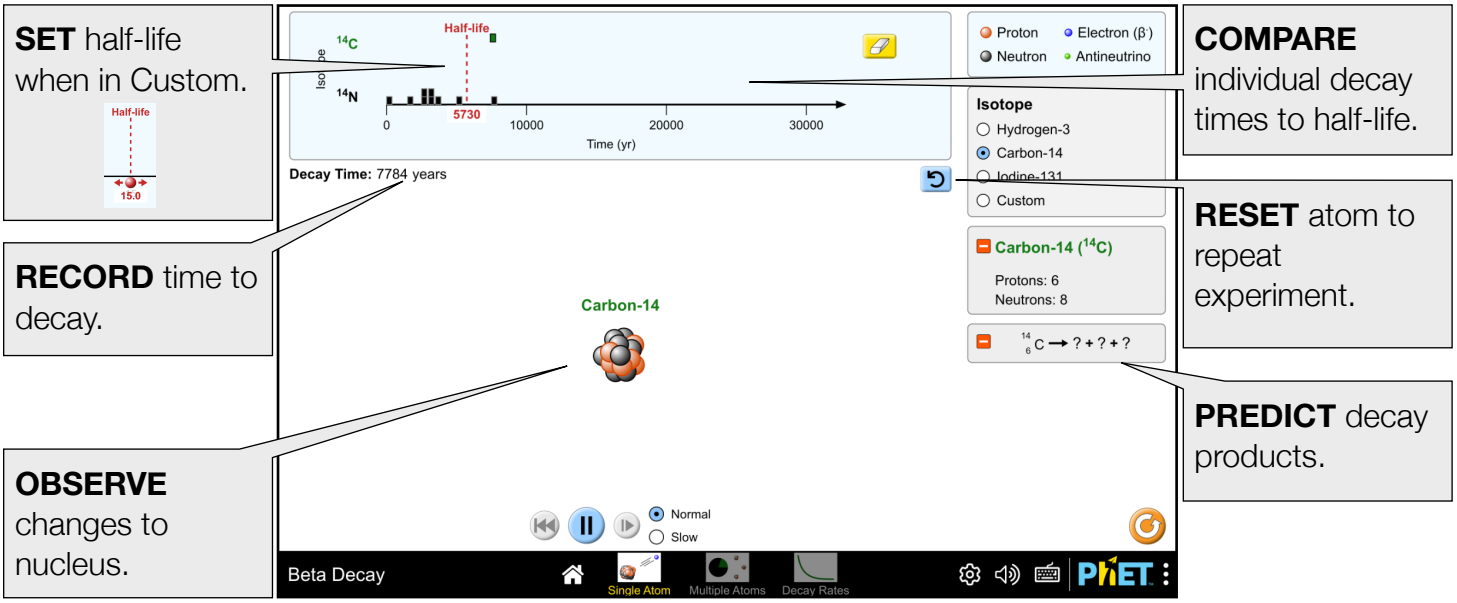
PhET Tips for Teachers — Beta Decay

The Beta Decay simulation allows students to explore the process of beta decay and investigate the concept of half-life.

