WHAT DOES THE MAP SHOW?
This map shows over 14,000 known earthquakes from 1841 to 2002. The Table to the bottom right is a summary of major quakes that have affected Oregon, causing ground shaking and damage. It shows that Oregonians face injury and property damage from earthquakes originating throughout the Pacific Northwest. For this reason, the Oregon Department of Geology and Mineral Resources produced this map of the epicenters of historic earthquakes in Oregon, off the coast, and along Oregon's border with southern Washington and northern California. Historic patterns show areas in Oregon that are especially vulnerable to earthquakes.

Learn more about earthquakes in Oregon

SOURCE OF EARTHQUAKES
Three sources cause earthquakes in Oregon. First, shallow earthquakes (depths of 0-10 miles) occur on active faults in the crust. Second, deeper earthquakes (depths of 10-31 miles) are associated with the subducting Juan de Fuca plate. Third, deep earthquakes (depths of 31-62 miles) happen where the continental crust and ocean floor plates are locked against each other and periodically snap loose.
The Juan de Fuca plate is a slab of ocean floor moving eastward from the Juan de Fuca Ridge, which is about 300 miles off the coastline of Oregon and Washington. The term Cascadia subduction zone was given to the part of the plate that has descended beneath the westbound continental crust of western Oregon. Earthquakes can be very large in the subduction zone and often produce damaging tsunamis.

The last great Cascadia subduction zone earthquake happened off the coast of Oregon and Washington in 1700, with an estimated magnitude of 9.0. Geological evidence indicates that huge subduction zone earthquakes have struck Oregon's coast every 300-800 years, with a record that extends back at least 11,000 years (Atwater and others, 1995; Atwater and Hemphill-Haley, 1997; Goldfinger, 1999). These earthquakes are not evenly spaced in time, and the calculated average intervals between events can be less or more. The Cascadia subduction zone is still continuing to creep and undoubtedly western Oregon will again experience the affects of a subduction-zone earthquake.
The earthquakes shown on the map were triggered within the Earth's crust at depths less than 25 miles. The largest of these earthquakes struck the coastline of Oregon and California near Brookings, Oregon, on November 23, 1873, with an estimated 6.8 magnitude.

EARTHQUAKE TERMS
An **earthquake** is defined as the "perceptible trembling to violent shaking of the ground, produced by the sudden displacement of rocks below the Earth's surface." Rocks respond to stress (being squeezed or pulled apart) near the Earth's surface by breaking. Where the rocks break and move, we call it a **fault**. The buildup of tectonic forces and release of stress on individual faults is what causes quakes. Higher stresses lead to larger earthquakes.

The earthquake's **epicenter** is the position on the Earth's surface directly above the focus of the earthquake. The **focus** is the location within the Earth where underground rock moves and sends out earthquake energy waves. We feel these waves as ground shaking. Earthquakes produce three main types of energy waves: **P-waves** (push-pull waves), **S-waves** (side-to-side waves), and **L-waves** (surface waves). Each radiates from the earthquake focus through the Earth at different rates.

The distribution of earthquakes over time is known as **seismicity**. The energy released from the earthquake is a basic quantity scientists have measured for more than fifty years. This energy release, or **magnitude**, is measured on the familiar Richter scale, invented by Charles F. Richter in 1934. Scientists calculate the magnitude of the earthquake from the largest seismic wave or vibration, and a seismograph records the vibrations (seismogram) that an earthquake makes.

Earthquakes with a magnitude of about 2 or less are usually called **microquakes**. They are not

usually felt and are generally recorded only on local seismographs. Magnitude 3 and 4 earthquakes are commonly felt, but rarely cause damage. Damaging ground shaking can accompany a magnitude 5 or 6 event, and major damage commonly occurs from earthquakes of magnitude 7 and greater. The Richter scale has no upper limit. Recently, another scale called the **moment magnitude scale** has been devised for more precise study of seismic activity. Moment magnitude is generally used now to describe earthquakes, but the categories are about the same.

Earthquake **intensity** is not the same as Richter's earthquake magnitude. They are frequently confused in media reports. Earthquake intensity describes the strength of shaking at a particular place, based on observations made of building damage. The intensity of an earthquake is expressed today as the **Modified Mercalli Scale**, devised in 1902 by Giuseppe Mercalli. The scale provides a series of idealized descriptions of the effects of an earthquake. Intensity 1 is imperceptible shaking. Intensity increases by steps to 10, which is total destruction. The intensity scale requires no instrumentation because any observer can make a classification. It provides a basis to estimate the size of historic earthquakes. Also, it is useful because an earthquake has only a single magnitude, but different intensities can be distributed throughout the affected area.