“Astronaut Training” with Rideable Hoverboards: An Educational & Memorable Activity For All Ages

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The case for rideable hoverboards

- Kinesthetic, engaging, educational
- Suitable for all ages
- Useful in many contexts
  - Physics curricular
    - Newton’s Laws of Motion (six of them!), and more
  - Space connections
    - “Astronaut training,” spacecraft control, and more
  - Outreach

Take-away: Every Space Grant (& physics teacher) (& ...) could benefit from having a couple rideable hoverboards.
Rideable Hoverboard parts

- 4-foot diameter hoverboard, with skirt and bumper
- Note – for some demonstrations you will want **TWO**
- Air source (leaf blower or shop-vac (with extension cord))
- Seat (optional, but strongly recommended – no standing!)

My favorite accessories

- Bungee cords (on meter sticks)
- Push/pull rod (8-foot 1-inch diameter pvc pipe)
- Torque ladder/bar (with socket wrench or vise grips)
- Spinning bicycle wheel (gyroscope)
- CO₂ fire extinguisher (modified to be a thruster)
An expensive but robust commercial solution: Pasco.com (board & blower only)
I much-prefer a plug-in blower, like a wet-dry shop vac – just make sure it has a “blow” mode. Here is one from Home Depot.
For about half the cost of one hoverboard from Pasco, you can make two home-built hoverboards and two seats (and also buy two blowers!), if you have the time.
Some Lesson/Demonstration Ideas

- Differences to expect when in outer space / Earth orbit
  - Misconception: “No gravity in outer space.” It is free-fall!
- Ways astronauts prepare to live and work in outer space
  - Hovercraft can simulate no-friction aspect of free-fall
- Newton’s Laws of Motions (3 “standard” & 3 “rotation”)
- Astronaut applications
  - Torque about a vertical axis (building in space)
  - Spinning wheel for steering (orientation/attitude control)
  - CO₂ “cold gas” rocket thruster (propulsion)
- Astronaut challenges like “go repair something over there”

Some demonstration videos posted at http://www.aem.umn.edu/people/faculty/flaten/MnSGC_video_clips_hoverboards/
Challenges

- Requires a hard floor (not carpet!) and some open space
- Noisy (might disturb people in nearby classrooms)
- Almost too popular (avoid battery-powered air source)
- $\text{CO}_2$ fire extinguisher (modified, consumable expense)

Safety

- Slippery (hold while mounting/dismounting; sit down)
- Need tenders (don’t over-run cord, start/stop gently)
- Spinning wheel: practice, don’t touch skin, hair, jewelry
- $\text{CO}_2$ thruster: practice, short bursts, stay clear of exhaust
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