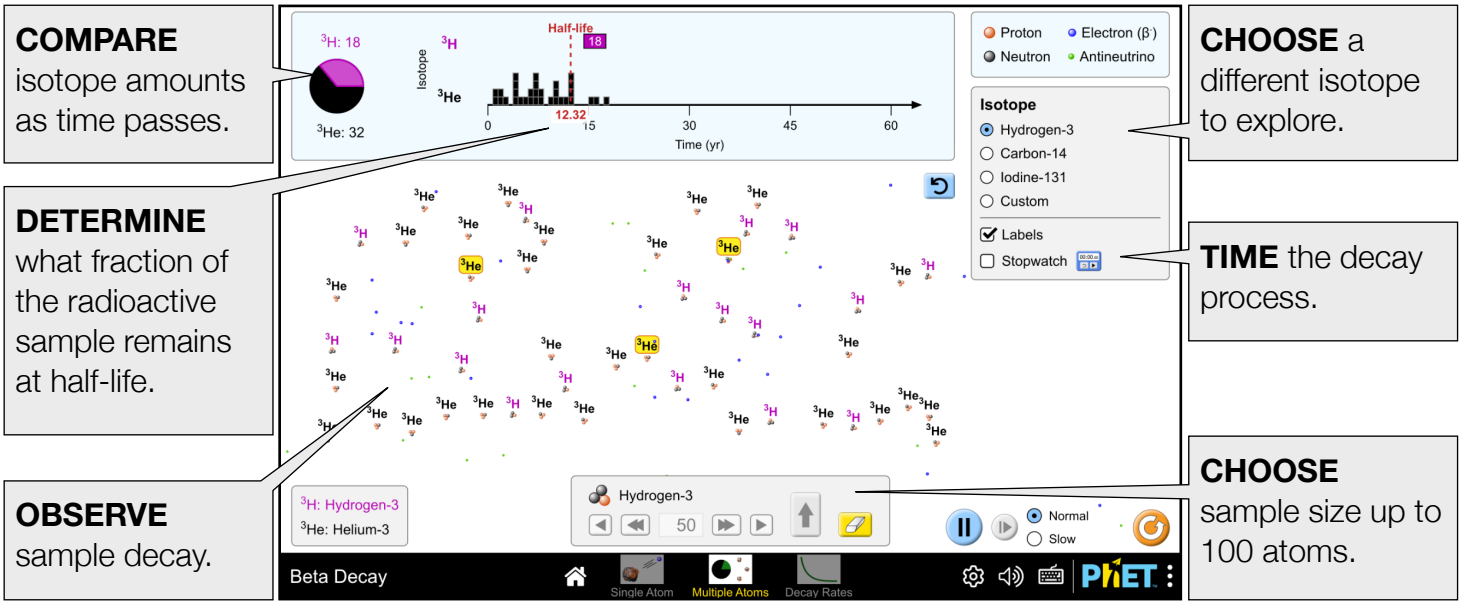
Single Atom Screen

In the Single Atom screen, students observe how a nucleus changes during beta decay and explore the randomness of individual decay events.



Multiple Atoms Screen

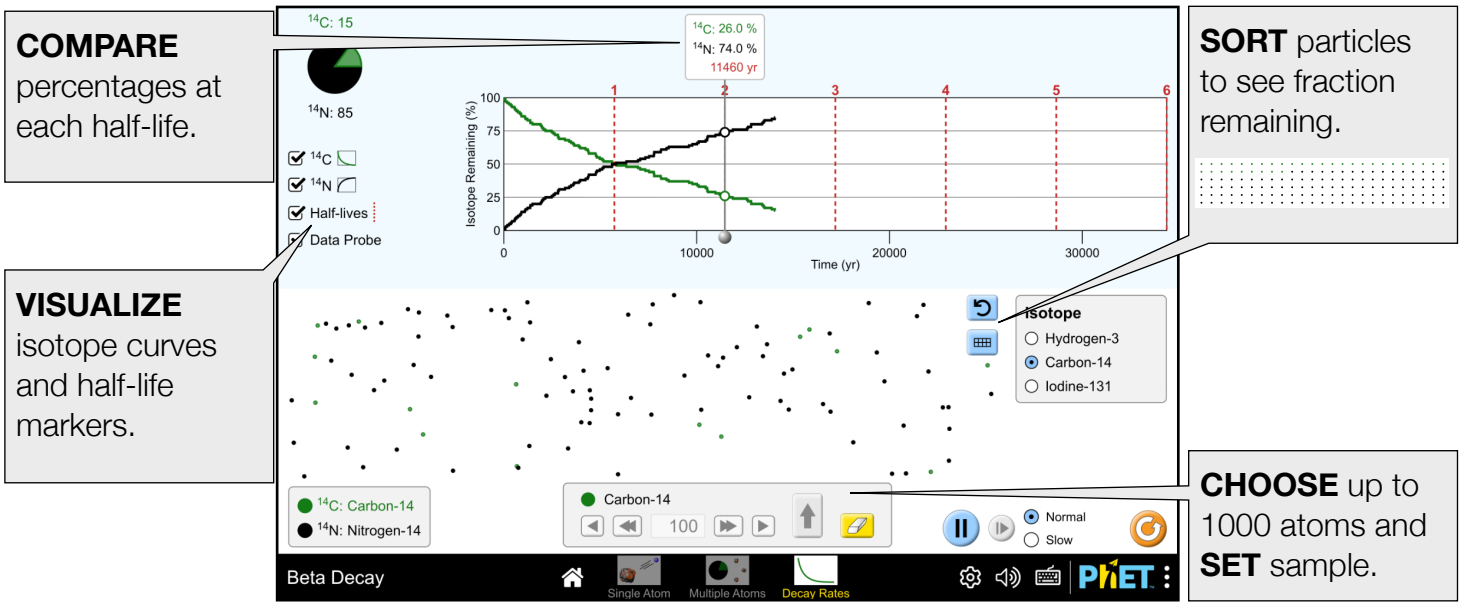
In the Multiple Atoms screen, students will explore the meaning of half-life.



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Decay Rates Screen

In the Decay Rates screen, students investigate the exponential pattern of radioactive decay.



Insights into Student Use

- Students may need support to recognize that a neutron changes into a proton. We added a subtle fade to help with this.
- Some students might not realize that the electron is coming from the nucleus.
- Students may not immediately know the half-life is draggable with the custom isotope.
- Students may need support connecting the sorted view to the fraction of isotope remaining.

Complex Controls

- The replay decay button rewinds to the time just before the last decay. Users are encouraged to pause and then step forward to view decay more easily.



