Pulsar Planet,
Puffy Planet,
Protoplanet,
Plutoids,
Pluto,
Plutino,
Planetoid,
Planetesimal,
Planetary Mass
Planetar,
Planet,
Planemo,
And
Dwarf Planets,
Among Others,
A Case Study in Today’s Science Writing and
A Spacetime/motion Analysis of the Word-concept “Planet”
As Defined by the International Astronomical Union

Table of Contents

Introduction .............................................................................................................................................. 3
Part One
A Geo-Centric Perspective in Science ...................................................................................................... 4
International Astronomical Union Definition of a Planet ........................................................................ 6
The IAU-2006 Definition of a Planet: The Underlying “Planetesimal Hypothesis” .............................. 7
Part Two
A Spacetime/motion Analysis of the IAU-2006 Definition of a “Planet .................................................. 22
Spacetime/motion Analysis .................................................................................................................... 23
Part Three
A Spacetime/motion Analysis of Massive Bodies in a Solar System ..................................................... 33
Characteristics of Massive Bodies in Solar Systems ............................................................................. 34
Part Four
A Selective Review of the Ruling Nomenclature of the Bodies of Mass in Our Solar System ............. 38
Selected Popular Word-Concepts for Planet Types ............................................................................... 39
ADDENDUM
Stars and Habitable Planets ..................................................................................................................... 54
A Case Study in Today’s Science Writing and
A Spacetime/motion Analysis of the Word-concept "Planet"
As Defined by the International Astronomical Union

Introduction

In Part One of this brief essay I review and comment how the official defining organizational body, the International Astronomical Union [IAU] defines the word-concept "planet" and related terms.

In Part Two, I present a spacetime/motion analysis of the IAU-2006 definition of the term "planet".

In Part Three, I present a brief analysis of the characteristics of a planet from the spacetime/motion perspective in order to demonstrate how word-concepts might represent the kinds of massive bodies in any solar system.

In Part Four, finally, I consider the popular nomenclature of the massive bodies in our solar system.

The theoretical problem at hand involves defining various features of spacetime/motion events into a single word-concept [i.e., planet], as will be shown, represents a nearly impossible task. It’s like attempting to define what a "real planet" is ---an idealized concept of a planetary body. The search for a one-word-concept to an infinitely rich specificity of matter-energy ultimately contradicts reality itself.

Consider the following opinion:

"In an 18 August 2006 Science Friday interview, Mike Brown expressed doubt that a scientific definition was even necessary. He stated, "The analogy that I always like to use is the word "continent". You know, the word "continent" has no scientific definition ... they're just cultural definitions, and I think the geologists are wise to leave that one alone and not try to redefine things so that the word "continent" has a big, strict definition." [www.wikipedia.com "IAU definition of planet". Emphasis mine].

At this late stage of the game, one may further ask whether it is even necessary to define the word-concept planet. One could view such a task as fruitless, even meaningless, there is, however, something to be learned from the analytical process of attempting to express in words the complexity of spacetime/motion events. The way we speak and write reflects the way we think. Attempting to put into words what exists in reality addresses the purpose in science writing.

This essay seeks to evaluate and clarify the IAU-2006 definition of a planet.
Part One

A Geo-Centric Perspective in Science

Consider certain comments on the IAU web-page [iau.org] concerning science writing in general.

**Q: What is the origin of the word planet?**
**A: The word planet comes from the Greek word for "wanderer", meaning that planets were originally defined as objects that moved in the night sky with respect to the background of fixed stars. [IAU-Ibid; emphasis mine.]**

This particular point illustrates how difficult it is to replace a traditional word-concept, such as that a planet, with more exact science writing. Today it is obvious that the planets do not wander as such. They have known orbital patterns and timings.

One could have expected the word-concept "planet" to be replaced long ago by a more representative expression for the planetary bodies in our solar system and beyond. One could image an expression such as "potentially-habitable bodies", or anything besides the trait of wandering aimlessly about in the solar system. Any physical trait might be better to define the planets than the idea of a "wanderer" which does not apply to any characteristic of the "planets". Even the idea of wandering across the night sky is hardly noticeable in terms of motion unless through prolonged observation.

Various word-concepts in science and specifically in the field of astronomy are often geo-centric in nature that is, defined as of the perspective and position of Earth.

