



As you come in:

- Choose a table to sit at
- Put your name on a name tent
- Start chatting!

Physics of Weather and Climate

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Tentative Schedule

Week 1: Why do I always ride my bike into the wind?

Week 2: Why do clouds stay up in the air?

Week 3: How does the earth keep warm, and why is it getting warmer?

Week 4: What can we do about climate change?

Week 5: **If you can't predict the weather, how can you predict the climate?**

Week 6: Why are there rainforests on the equator?

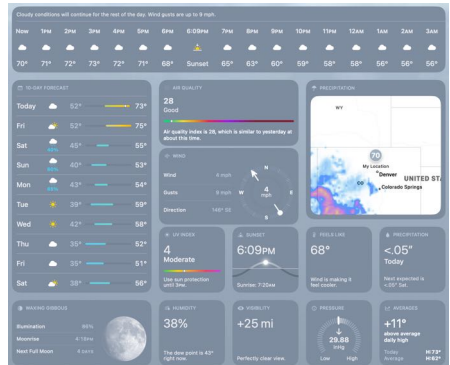
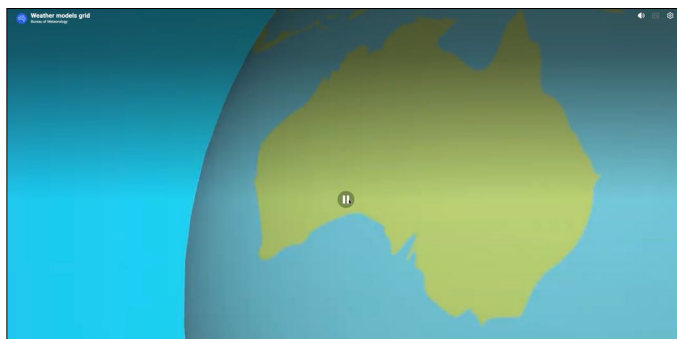
Week 7: What is weather like on other planets?

If you can't predict the weather, how can you predict the climate?



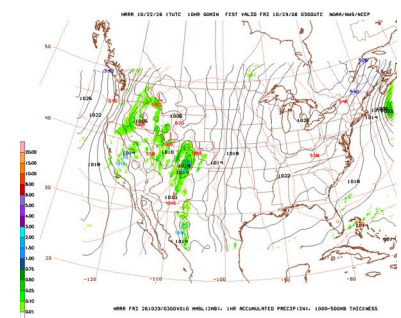
Question:

How Do People Predict the Weather?

Weather Models Use Physics — From media.bom.gov.au

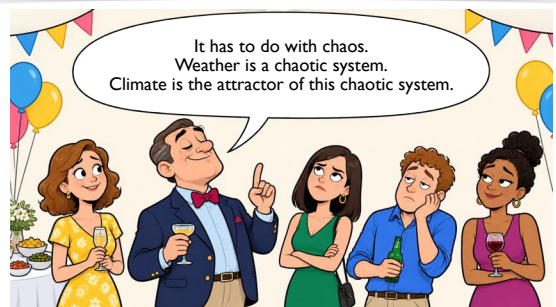
Scientists Use These Calculations to Make Weather Predictions



Here's the Thing....

Forecast range	How much weight to give it
Next 5 days	A reasonably strong basis for planning, while continuing to check updates. NOAA gives roughly 90% accuracy at five days.
Days 6–7	Useful advance notice, but keep plans flexible. NOAA gives roughly 80% accuracy at seven days.
Days 8–10	Treat the daily details as an early possibility, rather than a commitment. NOAA says forecasts at 10 days or beyond are right only about half the time.

If you want to sound like a know-it-all:



Let's Start with a Discussion

What is the difference between weather and climate?

Give a simple, straightforward explanation.

Or, if your group tends toward the poetic, please come up with an analogy.

Example:

Romantic love is like a flowering vine—full of color, reaching toward someone, and needing support. Friendship is like a shade tree—a comfortable place to sit, talk, and simply be yourself.

Basic Principles

Fractals

Chaos

Models

Statistics

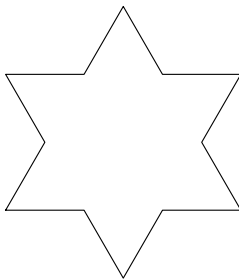
Fractals

A geometric notion that we'll return to.

How long is the coastline of Britain?

Koch Snowflake — Step 1

12 segments. Measure the total perimeter.

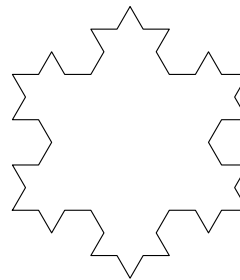


Measurement

What is the perimeter of this shape?

