

Franklin Jr./Sr High School Reading Article

How the Most Promising Hoverboards Actually work

Reading Strategy for the Article: Students will take turns reading aloud. Mark the text and write in the margins

Video Link <http://www.wired.com/2015/10/how-the-most-promising-hoverboards-actually-work/> (890L)

Instructions: COMPLETE ALL QUESTIONS AND WRITE NOTES in the margin box. This requires reading of the article more than once.

Step 1: Skim the article using these symbols as you read:

(+) agree, (-) disagree, (*) important, (!) surprising, (?) wondering

Step 2: Number the paragraphs. **Read** the article **carefully** and **make notes in the margin**.

Notes should include:

- Comments that show that you **understand** the article. A summary or statement of the main idea of important sections may serve this purpose.
- Questions you have that show what you are **wondering** about as you read
- Notes that differentiate between **fact** and **opinion**.
- Observations about how the **writer's strategies** (organization, word choice, perspective, support) and choices affect the article.

Step 3: A final quick read noting anything you may have missed during the first two reads.

Your margin notes will be assessed by your teacher along with your answers to the questions.

How the Most Promising Hoverboards Actually Work

I'm not sure why everyone is obsessed with hoverboards, but they are. Perhaps we could just blame Back to the Future II and the scene where Marty McFly used one. Personally, I am still just waiting for my flying car. In case you haven't been paying attention, there are three different working hoverboards that actually exist. Here is a review of the physics of these three different boards.

Omni Hoverboard: I think this is the model that is the most like what we would expect of a hoverboard. It's basically just a small helicopter, except you stand on top of the rotors instead of sitting underneath them.

How does it work? For all hoverboards, you need some upward force to push against the gravitational force. For the Omni hoverboard, this upward force is from the air. The props push air downward resulting in an upward force on the rotors. Here is a more complete explanation along with some calculations.

Why is it awesome? Just like a helicopter, you can move both up and down as well as side to side. If you don't think this flies like a hoverboard, I don't think you will find anything better. Also, as you can see in the video above, the Omni hoverboard can fly over water or land. It doesn't really matter what is below it.

Where does it fall short? The Omni hoverboard has two major flaws. First is the flight time. Since this is essentially like an electric powered quadcopter, it needs a battery. Batteries are heavy, so you can only power the propellers for a couple of minutes of flight time. Second, this thing looks super dangerous. What if you crash into a pedestrian standing on the ground? Would it kill that human or just seriously injure them?

Notes on my thoughts, reactions and questions as I read.

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Hendo Hoverboard: The Hendo hoverboard came out some time last year. It might not be just like the one in Back to the Future II, but at least Tony Hawk rode it. Also, it seems Hawk is helping with the next version of the hoverboard.

How does it work? The Hendo engine uses electromagnets that produce changing magnetic fields to interact with a conducting surface. Basically when these electromagnets change the magnetic field that produces an electric current in the metallic surface underneath the hoverboard. This electric current then produces its own magnetic field to repel the hoverboard electromagnets. Although the idea seems straightforward, it's difficult to get it to work in real life.

Why is it awesome? It's clearly a skateboard that hovers. That's pretty awesome.

Where does it fall short? The primary problem with this hoverboard is that it only hovers over a conducting surface. If you put this over water, the electromagnets would still make changing magnetic fields but without an electric conductor below it there would be no repulsion. The other small problem is that it doesn't ride like a skateboard. Hopefully this can change with the help of Tony Hawk.

The Lexus Hoverboard: Yes, it's true. Lexus made a hoverboard. It really works too. I'm still not sure why they did it.

How does it work? Again, this hoverboard uses magnetic fields. Instead of changing magnetic fields from an electromagnet, the Lexus hoverboard uses superconductors. When a superconductor is placed near a magnet, you can get a levitation effect. That's essentially what happens here. The magnets are in the ground and the superconductor is inside the board.

Why is it awesome? This board is awesome because it's much smaller than either the Hendo or the Omni hoverboard (at least for now). It looks the most like a skateboard that also hovers.

Where does it fall short? Just like the Hendo, this board also requires a special

Where does it fall short? Just like the Hendo, this board also requires a special surface to ride it on. It doesn't work over water or any other surface that doesn't already have magnets embedded in the ground. Another drawback is the superconducting magnets. Superconductors need to be very cold in order to have the levitating properties. This means that you need to add something like liquid nitrogen (-320°F or 77K) to keep them cold. You can see the water vapor condensing in the air from the very cold magnets. That gives a cool look but you would have to keep adding liquid nitrogen as you ride.

I guess we are still waiting for the perfect hoverboard.

Visit this site to see the hoverboards in action:

<http://www.wired.com/2015/10/how-the-most-promising-hoverboards-actually-work/>

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Comprehension questions – answers may be in phrases.

1. What does Lexus manufacture aside from hoverboards?
2. What part of the Omni hoverboard would appear to cause danger to those around it?
3. Define the phrase **levitate** as used in the article.
4. What is the Fahrenheit temperature of liquid nitrogen, and what does liquid nitrogen have to do with hoverboards?
5. Define **rotors** as used in the text.

Answer the following questions in one or more complete sentences.

1. Who is Tony Hawk, and why would a hoverboard manufacturer want him involved in the process?
2. What surface types will each of the hoverboards work on?
3. Watch a piece of each of the three videos. Provide a short visual description of each hoverboard.

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4. This *Wired* article is written from a from a **first person perspective**. As a result of the author's style, the article is full of both factual information and opinions. Using the chart, cite 6 facts and 6 opinions found in the text. Provide reasoning for placement in each category.

FACT

OPINION

5. Based on the information presented in the text, are any of the prototypes ready for sale? Are hoverboards a means of future transportation or simple a passing fad? Cite evidence from the text to support your claim. Answer in a well-developed paragraph. Include at least two sentences addressing the counter claim.