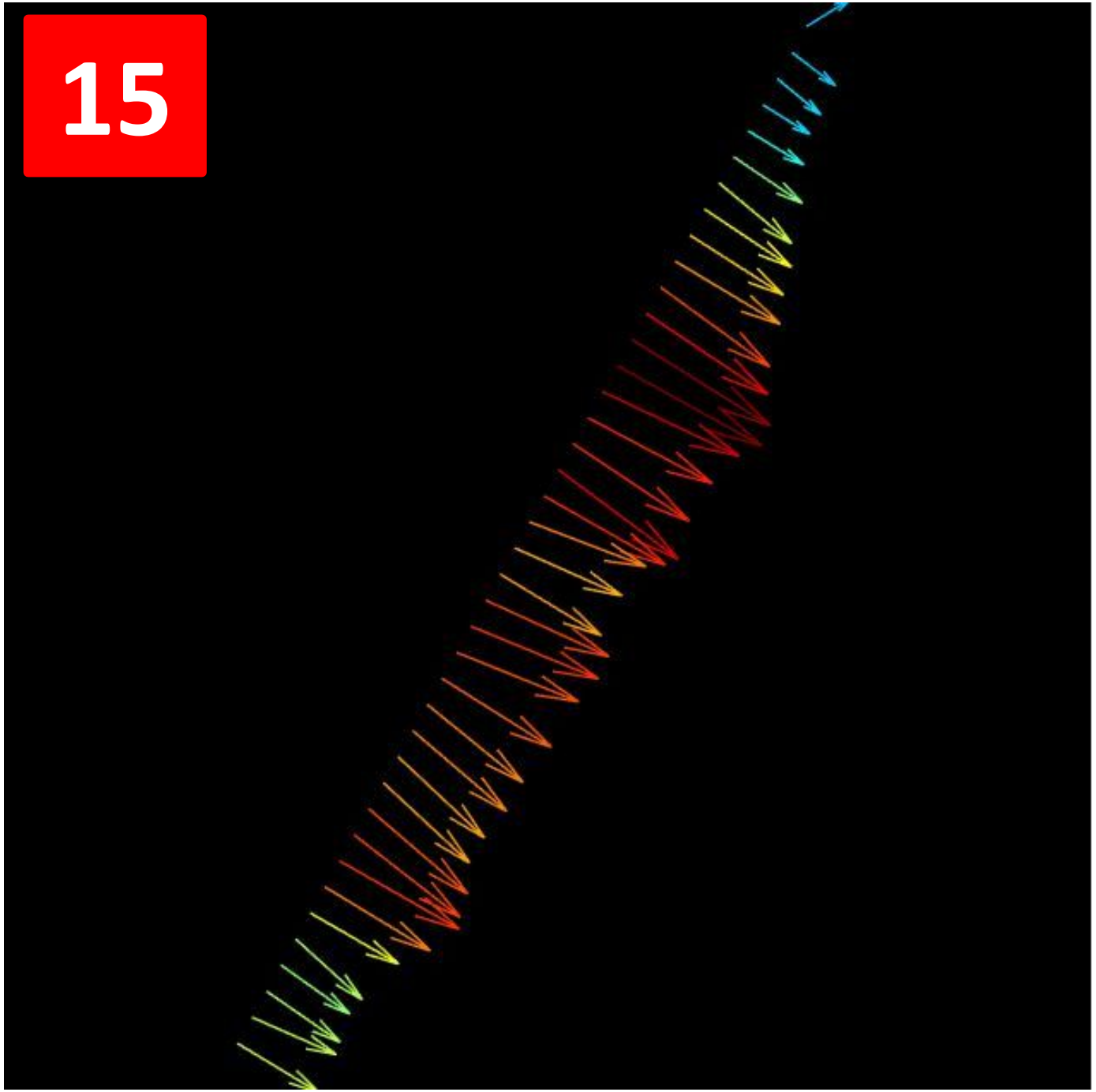

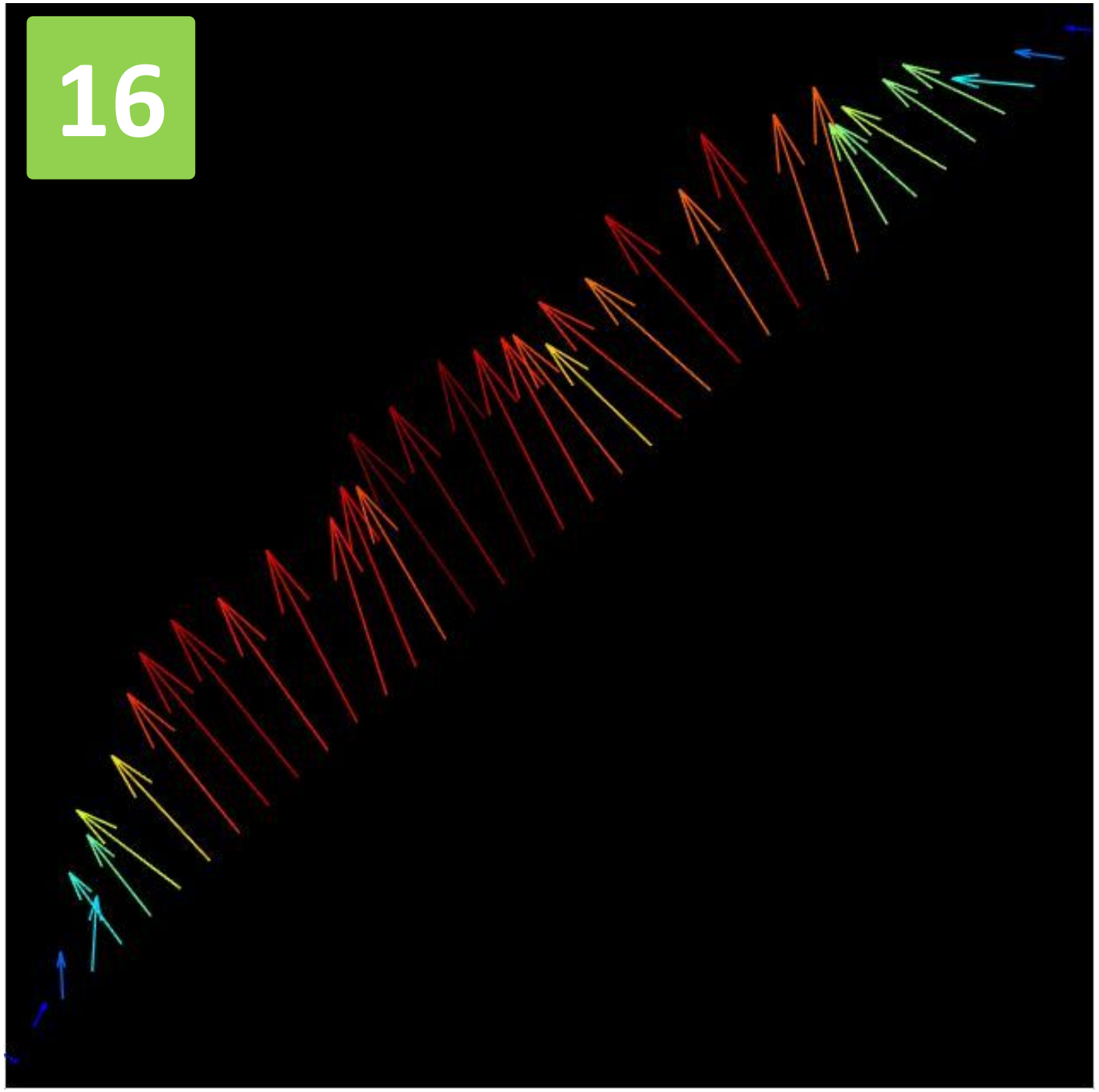