The word-concept 'dwarf planet' launched in 2006 by the International Astronomical Union suffers from this customary practice. My interest in the word-concepts 'planet' and 'dwarf planet' stems not only from the fact that their 'official' adoption is on weak theoretical ground. Their definitions are still under consideration by the world community of astronomers. Before treating, however, these word-concepts other observations are in order.

For example, consider the word-concept of the astronomical unit [AU]. In a previous essay, I suggested that the astronomical unit, the mean distance between the Earth and the Sun [the Earth's sun] be changed. This distance has been historically and arbitrarily employed to measure distances between celestial bodies throughout the Universe.

As far as I know, there is no theoretical or material foundation that substantiates the use of the mean distance between Earth and the Sun to measure astronomical, galactic, or universal distances of celestial bodies. In other words, there is no material spacetime basis that would identify the distance between the Earth and its sun as representing some kind of basic Universal quantum as an astronomical unit.
There is no theoretical substantiation in terms of matter-energy, gravity, mass or energy and the like that elementary event throughout the Universe.

In 2000, I proposed employing the distance between the planet Mercury and the Sun in our solar system as the astronomical unit [www.earthmatrix.com/orbital/astronomical_unit.html]. I also suggested the alternative of employing the mean distance between the planet Pluto and the Sun as a possible unitary measurement for the AU. I made that proposal six years before the IAU demoted the planet Pluto to being a 'dwarf planet'. I still maintain that proposal today ---for the same physical reasons, which are Mercury|Pluto form the inner|outer boundaries of the solar system; i.e., multi-gravitational relations as unit one. When Mercury is unit 1.0, then Pluto is 100 on that unit scale.

There is a material basis for proposing either the planet Mercury or the planet Pluto as representing a basic unit of measurement for distances between celestial bodies. The Sun|Mercury relationship represents the identified shortest gravitational distance of the solar system. And, the Sun|Pluto relationship represents the longest gravitational distance of the solar system. The proposal suggests employing either the shortest or longest gravitational distances between the Sun and its planets, as its inner [Mercury] and outer [Pluto] boundaries of the gravitational relationships in the solar system. Gravity is gravity still, no matter whether Pluto is defined as a planet or not.

The historically accepted astronomical unit [AU], based on the mean distance between the Sun and the Earth represents a geo-centric word-concept within astronomy here on Earth. The reason that the distance between the Sun and the Earth has been historically chosen to measure all distances in the Universe/Cosmos may be attributed to the fact that we live on Earth. There is no material basis to defining the astronomical unit of celestial bodies as of the relationship of the Sun [a star] with its third planetary orbital body [the Earth].

There is no scientific material substantiation for the word-concept astronomical unit based on matter-energy relationships of spacetime in terms of a star with its planetary bodies. One might reconsider such a Universal quantum word-concept at the galactic level; possibly galaxy to galaxy. But, such considerations would require a distinct essay from the one at hand.

Now, if we lived on the planets of Venus or Mars, either of these two planets would have likely been chosen to represent the astronomical unit, given the nature of human reasoning. Living on Venus or Mars, I would still propose Sun|Mercury relation for astronomical unit measurement. Let us offer the numbers as of the system of distance measurement utilizing the planet Mercury as the unit one (1.0). The corresponding numbers for the ratios would then be:

<table>
<thead>
<tr>
<th>Planet</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>1.0</td>
</tr>
<tr>
<td>Venus</td>
<td>1.846153846</td>
</tr>
<tr>
<td>Earth</td>
<td>2.564102564</td>
</tr>
<tr>
<td>Mars</td>
<td>3.8974358</td>
</tr>
<tr>
<td>Jupiter</td>
<td>13.333</td>
</tr>
<tr>
<td>Saturn</td>
<td>24.46153846</td>
</tr>
<tr>
<td>Uranus</td>
<td>49.17948718</td>
</tr>
<tr>
<td>Neptune</td>
<td>77.076923</td>
</tr>
<tr>
<td>Pluto</td>
<td>101.333</td>
</tr>
</tbody>
</table>
Now, a sense of proportion becomes even more definite and comprehensible. The system now stretches from 1.0 to 101.333, almost a perfect $1 - 100$ system of proportion; something that mentally, we can easily grasp. [Johnson, Charles William, *The Distance of the Planets from the Sun and Their Atmospheric Composition*, http://earthmatrix.com/extract62/mercury.html]. The current astronomical unit between Earth and the Sun denies a similar proportional rendering of the distances measurements of the solar system as shown here.

