

As of **March 2026**, we have confirmed over **6,100 exoplanets**, and the field is moving faster than ever thanks to the James Webb Space Telescope (JWST).

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## Unit 11 – Exoplanets: The Search for New Worlds

**Duration:** 60 Minutes

### 1. Introduction: The "Second Copernican Revolution" (10 Minutes)

- **The Hook:** Start with a "then vs. now" comparison.
  - **Then:** Until the early 1990s, we only knew of the planets in our own solar system.
  - **Now:** We know of over **6,128 confirmed worlds** (as of late Feb 2026).
- **Definition:** What is an exoplanet? Simply put, any planet orbiting a star other than our Sun.

### 2. How Do We Find Them? (15 Minutes)

- **The Problem:** Planets are tiny and dim compared to their stars. It's like trying to see a firefly hovering next to a lighthouse from miles away.
- **The Solutions:**
  - **The Transit Method:** Explain how we watch for a star to "dim" slightly as a planet passes in front (like a mini-eclipse).
  - **The Wobble (Radial Velocity):** Explain how a planet's gravity tugs on its star, making the star "wobble" back and forth.
  - **Direct visualization**

### 3. A Tour of Exotic Worlds (15 Minutes)

- **Variety is the Spice of Space:** We used to think all solar systems looked like ours. We were wrong.
- **Highlight Real Discoveries:**
  - **"Hot Jupiters":** Massive gas giants that orbit so close to their stars that their "year" lasts only a few days.
  - **TRAPPIST-1:** A system with **seven Earth-sized rocky planets** orbiting a tiny, cool red star.
  - **Rogue Planets:** Worlds with no "home" star, drifting alone in the dark.
- **The Latest (2026 Update):** Mention the recent discovery of **HD 137010 b**, a "Cold Earth" candidate that is Earth-sized but potentially frozen like Mars.

## 4. The "Goldilocks Zone" and the Search for Life (10 Minutes)

- **Habitable Zone:** Explain the distance from a star where it's not too hot and not too cold for liquid water.
  - **Atmosphere Detectives:** How JWST is now "sniffing" the air of these planets to look for oxygen, methane, or carbon dioxide.
  - **The Perspective:** Even if a planet is "Earth-like," it doesn't mean it has life—but the odds are getting better.
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### Suggested Handouts / Visuals

- **A "Light Curve" Diagram:** To show how the Transit Method works visually.
- **The Solar System vs. TRAPPIST-1 Comparison:** To show how compact other systems can be.
- **Current Stats:** A small card with the "Total Confirmed" count to show the scale of current progress.

[The NASA Exoplanet Archive](#) This video provides a tour of the NASA Exoplanet Archive, which is a great tool for students to see the real-time data and tools used by scientists to catalog these thousands of worlds.

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## Student Handout: The Exoplanet Cheat Sheet

*Perfect for distribution at the start of class.*

Term	Simple Definition
<b>Exoplanet</b>	A planet orbiting a star other than our Sun.
<b>Light Year</b>	The distance light travels in a year ( 6 trillion miles).
<b>Transit</b>	When a planet passes in front of its star, causing a "dip" in light.
<b>Goldilocks Zone</b>	The "just right" distance from a star where liquid water can exist.
<b>Biosignature</b>	Gases (like Oxygen + Methane) that suggest life might be present.

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# Deep Dive: How the JWST "Sniffs" Air (5 Minutes)

*Seniors often ask: "If we can't see the planet, how do we know what's in the air?"*

Explain it using the **Stained Glass Window** analogy:

1. **The Star** is a giant flashlight.
  2. **The Planet's Atmosphere** is like a piece of stained glass.
  3. As the planet passes in front of the star, the "flashlight" shines through the "glass."
  4. By looking at which colors of light are blocked, scientists can identify specific chemicals. For example, water vapor blocks specific "colors" of infrared light that we can't see with our eyes, but the James Webb Space Telescope can.
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# 5 Stars You Can See Tonight (That Have Planets)

## 1. Pollux (The "Twin" in Gemini)

- **Where to find it:** Look almost straight overhead after sunset. Pollux is one of the two bright "heads" of the Gemini twins (the other is Castor).
- **The Planet: Pollux b** (also named *Thestias*).
- **The Fact:** This was the first planet discovered around a star visible to the naked eye. It's a giant gas planet, about twice the mass of Jupiter.
- **Talk Track:** "When you look at the orange-tinted twin tonight, remember there is a giant world swinging around it every 590 days."

## 2. Aldebaran (The "Eye of the Bull" in Taurus)

- **Where to find it:** High in the west. It is a distinct, bright reddish-orange star in the V-shaped cluster (the Hyades) that forms the face of Taurus the Bull.
- **The Planet: Aldebaran b.**
- **The Fact:** Aldebaran is a "Red Giant" star. Its planet is a massive gas giant. Because the star is so huge, its planet has a very wide orbit to stay safe.
- **Talk Track:** "That red eye of the bull isn't just a star; it's a solar system. Its planet is over 6 times the mass of Jupiter!"

