The biggest question many science fiction movies pose or attempt to answer is one in any Astronomy buff’s head: is there life on other worlds somewhere out there? As it turns out, advancements in technology and in the fields of Astronomy and Astrobiology can finally begin to look for a few answers. These solutions, or at least their building blocks, can be found by means of honing the habitable zone (a planet’s range of distance from its star where liquid water may be present on the surface) and determining the composition of other stars that are found to host little rocky planets like ours.

The first step is rather obvious: find other planets like our own. There are many useful methods for finding planets, but it turns out the most fruitful is the transit method. This method involves looking at the light of a star for a long time and hoping to see a dip in that light due to a planet crossing in front of its host star (depicted in Illustration 1). While this is quite a feat to swallow, the Kepler Mission did it very well. The Kepler Mission is a space telescope that looked unblinkingly at a patch of sky about the size of an outstretched hand for 4 years, searching for dips in the light curves of many stars that could suggest planets. The mission was a resounding success, finding thousands of planet candidates in only a few years.

The most surprising result of this new data was that most terrestrial planets found were orbiting small stars known as M dwarfs. M dwarfs are the most common stars in the universe, and they are around 10-20% the size of our star. They burn dimly with stellar effective temperatures ranging from 2000-4000 K, and therefore emit light mostly at infrared wavelengths (the wavelength of light that humans detect as heat) so they are not visible to the naked eye (1). Data from the Kepler mission suggests that the majority of these cool stars haven terrestrial planets orbiting them, many with the planetary radius ranging from 0.5-3 times the mass of earth (2). Kepler has also found a planet in the habitable zone that has a radius very close to that of the Earth with an M dwarf stellar host (3). The importance of this is not lost on astronomers, considering these stars...
comprise nearly 70% of the universe. If most of these little guys (M dwarfs) have terrestrial planets orbiting them, the sheer number of planets would make it likely that there are many in the habitable zone, which in the case of these small stars, can be smaller than the distance from the Sun to Mercury.

Illustration 2: Artist representation of planets orbiting an M dwarf (seen behind the two planets)

These interesting exoplanets have been found via the transit method, but there is much work that has yet to be done. Transits do not give information about the composition of the star or its planet, as they are only measuring the star’s change in flux (the amount of light that astronomers can detect coming from the star). This is where the importance of spectroscopy comes in. Spectroscopy allows scientists to analyze how much light comes in at each wavelength, and they use that information to understand stars better. Many astronomers are now taking spectra of the M dwarf hosts in the infrared and using the absorption features to discover the metallicity of the star, or how many metals heavier than hydrogen or helium are present (4). The composition of the star, once known, can provide insight into the composition of the exoplanet to understand the similarities of these planets to Earth. The habitability of a planet is not solely dependent on the distance from its star, the atmosphere of the planet is also a key factor in understanding its likelihood to sustain life (3). A possible way to determine the planetary atmosphere is to take spectra at the time of planet transit. This is being done by astronomers at the University of Geneva (5), although not yet on dim stars such as M dwarfs.

As it has been shown here, it takes more than listening for aliens like they did in Contact to find them. There are many scientific steps to be taken, and it is likely that we are not as close to finding little green men as we would hope. However, with more analysis of the planets orbiting these little stars, it may be possible to answer the big question that many are thinking: is Earth the only planet with the ability to host life?

Sources Cited
(5) http://exoplanets.ch/research/exoplanet-atmospheres/