Plate Tectonic Theory—from birth, to hypothesis, to paradigm

I. Continental Drift
  a. Alfred Wegener—German meteorologist
    i. Suspected continents were once joined across the Atlantic Ocean—hypothesis suggested by obvious fit of coastlines
    ii. Supported by restricted range of coastal swamp reptile Mesosaurus—
      1. appearing on both South America and Southern Africa, in Permian age rocks, but not elsewhere in the same age rocks
      2. if it could swim the Atlantic Ocean to get to the other continent, why was it not more widespread?
    iii. Set out to find additional evidence to support hypothesis
      1. 2.2 billion year old granite in Brazil and Africa
      2. similar aged mountain belts from North America to Europe
      3. Glacial deposits in tropical areas
      4. Equatorial swamp deposits in temperate areas
    iv. Rejoined land masses into Pangaea in the early Jurassic Period
  b. Challenged to find a mechanism for continents to plow through the ocean basins
    i. Suggested tidal forces, but this was easily countered by physicists
    ii. But just because there were holes, and some misconceptions (plowing through ocean basin) doesn't make the supporting evidence wrong.
II. Plate Tectonics
  a. Additional data about the nature of our world came to be known throughout the middle of the twentieth century
    i. Sonar mapped the sea floor
      1. showed oceanic ridge system, crossed by fracture zones, and presence of deep arcuate trenches
    ii. Earthquake studies showed distinct patterns of locations and depths of earthquakes
    iii. Magnetic data from continents and the sea floor
      1. sea floor showed parallel bands of greater and lesser magnetism symmetric across the mid-ocean ridge
      2. continents showed location of North Pole relative to the land area had changed through time: Polar Wandering. Each continent had a different path of polar wandering unique to itself.

b. Plate Tectonics Paradigm is a ‘super theory’: so well supported and able to explain large amounts of apparently unrelated data
    i. Earth’s surface is composed of rigid lithospheric plates—from a few km to a few hundred km thick
        1. These move as coherent units with respect to one another
        2. Each plate has little to no internal deformation
        3. i.e.: New York moves with respect to London, but the distance between New York and Denver remains essentially the same.
    ii. There are seven major lithospheric plates, most of which contain both continental crust and oceanic crust, and numerous smaller plates
        1. Lithospheric plates
            a. Contain both crust and uppermost rigid mantle
            b. Slide over the asthenosphere, which is composed of rocks that are nearly melted
        2. crust types
            a. continental crust is granitic, less dense, more silicic (about 80%)
            b. oceanic crust is basaltic, more dense, about ½ silica
        3. seven major plates
            a. Pacific
            b. North American
            c. South American
            d. Eurasian
            e. Australian-Indian
            f. Antarctic
        4. intermediate plates
            a. Juan de Fuca
            b. Cocos
            c. Nazca
            d. Caribbean
            e. Scotia
            f. Philippine
            g. Arabian
        5. over a dozen small plates have been identified of local significance
        6. Plate boundaries are defined by earthquake locations
    iii. plates interact on their edges
        1. Divergent boundaries
        2. convergent boundaries
        3. transform boundaries