*Pluto, the classical god of the underworld*

**International Astronomical Union Definition of a Planet**

"The refining understanding of Pluto echoed a debate in the 19th century that began with the discovery of Ceres on January 1, 1801....Astronomers immediately declared the tiny object to be the "missing planet" between Mars and Jupiter. Within four years, however, the discovery of two more objects with comparable sizes and orbits had cast doubt on this new thinking. By 1851, the number of "planets" had grown to 23, and it was clear that hundreds more would eventually be discovered. Astronomers began cataloguing them separately and began calling them "asteroids" instead of 'planets'."] [www.wikipedia.com. "IAU Definition of Planet." Emphasis mine.]

Well, if there are hundreds, thousands of planets in the solar system, so be it. What's the problem. Apparently, the astronomers did not like the idea of there possibly being so many planets in the solar system. An analogy on the galactic level, might be their not wanting so many billions of stars to exist in the galaxies. Our solar system contains what it contains, like so the galaxies ---it is not a question of theoretically abstracted definitions. Why would one consider the idea that a solar system [our solar system] must have a small limited number of planets?

"Starting in 2000, with the discovery of at least three bodies (Quaoar, Sedna, and Eris) all comparable to Pluto in terms of size and orbit, it became clear that either they all had to be called planets or Pluto would have to be reclassified. Astronomers also knew that more objects as large as Pluto would be discovered, and the number of planets would start growing quickly. They were also concerned about the classification of planets in other planetary systems. "In 2006, the matter came to a head with the measurement of the size of 2003 UB313. Eris (as it is now known) turned out to be slightly larger than Pluto, and so was thought to be equally deserving of the status of 'planet'. [www.wikipedia.com. "IAU Definition of Planet." Emphasis mine.]"
The previous quote represents an example of false reasoning based solely upon the concern about the "size" of planets per their definition. Apparently based on that principal concern alone, there existed an effort to define what constitutes a planet. "The IAU has been responsible for the naming and nomenclature of planetary bodies and their satellites since the early 1900s. Hence, IAU recommendations should rest on well-established scientific facts and have a broad consensus in the community concerned." [Ibid]

In 2006, a resolution was drawn up at the conference of the International Astronomical Union, and a definition of a planet was agreed upon. The definition of a Planet by the International Astronomical Union, 2006 follows.

"A celestial body that (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, and (c) has cleared the neighbourhood around its orbit." [Source: IAU website. http://www.iau.org/public/themes/pluto/]

The IAU-2006 Definition of a Planet: The Underlying "Planetesimal Hypothesis"

The definition reminds me of the planetesimal hypothesis forwarded by Thomas C. Chamberlin (geologist) and Forest R. Moulton (astronomer), and explained by Donald H. Menzel, about the formation of the solar system. Consider the following citation:

"Chamberlin and Moulton hypothesized that this force was the close approach of a passing star that produced huge tides in the outer layers of the sun. These tides caused the sun to spew great quantities of material into space, some of which chased along after the star and started revolving around the sun. The intruding star disappeared into the distance, leaving the sun enveloped in a hot, spinning cloud. The mass of gas eventually cooled, congealing into small solid lumps, the planetesimals. A few of the larger lumps acted as centers of condensation, sweeping up the smaller planetesimals and gradually clearing out the debris caused by the near collision with the hit-run star." [Menzel, Donald H., Astronomy, Random House, New York, 1970, page 223. Emphasis in bold mine.]

The IAU-2006 definition of a planet appears to have relied upon this kind of science writing based on the terms such as size ["large and small"] and planetary activity ["sweeping up" and "clearing out debris"]. From this perspective, it would appear as though the IAU-2006 definition of a planet, dwarf planet and small solar system bodies has its roots firmly placed in the planetesimal hypothesis, as least in wording and structure.
The planetesimal theory is based upon various hypothetical suppositions about the formation of the solar system. Given that the IAU-2006 definition of a planet appears to be based upon the Planetesimal hypothesis, then if this theory about the formation of the solar system finally shows itself to be incorrect, the IAU-2006 definition shall necessarily require a reformulation.

Returning to our discussion, it would appear that some astronomers became frightened at the idea that certain massive bodies beyond Pluto might be larger and more numerous than the planet Pluto itself. And, for some unrecognizable reason suggested therefore the definition of a planet should be modified.

