

General Relativity Animations

Gravity is Global

By Mark Egdall 6/15/ 09
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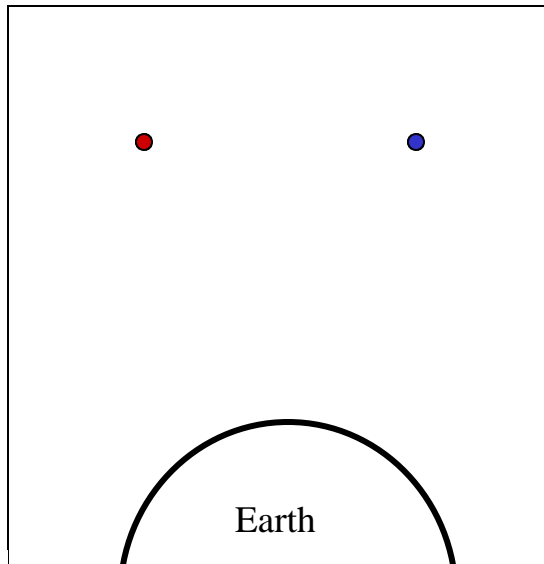
Animation on Gravity is Global:

- There is no way to tell whether a *single* point is A) in *free-fall* above the Earth, or B) *floating* far away in outer space at zero gravity.
- But *two* points sufficiently separated do indicate the presence of gravity:
 - They converge tangentially and diverge radially over time if falling to the Earth.
 - If they were in outer space with no gravity, they would remain the *same* distance apart.

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- **This “tidal acceleration” indicates the presence of a gravitational field. (The Earth's tides are similarly affected by the Moon’s gravity.)**

Evidence that Gravity is “Global”*



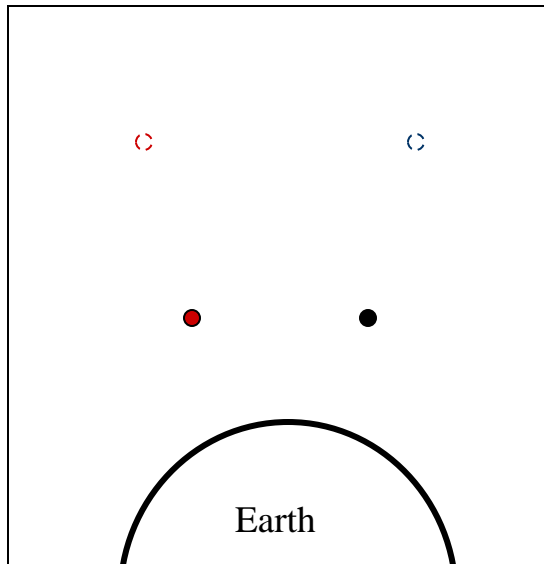
Tangentially separated objects

- fall towards the center of gravity

→ they become closer and closer

* Based on p. 317, *Einstein's Theory of Relativity*, Born

Evidence that Gravity is “Global”*



Tangentially separated objects

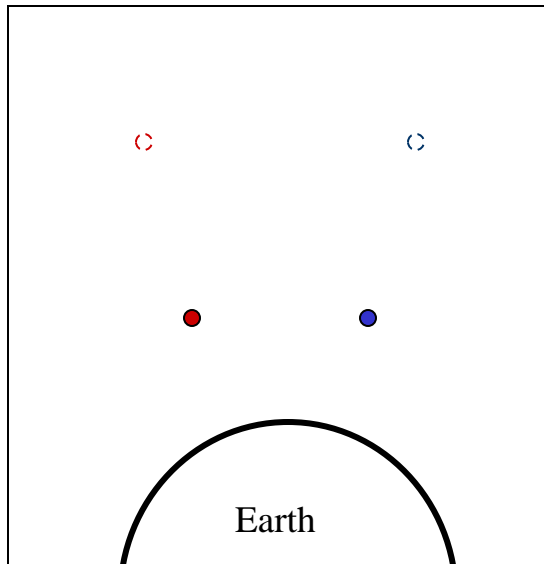
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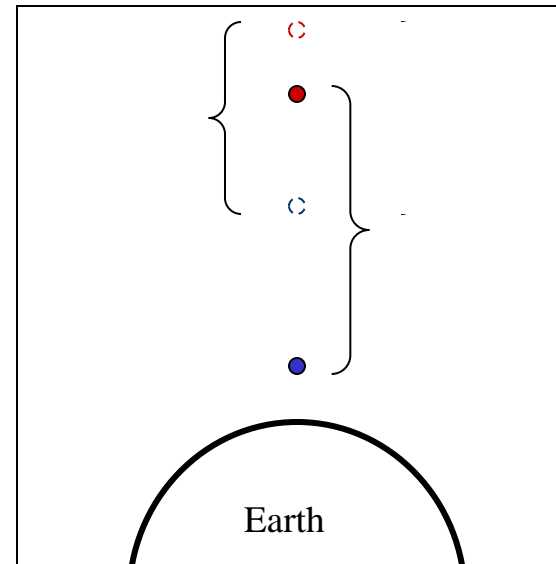


