

Groundwater pumping by humans has tilted Earth's axis

19th June 2023



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Perhaps it's only geophysicists who are aware of the importance of underground reservoirs on maintaining Earth's balance. Geophysicist Ki-Weon Seo from Seoul National University has discovered that humans have extracted so much groundwater from under

our feet that they have changed the tilt of Earth's axis. This shift has been significant enough to physically relocate the geographic North Pole. The mass of polar ice is drifting by 4.36 centimetres a year. Professor Seo calculated that we extracted more than two trillion tons of groundwater between 1993 and 2010, causing Earth to wobble. Seo added that the pumping of groundwater has caused sea levels to rise by 6.24 millimetres.

Professor Seo explained how groundwater affects Earth's gravity. He said: "Every mass moving around on the surface of the Earth can change the rotation axis." Scientists have only recently discovered how groundwater can change Earth's axis. They previously believed water-driven shifts were caused by melting glaciers and ice caps. Seo and his colleagues were puzzled at how this could cause such a tilt. They concluded that the depletion of underground water was also a factor. Much of the extraction of groundwater is due to irrigation, especially in north-western India and western North America. Another researcher said: "The very way the planet wobbles is impacted by our activities."

Sources: [nature.com](https://www.nature.com) / [science.org](https://www.science.org) / [eurekalert.org](https://www.eurekalert.org)

Writing

There should be limits on the amount of water we use. Discuss.

Chat

Talk about these words from the article.

geophysicist / underground / reservoir / humans / tilt / North Pole / wobble / sea level / gravity / surface / rotation / axis / glaciers / ice caps / factor / irrigation / the planet

True / False

- 1) Everyone knows the importance of underground reservoirs. T / F
- 2) Underground reservoirs affect the balance of Earth. T / F
- 3) The pumping of groundwater is moving the North Pole. T / F
- 4) The pumping of groundwater has made sea levels rise. T / F
- 5) The article says groundwater has no effect on gravity. T / F
- 6) Scientists knew groundwater affected Earth's axis centuries ago. T / F
- 7) Most groundwater pumped out of the ground is for irrigation. T / F
- 8) The article says human activity makes Earth wobble. T / F

Synonym Match

(The words in **bold** are from the news article.)

- | | |
|-----------------------|-----------------|
| 1. aware | a. using up |
| 2. importance | b. taken out |
| 3. discovered | c. turning |
| 4. relocate | d. significance |
| 5. extracted | e. actions |
| 6. affects | f. move |
| 7. rotation | g. conscious |
| 8. puzzled | h. influences |
| 9. depletion | i. confused |
| 10. activities | j. found |

Discussion – Student A

- a) What do you think about what you read?
- b) What do you know about gravity?
- c) How much do you worry about melting glaciers and ice caps?
- d) What can farms do if they do not have enough water?
- e) What does it matter if the world wobbles more?
- f) What three adjectives best describe this story?
- g) What are we doing to impact Earth?
- h) What questions would you like to ask the geophysicists?

Phrase Match

- | | |
|--|--------------------------------|
| 1. Perhaps it's only geophysicists | a. Earth's gravity |
| 2. they have changed the tilt | b. of underground water |
| 3. The mass of polar ice | c. sea levels to rise |
| 4. we extracted | d. were puzzled |
| 5. pumping of groundwater has caused | e. is drifting |
| 6. how groundwater affects | f. impacted by our activities |
| 7. caused by melting glaciers | g. more than two trillion tons |
| 8. Seo and his colleagues | h. and ice caps |
| 9. the depletion | i. of Earth's axis |
| 10. The very way the planet wobbles is | j. who are aware |

Discussion – Student B

- What do you know about groundwater?
- What do you know about Earth's balance?
- What do you know about geophysics?
- How important is it that Earth tilts at the correct angle?
- What do you know about the North Pole?
- What does it matter if the North Pole is drifting?
- Should we stop using so much groundwater?
- How can we conserve water?

Spelling

- it's only hietpcsygsosi who are aware
- underground eorrrevssi
- humans have extadctre so much groundwater
- significant enough to phslcyaliy relocate
- Seo ctcleluaad that
- causing Earth to eowblb
- groundwater affects Earth's igarytv
- on the acfusre of the Earth
- change the toiatron axis
- his cgelseualo were puzzled
- the itdenelop of underground water
- due to oniraitgri

Answers – Synonym Match

1. g	2. d	3. j	4. f	5. b
6. h	7. c	8. i	9. a	10. e

Role Play

Role A – Watering Flowers

You think watering flowers is the most important use of water. Tell the others three reasons why. Tell them what is wrong with their uses. Also, tell the others which is the least important of these (and why): washing the car, aquariums or water parks.

Role B – Washing the Car

You think washing the car is the most important use of water. Tell the others three reasons why. Tell them what is wrong with their uses. Also, tell the others which is the least important of these (and why): watering flowers, aquariums or water parks.

Role C – Aquariums

You think aquariums is the most important use of water. Tell the others three reasons why. Tell them what is wrong with their uses. Also, tell the others which is the least important of these (and why): washing the car, watering flowers or water parks.

Role D – Water Parks

You think water parks is the most important use of water. Tell the others three reasons why. Tell them what is wrong with their uses. Also, tell the others which is the least important of these (and why): washing the car, aquariums or watering flowers.

Speaking – Water Uses

Rank these with your partner. Put the most important at the top. Change partners often and share your rankings.

- | | |
|-------------------------|--------------------|
| • Fountains | • Washing dishes |
| • Aquariums | • Watering flowers |
| • Watering golf courses | • Taking a bath |
| • Water parks | • Washing the car |

Answers – True False

1	F	2	T	3	T	4	T	5	F	6	F	7	T	8	T
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Answers to Phrase Match and Spelling are in the text.