By that same logic, had a similar fear arisen when the moons of Jupiter were found to be larger than some planets, possibly a modified definition of a planet would have been in order then. In other words, the size and/or number alone cannot substantiate what constitutes a planet as distinct from what makes up a "dwarf planet". It appeared that for that reason, the IAU astronomers included the idea about "clearing its path" in their definition. However, as shown previously, the reason may simply have been due to its proponents believing in the planetesimal hypothesis.

The IAU web-page goes on to talk about "A new class of objects and how to define a planet". Pluto is not a "new class of objects". What has occurred is that a distinct perspective has been assumed for defining what has long been known to be a planetary body in our solar system: Pluto.

"The IAU Resolution means that the Solar System officially consists of eight planets Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune." [Emphasis mine; Ibid]

The previous statement represents an unfortunate example of today's science writing, as many astronomers have already pointed out in no uncertain terms about the IAU-2006 definition. Consider the same statement paraphrased in its fundamental meaning:

"The ...Solar System ... consists of eight planets Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune."

Science, in the field of astronomy, concerns itself not with what "officially" exists, but what materially exists". So, what is a dwarf planet? --- materially speaking.

"A new distinct class of objects called dwarf planets was also decided on. It was agreed that planets and dwarf planets are two distinct classes of objects." ..."The dwarf planet Pluto is recognized as an important prototype of a new class of Trans-Neptunian Objects. The IAU has given a new denomination for these objects: plutoids." [Emphasis mine; Ibid.]

Now, the word-concept "prototype" requires a definition in terms of what it means for a planet; none given however, its meaning is simply taken for granted.
"A plutoid or ice dwarf is a trans-Neptunian dwarf planet: that is a body orbiting beyond Neptune that is large enough to be rounded in shape. The term plutoid was adopted by the International Astronomical Union (IAU) working group Committee on Small Bodies Nomenclature, but was rejected by the IAU working group Planetary System Nomenclature. The term plutoid is not widely used by astronomers, though ice dwarf is not uncommon."

"There are thought to be thousands of plutoids in the Solar System, although only four have been formally designated as such by the IAU. [www.wikipedia. "Plutoid". Emphasis mine.]

So, not only do you now have dwarf planets, but some of these are plutoids.

Q: What are plutoids?
A: Plutoids are celestial bodies in orbit around the Sun at a semimajor axis greater than that of Neptune that have sufficient mass for their self-gravity to overcome rigid body forces so that they assume a hydrostatic equilibrium (near-spherical) shape, and that have not cleared the neighborhood around their orbit. Satellites of plutoids are not plutoids themselves, even if they are massive enough that their shape is dictated by self-gravity. The two known and named plutoids are Pluto and Eris. It is expected that more plutoids will be named as science progresses and new discoveries are made. [Emphasis mine; Ibid.]

Synonymous word-concepts appear to be: dwarf planet; prototype; trans-Neptunian objects; plutoids; ice dwarf; and, trans-Neptunian dwarf planet. Confused? No need to be. Consider an additional idea:

Q: Can a satellite orbiting a plutoid be a plutoid too?
A: No, according to the IAU Resolution B5 a dwarf planet can not be a satellite, even if they are massive enough that their shape is dictated by self-gravity. [Emphasis mine; Ibid.]

From the foregoing, it appears that "dwarf planet" and "plutoid" are synonymous word-concepts. I say "appear" because at this rate most likely their definition may be modified. Now we know.

The cited effort at defining word-concepts by the IAU illustrates how difficult it is to follow through on paradigm shifts in scientific knowledge. When a paradigm shift occurs it is difficult to foresee the adjustments required to all theoretical word-concepts in such a shift. The adoption of the word-concept 'dwarf planet' may appear to require a simple resolution. But once injected into the community of science writers in astronomy the debate over many related word-concepts obtains.

Consider an attempt to translate the IAU-2006 definition into a language we might all understand.
Q: In plain language, what is the new definition of planet?
A: A planet is an object in orbit around the Sun that is large enough (massive enough) to have its self-gravity pull itself into a round (or near-spherical) shape. In addition, a planet orbits in a clear path around the Sun. If any object ventures near the orbit of a planet, it will either collide with the planet, and thereby be accreted, or be ejected into another orbit. [IAU-Ibid; Emphasis mine]

I am at a loss as to what constitutes 'plain language'. Possibly the following expression may qualify:

Pamela Gay: "Planets are things that orbit stars."
"So here's where the IAU kicks Pluto out of planet classification. The definition now says it has to have cleared its orbital neighbourhood of other stuff, and Pluto's orbit is jam-packed with other stuff."
[Fraser Cain, Why Pluto is No Longer a Planet, January 5, 2012; (http://www.space.com/2791-pluto-demoted-longer-planet-highly-controversial-definition.html)]