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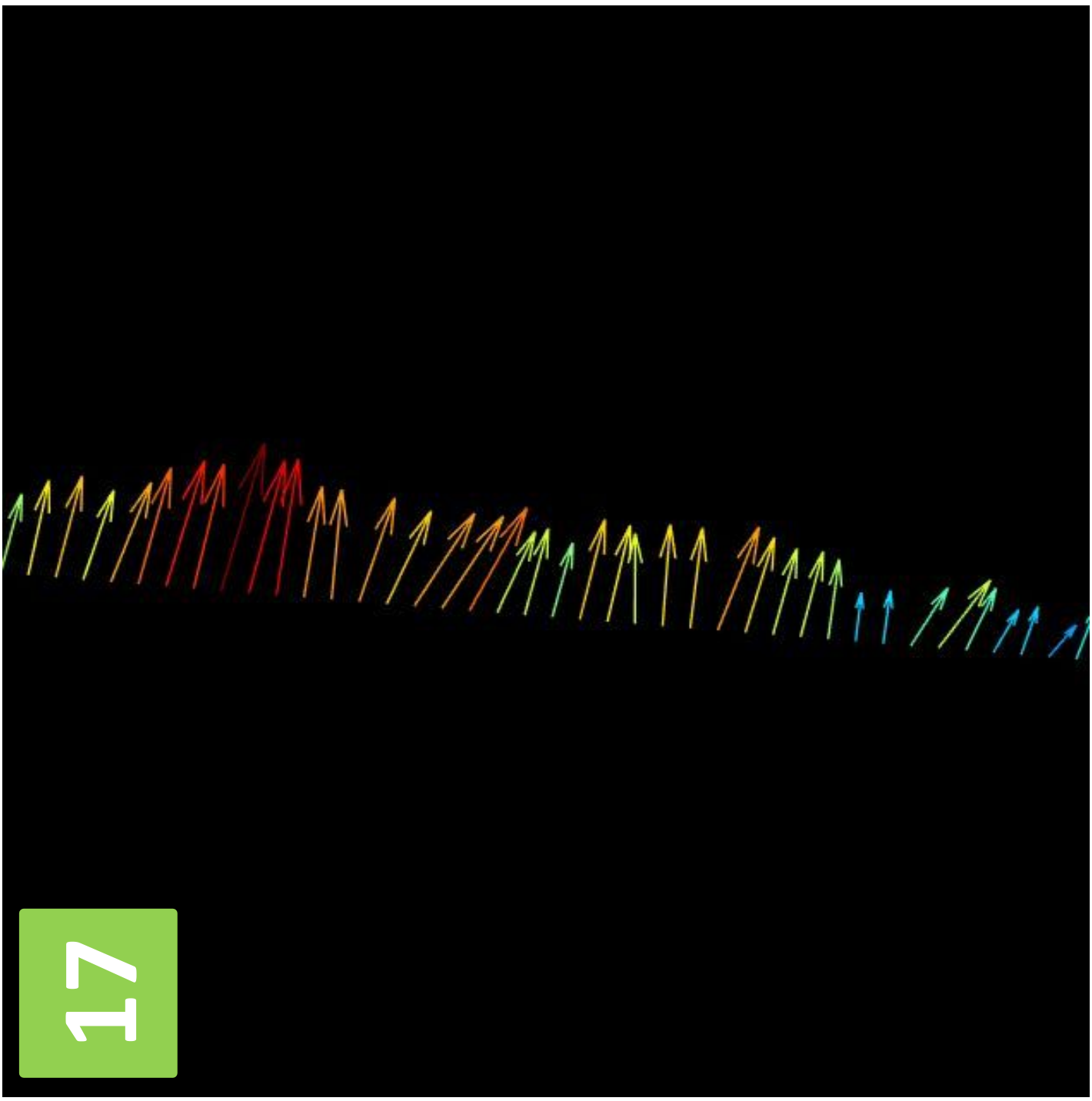

