Key points from Lecture 7 of ASTR 350

1. In free fall, objects travel between events in the shortest spacetime path: a geodesic. But because spacetime is curved, it looks like a curve to us. Example: to go from one point to the other on the surface of the Earth in the shortest possible distance, you travel on a segment of a great circle (one that is centered on the center of the Earth).
2. The curvature of spacetime means that geometry can be different from what it is on a plane. For example, the interior angles of a triangle need not add up to 180°, initially parallel lines can cross or diverge from each other, and so on.
3. General relativity (GR): the presence of mass and energy warps spacetime. In a powerful sense, gravity *is* the geometry of spacetime!
4. The master equation of GR, the *Einstein Field Equations*, relate the geometry of spacetime to the presence, location, and properties of matter, energy, pressure, and stresses.
5. An early success of GR was the explanation of the otherwise-unexplained extra precession of Mercury's orbit.
6. Different astronomical systems probe different degrees of the curvature of spacetime: from the Solar System to binary pulsars to, ultimately, black holes.
7. Starting in September 2015, direct observations of gravitational waves (mostly from binary system with two black holes) have provided strong new tests; GR has passed all of them so far!