Now, consider a voice of reason:

"There continues to be criticism regarding the wording of the final draft of the definition. Notably, the lead scientist on NASA's robotic mission to Pluto, Alan Stern, contends that, like Pluto, Earth, Mars, Jupiter and Neptune have not fully cleared their orbital zones either. Earth orbits with 10,000 near-Earth asteroids. Jupiter, meanwhile, is accompanied by 100,000 Trojan asteroids on its orbital path. "If Neptune had cleared its zone, Pluto wouldn't be there", he added." [www.wikipedia.com "IAU definition of planet". Emphasis mine.]

With this kind of impeccable reasoning expressed by Alan Stern one wonders how the IAU-2006 definition even came into existence.

"One of the main points at issue is the precise meaning of "cleared the neighbourhood around its orbit". Alan Stern objects that "it is impossible and contrived to put a dividing line between dwarf planets and planets,"... and that since neither Earth, Mars, Jupiter, nor Neptune have entirely cleared their regions of debris, none could properly be considered planets under the IAU definition..." [www.wikipedia.com "Clearing the Neighborhood". Fair use. Emphasis mine.]

The measured point of view expressed by Dr. Stern is countered by the following distraction:

"Mike Brown counters these claims by saying that, far from not having cleared their orbits, the major planets completely control the orbits of the other bodies within their orbital zone. Jupiter may coexist with a large number of small bodies in its orbit (the Trojan asteroids), but these bodies only exist in Jupiter's orbit because they are in the sway of the planet's huge gravity." [www.wikipedia.com "Clearing the Neighborhood". Emphasis mine.]
It must be pointed out that the definition clearly states "clearing the neighborhood", not merely "controlling" it. To counter Dr. Stern's point with the idea about "control" misses the argumentative point on purpose it would seem.

"Brown notes, however, that were the "clearing the neighborhood" criterion to be abandoned, the number of planets in the Solar System could rise from eight to more than 50, with hundreds more potentially to be discovered...." [www.wikipedia.com "Clearing the Neighborhood". Emphasis mine.]

Here again, what's the problem? Is there a problem with Jupiter having 67 moons while the Earth has only one? If the 50-plus massive bodies in the solar system are "planets", well, then that is the number of planets in our solar system. Some astronomers, it appears, fear having too many planets in the solar system ---for what reason, it is not clear. Science cannot survive if it adjusts a definition to accommodate a pre-conceived notion, denying the spacetime event under analysis.

Some astronomers counter answer as in the following case where a new criterion rationalizes the proposed IAU-2006 definition. However, this new criterion is not included in the original 2006 definition: "gravitational dominance":

"The orbits of these objects are entirely dictated by Neptune's gravity, and thus, Neptune is gravitationally dominant." [www.wikipedia.com "IAU definition of planet". Fair use. Emphasis mine.]

The definition stipulates "clearing the neighborhood", which means no other objects in its path. It does not state or suggest "clearing the neighborhood with other objects in its path as long as its own gravity dominates them". Exceptions to the definition are accepted by way of rationalizations, not material reasons in accordance with the terms of the definition. And, as Dr. Stern mentioned, if Neptune had cleared its orbit, then Pluto would not even exist! And, logically enough if 'other objects' are gravitationally dominant then they have not been cleared from the path.

Other aspects of the IAU-2006 definition are equally deficient in my view. Consider other specific word- concepts expressed by the IAU website.

Q: What is the exact wording of the official IAU proposed definition of planet?
A: A planet is a celestial body that (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium nearly round shape, and (c) has cleared the neighbourhood around its orbit. [IAU-Ibid]

The use of the word-concepts 'around' and 'round' in the definition are misleading at best. It is known that planetary/lunar orbits are represented by spiraling trajectories/path. They do not go "around" a particular sun or planetary object. The non-exact word-concepts such as 'around' and 'round' do not reflect the material relations that they supposedly represent, thus causing deficiencies in the definition.
The satellites/moons of planets also "orbit around the Sun"; they also pull-to-center their mass into nearly spherical or into oblate spherical shapes. And, although one may question the idea about planets orbiting "in a clear path", the moons of the planetary bodies in our solar system also "orbit in a clear path" around their respective planets, and around the Sun. This latter fact may be considered regarding the Earth|Moon binary system and their corresponding barycenter.