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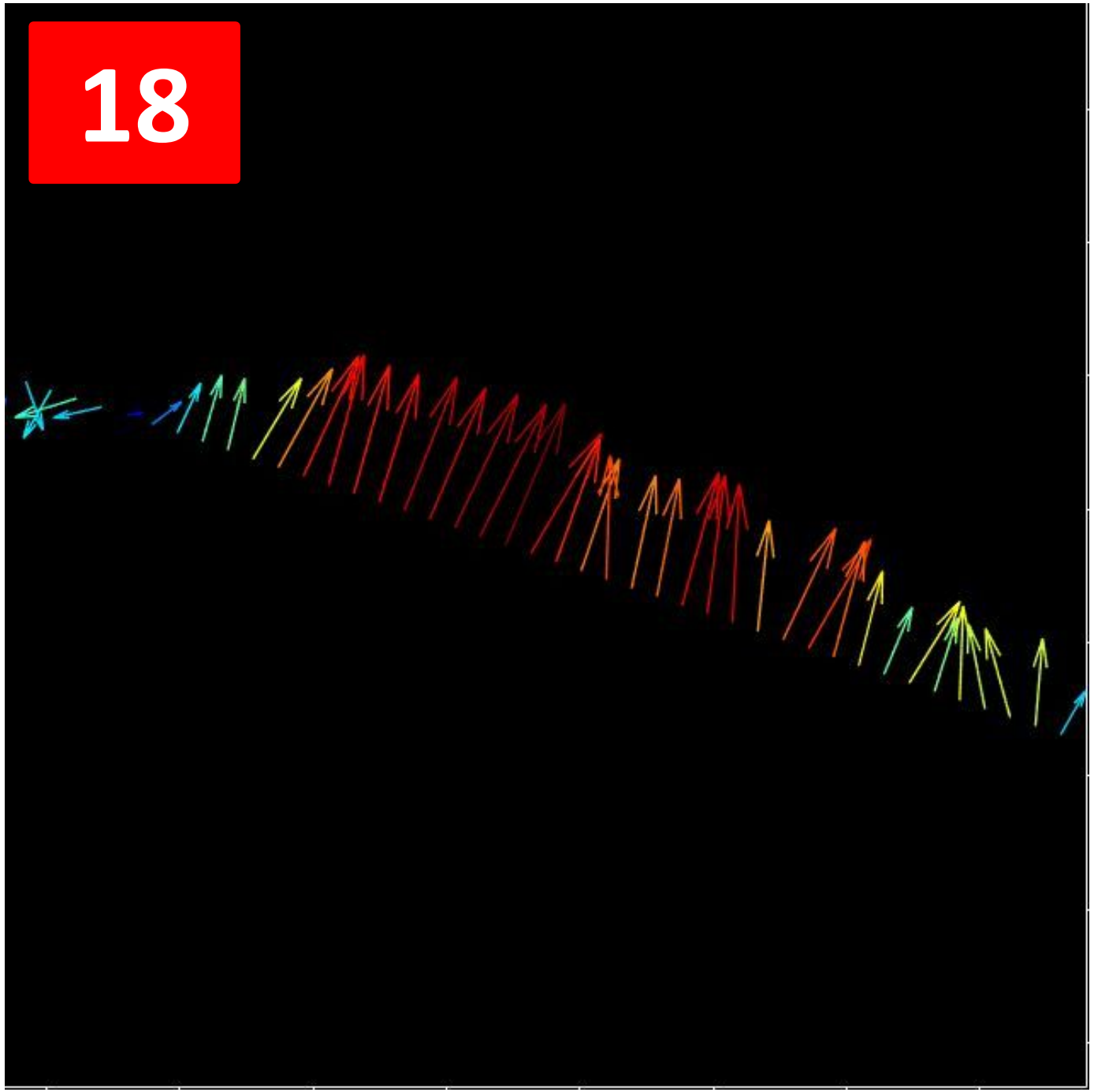