Evidence that Gravity is “Global”*



Tangentially separated objects

- fall towards the center of gravity
- they become closer and closer



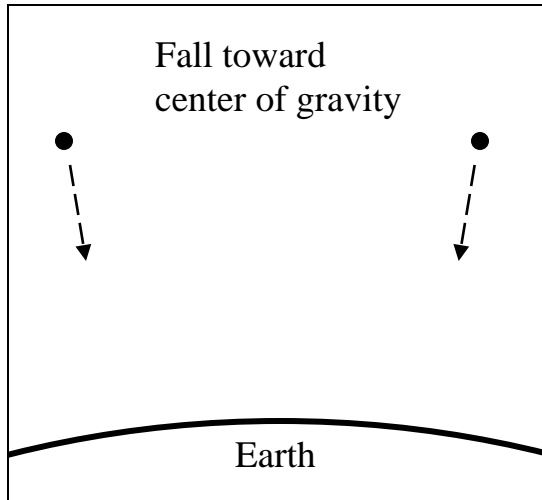
Radically separated objects

- fall at different rates due to strength of gravity
- they become further apart

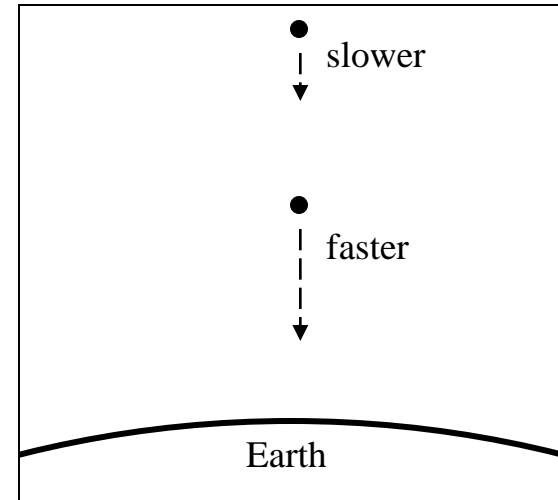
Not to Scale

* Based on p. 317, *Einstein's Theory of Relativity*, Born

Evidence that Gravity is “Global”*



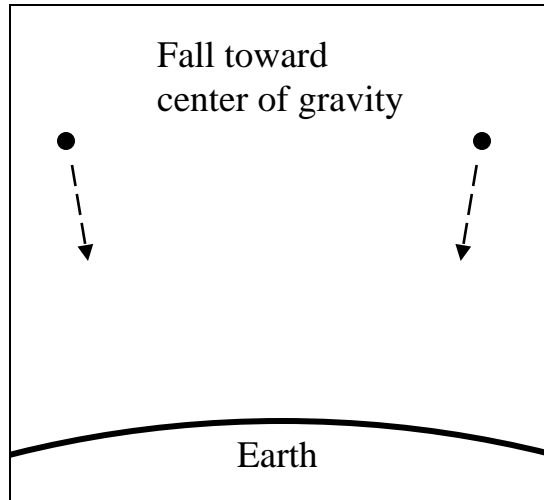
Tangentially separated objects fall towards the center of gravity, so they become closer and closer



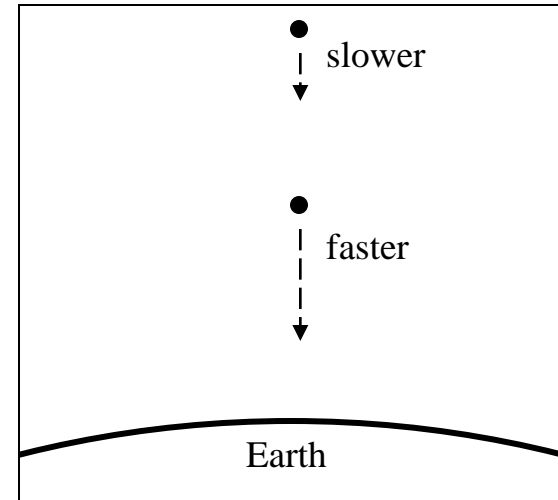
Radically separated objects fall at different rates due to strength of gravity (it's stronger closer to the Earth), so they become further and further apart

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Evidence that Gravity is “Global”*



Tangentially separated objects fall towards the center of gravity, so they become closer and closer



Radically separated objects fall at different rates due to strength of gravity, so they become further and further apart