- The stopwatch will begin playing once atoms are added to the sample and stop once all atoms are decayed. Use the play/pause button to pause at half-life times rather than the pause button on the stopwatch.
- The spinner's arrows set the number of atoms to add: the single arrow changes it by one, the double arrow by 10 on the Multiple Atoms screen or 100 on the Decay Rates screen. Pressing the orange set sample button places that number in the play area and disables both controls. Pressing erase clears the sample and re-enables them.



- The sort button arranges atoms to more easily visualize the fraction remaining. The number of rows and columns and distance between particles will vary depending on sample size.



Suggestions for Use

See all published activities for Beta Decay.

Sample Challenge Prompts

- On the Multiple Atoms screen, how much of a radioactive sample remains after one half-life? Use your observations to construct a definition of half-life.

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- On the Multiple Atoms screen, experiment with different amounts of atoms to determine the effect of sample size on the half-life.
- On the Decay Rates screen, examine the percent of atoms remaining at each half-life marker. What pattern do you notice?

Sample Prediction Questions

- On the Single Atom screen, predict how the atomic number, mass number, and element present will change after decay. Run the simulation to test your prediction.
- On the Single Atom screen, predict when a single atom will decay relative to the half-life time across several trials. What does this tell you about the nature of decay?

Simulation Details

See this sim's Model Documentation for more details.

- Only beta-minus decay is modeled in this simulation.
- Even though decay is instantaneous, we show a subtle fade from a neutron to proton to help users understand what is happening in the nucleus.
- Electron clouds are omitted to focus on nuclear changes.
- On the Decay Rates screen emitted particles are not shown to optimize performance for large sample sizes.
- The positioning of atoms is for visual clarity and does not represent a physical state.

Inclusive Features

See the simulation page for all supported inclusive features.

Alternative Input

- This simulation supports custom alternative input interactions, including hotkeys to play or pause the simulation. See the Keyboard Shortcuts dialog in the simulation for more information.

Sound and Sonification

- This simulation includes Basic Sounds, which provides audible confirmatory feedback to indicate successful interaction, such as when pressing a button or checking a checkbox.
- In addition, a unique sound is played when each atom decays. How often this sound occurs should help low or no vision users determine how the rate of decay changes over time.

Interactive Description (Core)

Core description is a subset of a fully described interactive experience.

- Teachers can access the Accessibility (A11y) View to see the descriptions available to screen reader users to decide if the sim's description meets their instructional needs. *Please note: A11y View is not intended for student use and will not provide a good experience for learners using screen reader software.*

Customization Options

Option 1: Use PhET Studio to configure a sim exactly how you want students to see it, save your preset, then send the preset link to your students. This is a premium product. Start a free trial today!

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Option 2: Query parameters allow for customization of the simulation, and can be added by appending a '?' to the sim URL, and separating each query parameter with a '&'. The general URL pattern is: …html?queryParameter1&queryParameter2&queryParameter3

For example, in Beta Decay if you only want to include the 1st and 2nd screens (screens=1,2), with the 2nd screen open by default (initialScreen=2) use: https://phet.colorado.edu/sims/html/beta-decay/latest/beta-decay_all.html?screens=1,2&initialScreen=2

- To run this simulation in Spanish (locale=es), the URL would become: https://phet.colorado.edu/sims/html/beta-decay/latest/beta-decay_all.html?locale=es
- All available query parameters are shown in the table.

⚙ Indicates this customization can be accessed from the Preferences menu within the simulation.

Query Parameter and Description	Example Links
⚙ antineutrinoVisible- when false, hides the antineutrino during emission and removes it from the particle legend. Default is true.	antineutrinoVisible=false
⚙ electronLabel- term displayed for particle in legend.	electronLabel=electron electronLabel=betaParticle
screens - specifies which screens are included in the sim and their order. Each screen should be separated by a comma. For more information, visit the Help Center.	screens=1 screens=2,1
initialScreen - opens the sim directly to the specified screen, bypassing the home screen.	initialScreen=3
⚙ locale - specify the language of the simulation using ISO 639-1 codes. Available locales can be found on the simulation page on the Translations tab. Note: this only works if the simulation URL ends in "_all.html".	locale=es (Spanish) locale=fr (French)
audio - if muted, audio is muted by default. If disabled, all audio is permanently turned off.	audio=muted audio=disabled
⚙ interactiveHighlightsInitiallyEnabled - opens simulation with interactive highlights enabled	interactiveHighlightsInitiallyEnabled
allowLinks - when false, disables links that take students to an external URL. Default is true.	allowLinks=false
supportsPanAndZoom - when false, disables panning and zooming using pinch-to-zoom or browser zoom controls. Default is true.	supportsPanAndZoom=false

Additional PhET Resources

See PhET's Inclusive Features page to learn more about each Inclusive Feature and how to use them with your students.
For more tips on using PhET sims with your students, see Teaching with PhET.
To learn more about ways to create and facilitate sim-based lessons, visit our free Virtual Workshops.