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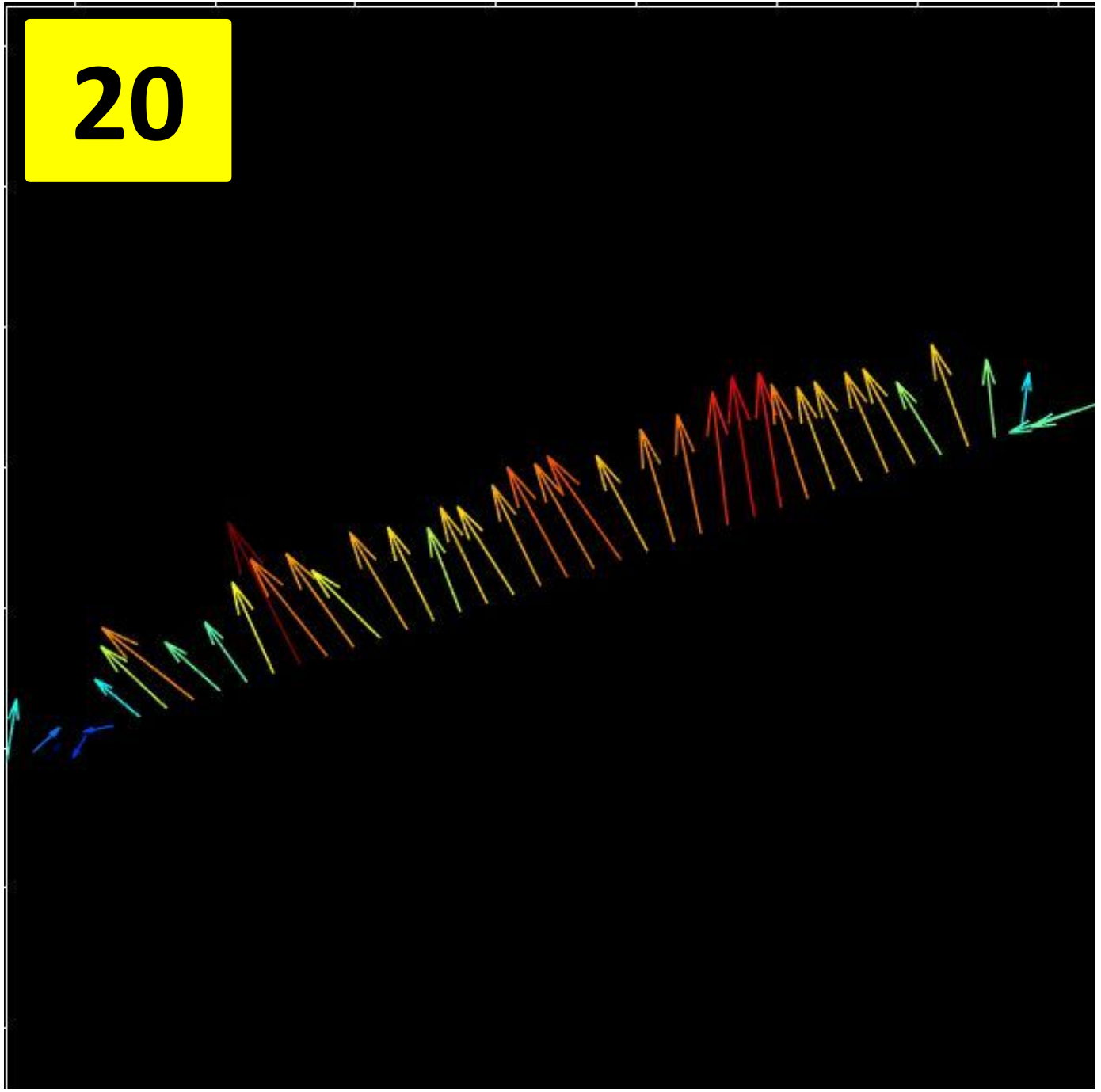
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Quiz – River Anatomy and Age of Rivers