## 3. Regulus (The "Heart of the Lion" in Leo)

- **Where to find it:** Look to the East/Southeast. It's at the bottom of the "Backward Question Mark" pattern that makes up the head of Leo.
- **The Planet: Regulus d.**
- **The Fact:** Regulus is a very fast spinner—it rotates so fast it's shaped like an egg!
- **March 2026 Special:** On **March 29, 2026**, the Moon will pass very close to Regulus, making it extremely easy for your students to identify.

## 4. Tau Ceti (The "Nearby Neighbor" in Cetus)

- **Where to find it:** Lower in the Southwest sky in early March.
- **The Planets:** It has at least **4 confirmed planets**, and potentially more.
- **The Fact:** This star is very similar to our Sun (a G-type star). It is only 12 light-years away—essentially "next door" in galactic terms.
- **Talk Track:** "This is one of the best places to look for an 'Earth 2.0.' If there's anyone looking back at us, they're seeing the Earth as it was in 2014."

## 5. Gamma Cephei (The "Future Pole Star")

- **Where to find it:** Look North. It is the tip of the "roof" of the house-shaped constellation Cepheus.
- **The Planet: Gamma Cephei Ab** (also named *Tadmor*).

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## 1. The 4 Main "Families" of Exoplanets

Scientists generally group the thousands of planets we've found into four categories. Interestingly, our solar system is missing the most common type in the galaxy!

Planet Type	Description	Comparison
<b>Gas Giants</b>	Massive worlds made of hydrogen and helium.	Jupiter or Saturn
<b>Neptunian</b>	Similar in size to Neptune/Uranus; often have thick, hazy atmospheres.	Neptune
<b>Super-Earths</b>	Rocky worlds larger than Earth but smaller than Neptune. <b>(Most common in the galaxy!)</b>	<i>None in our Solar System</i>
<b>Terrestrial</b>	Small, rocky worlds. These are the hardest to find but the most likely to host life.	Earth, Mars, Venus

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## 2. 2026 Discovery Spotlight: HD 137010 b (The "Cold Earth")

Just weeks ago, in **February 2026**, astronomers confirmed a very unusual world.

- **The World:** It is nearly the same size as Earth and orbits its star once a year.
- **The Twist:** Its star is much dimmer and cooler than our Sun.
- **The Climate:** Because of this, it is an "Icy Earth." Temperatures are estimated at **-68°C (-90°F)**—colder than most of Mars.

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- **The Hope:** Scientists believe if it has a very thick atmosphere of Greenhouse gases (like ), it might actually be warm enough for liquid water to exist under the ice.
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### 3. "Super-Puffs" and Evaporating Worlds

Some planets defy what we thought was physically possible.

- **Super-Puffs:** Imagine a planet the size of Jupiter but with the weight of a marshmallow. These "Super-Puff" planets (like **WASP-107b**) have atmospheres so thick and light they are essentially giant cotton candy balls in space.
  - **Atmospheric Shedding:** In late 2025/early 2026, the **James Webb Space Telescope (JWST)** captured a "Super-Puff" actually *bleeding* its atmosphere into space. The gas is being stripped away by the star's heat so violently that it forms a tail like a comet, stretching 10 times the size of the planet!
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### 4. The "Radius Valley" Mystery

One of the most interesting "senior-level" concepts is a gap in our data.

- **The Observation:** We find plenty of planets **1.2 times** the size of Earth. We find plenty **3 times** the size of Earth.
  - **The Gap:** We almost *never* find planets exactly **1.5 to 2 times** the size of Earth.
  - **The Theory:** Astronomers think this is the "Point of No Return." If a planet gets bigger than 1.5 Earths, its gravity becomes strong enough to start "grabbing" gas from space, quickly ballooning into a mini-Neptune. If it stays smaller, it remains a rocky "Earth."
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### 5. Rogue Planets: The Galactic Nomads

Perhaps the most poetic discovery is that not every planet has a sun.

- **What they are:** "Rogue planets" are worlds that were kicked out of their original solar systems by gravitational tug-o-wars.
  - **The Count:** Estimates suggest there may be **more rogue planets** drifting in the darkness between stars than there are stars in the Milky Way.
  - **The Future:** NASA's next big mission, the **Nancy Grace Roman Space Telescope** (launching later this year/early 2027), is designed specifically to find these lonely "wandering" worlds.
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As of **March 2026**, although there are over **6,128 confirmed worlds**, we only have precise radius measurements for approximately **4,561** of them. The graph below reflects those confirmed measurements.

### **Exoplanet Size Distribution (March 2026)**

Category	Size Range	Count	Description
<b>Earth-sized</b>		<b>546</b>	Small, likely rocky worlds similar to Earth or Venus.
<b>Super-Earths</b>		<b>1,119</b>	Larger than Earth but smaller than Neptune; may be rocky or "ocean worlds."
<b>Sub-Neptunes</b>		<b>1,941</b>	The most common type; likely "puffy" worlds with thick gas envelopes.
<b>Gas Giants</b>		<b>729</b>	Large worlds dominated by hydrogen and helium, like Jupiter or Saturn.
<b>Super-Jupiters</b>		<b>226</b>	Massive gas giants, some approaching the size of small stars.

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