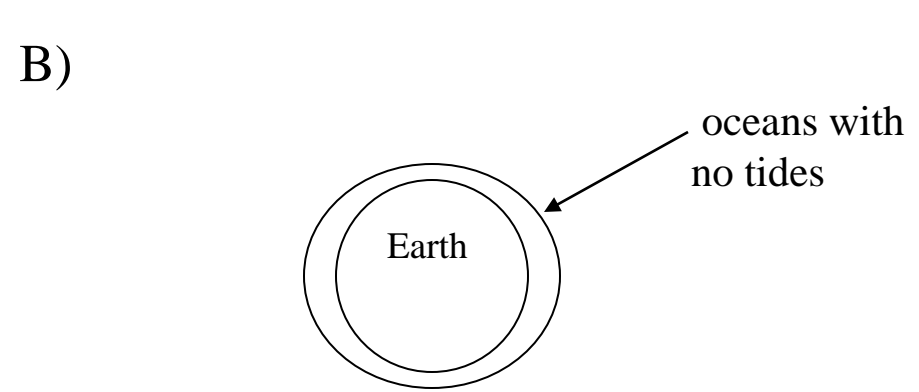
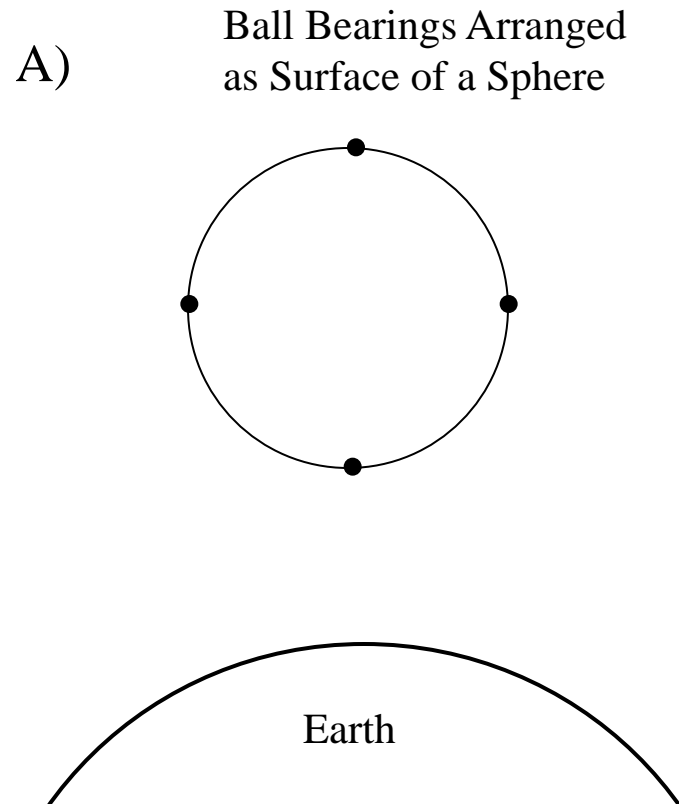
We can always annul these “global” effects of gravity by choosing a small enough “local” spacetime ,

e.g. short enough time and small enough space

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Tidal Acceleration due to Gravity

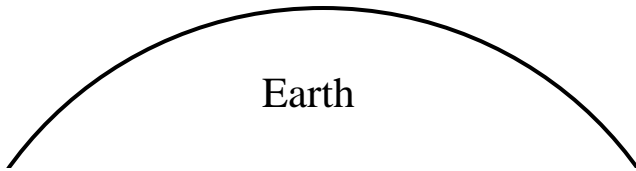
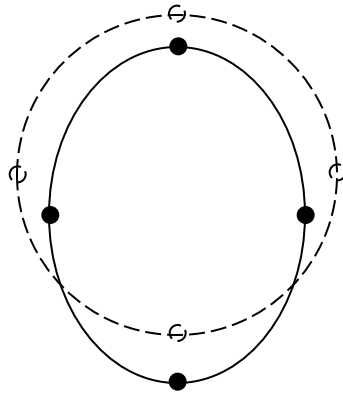




Tidal Acceleration

A)

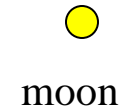
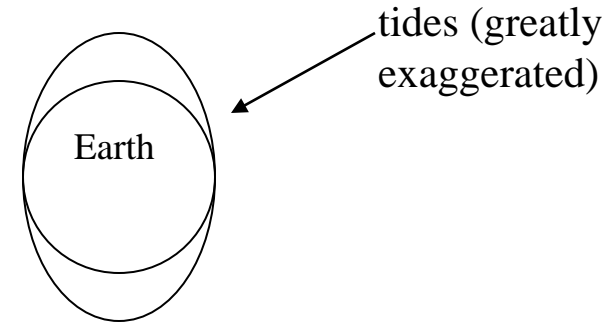
Becomes ellipsoid



Earth's gravity causes sphere to become ellipsoid

not to scale

B)



Moon's gravity causes ocean tides on earth

not to scale

End of Animation