Part 1: Match the following vocabulary terms with their definitions.

(A) Headwaters	(D) Deposition	(G) Cutbank	(J) Oxbow Lake
(B) Mouth	(E) Erosion	(H) Point Bar	
(C) Delta	(F) Meander	(I) Thalweg	

____ 1. A bend in the river

____ 2. Part of the river that no longer has a current and is cut off from the rest of the river, but is full of water

____ 3. A steep structure which forms on the outside of a meander - especially in erodible soils

____ 4. Fastest, deepest path of water in a river

____ 5. Start of a river

____ 6. Shallow area on the inside of a meander where sediment is deposited

____ 7. Landform created by deposition of sediment that is carried by a river as the flow leaves its mouth and enters slower or stagnant water

____ 8. Slower flowing water allows sediment to settle out of the water

____ 9. Action of surface processes that removes soil, rock, or dissolved material from one location and transports it to another location

____ 10. Part of a river where the river flows into another river, lake, reservoir, sea, or ocean

Part 2: Draw and label a young stream and a mature/old age stream below.

YOUNG STREAM: On your drawing, label the headwaters and mouth.

MATURE/OLD AGE STREAM: On your drawing, label the headwaters, mouth, cutbank, point bar, meander, erosion, deposition, delta, thalweg, and oxbow lake.

Quiz – River Anatomy and Age of Rivers (KEY)

Part 1: Match the following vocabulary terms with their definitions.

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(B) Mouth	(E) Erosion	(H) Point Bar	
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I 4. Fastest, deepest path of water in a river

A 5. Start of a river

H 6. Shallow area on the inside of a meander where sediment is deposited

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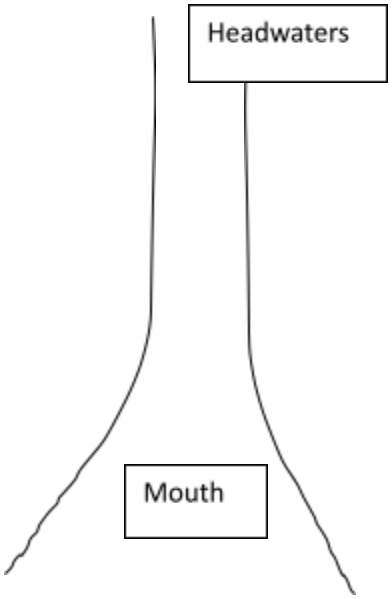
Part 2: Draw and label a young stream and a mature/old age stream below.

YOUNG STREAM: On your drawing, label the headwaters and mouth.



MATURE/OLD AGE STREAM: On your drawing, label the headwaters, mouth, cutbank, point bar, meander, erosion, deposition, delta, thalweg, and oxbow lake.