Koch Snowflake — Step 2

48 segments. Measure the total perimeter.

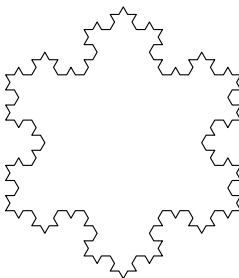


Measurement

What is the perimeter of this shape?

Koch Snowflake — Step 3

192 segments. Measure the total perimeter.

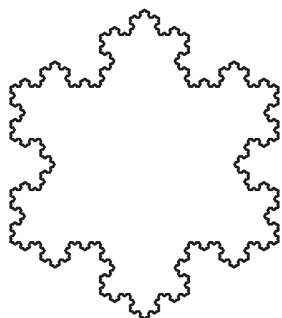


Measurement

What is the perimeter of this shape?

Discussion

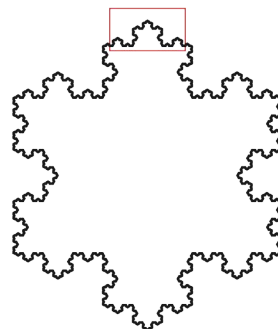
What is the perimeter of this shape?



Strange, but True...

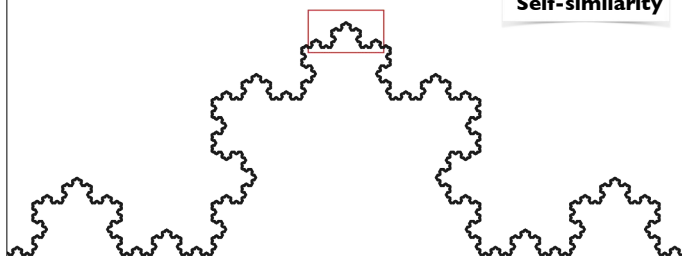
The perimeter has infinite length, even though the size of the snowflake is finite.

1×



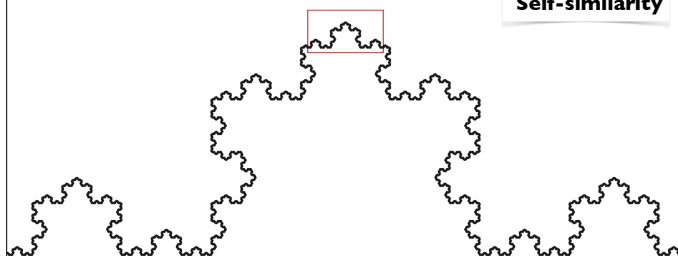
A property of fractals:
Self-similarity

9×



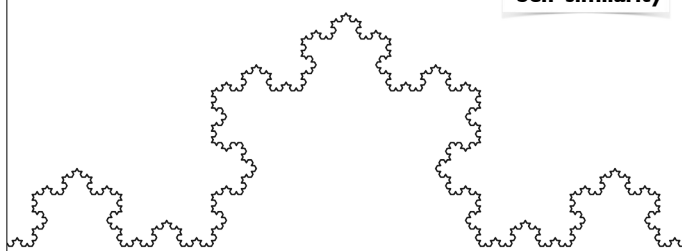
A property of fractals:
Self-similarity

81×



A property of fractals:
Self-similarity

729×



A property of fractals:
Self-similarity

Clouds are fractals.



What is the surface area of this cloud?



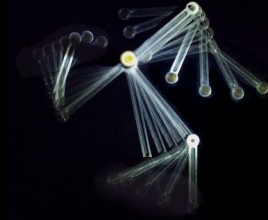
Fractal structures are produced by chaotic dynamics.



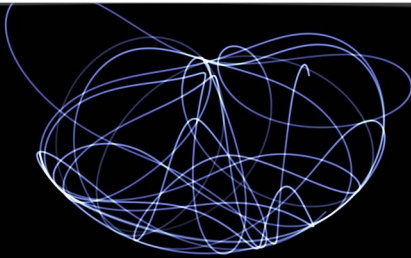
- They have extreme sensitivity to initial conditions.
- You can't predict in detail what is happening at any specific time, but broad trends are clear.



Two linked pendulums gives motion that is chaotic.



Two linked pendulums gives motion that is chaotic.

[illegible]

Trials 5, 10, and 70 are in red.



- Set the feedback parameter to 3.6.
- Now, use the slider to change the starting value.
- Suppose the vertical axis represents the temperature. How would you describe the “climate” for this situation?