Haumea's extreme elongation makes it unique among known dwarf planets. It does not have a spherical shape, and therefore in fact violates the second part of the IAU-2006 definition.

"However, there is no one point at which an object can be said to have reached hydrostatic equilibrium. As Soter noted in his article, "How are we to quantify the degree of roundness that distinguishes a planet? Does gravity dominate such a body if its shape deviates from a spheroid by 10 percent or by 1 percent? Nature provides no unoccupied gap between round and nonround shapes, so any boundary would be an arbitrary choice...." [www.wikipedia.com "Clearing the neighbourhood". Emphasis mine.]

To state a definition that proposes the idea that planets "orbit around the Sun" is deficient on so many counts, too many to address fully. But, to propose the idea that planets "orbit around the Sun" as though their moons do not orbit around the Sun is simply incorrect. Especially when considering binary systems of a planet and its so-called satellite [Earth|Moon].

Coupled with the definition of a planet, the planet Pluto was said to not be a planet, but rather a "dwarf planet". If you accept the idea that "Pluto is not a planet, it is a dwarf planet", it is based on faulty logic of course, requiring no critical explanation. Secondary and subsequent definitions of what constitutes a 'dwarf planet' reflect the same lack of precision as the definition of a planet.

In fact, as we shall observe below, the term "dwarf" means "medium" size in the context of the IAU-2006 definition, ---not "small".

"The upper and lower size and mass limits of dwarf planets have not been specified by the IAU. There is no defined upper limit, and an object larger or more massive than Mercury that has not "cleared the neighborhood around its orbit" would be classified as a dwarf planet...." [www.wikipedia.com "Clearing the neighborhood". Fair use. Emphasis mine.]

A self-fulfilling prophecy as definition: certain things happen on a large planet like "squishing large mountains" 'because it is a large planet'.

Fraser: Right, I’ve heard that Mount Everest here on Earth for example, is the maximum size you can have a mountain, and that any larger and its just getting
smashed or squished at the bottom as fast as it’s growing on top. Pamela: Exactly, and this is because we have a large planet. It squishes large mountains and makes them just not get any bigger. [-Fraser Cain, Why Pluto is No Longer a Planet, January 5, 2012; (http://www.space.com/2791-pluto-demoted-longer-planet-highly-controversial-definition.html).]

Undoubtedly, the nomenclature regarding size of massive celestial bodies in astronomy in this regard has become somewhat confusing. To date, then, various word-concepts exist with shades of meaning proposed regarding the size of massive bodies in the solar system.

a) dwarf planets [Pluto, Eris, Ceres, Makemake and Haumea];
b) plutoids [Pluto and Eris two known and named plutoids]
c) ice dwarf [Ibid]
d) Plutinos [trans-Neptunian objects that share Pluto's type of orbit; a 3:2 resonance with Neptune]
   "In astronomy, a plutino is a trans-Neptunian object in 2:3 mean motion resonance with Neptune. For every 2 orbits that a plutino makes, Neptune orbits 3 times. Plutinos are named after Pluto, the first discovered object with this resonance." [www.wikipedia.com "Plutino". Emphasis mine.]

e) Trans-Neptunian Objects
f) Trans-Neptunian Dwarf Planet
g) small solar system bodies [solar system asteroids, near-Earth objects, Mars and Jupiter Trojan asteroids, most centaurs, most Trans-Neptunian objects and comets];
h) minor planets [still to be used, a synonym with small solar system bodies] and,
   "A minor planet is an astronomical object in direct orbit around the Sun that is neither a planet nor originally classified as a comet. Minor planets can be dwarf planets, asteroids, trojans, centaurs, Kuiper belt objects, and other trans-Neptunian objects."... Before 2006, the IAU had officially used the term minor planet. During its 2006 meeting, the Union reclassified minor planets and comets into dwarf planets and small Solar System bodies." [www.wikipedia.com "Minor planets". Emphasis mine.]
   "The term distant minor planet is used by the International Astronomical Union's Minor Planet Center to refer collectively to those minor planets found in the outer Solar System that are not commonly thought of as "asteroids". Included are the populations centaurs, Neptune trojans, and trans-Neptunian objects." [www.wikipedia.com "Distant minor planets". Emphasis mine. ]
i) planetesimals
j) embryonic planet
   "Scientists describe Ceres as an "embryonic planet." Gravitational perturbations from Jupiter billions of years ago prevented it from becoming a full-fledged planet. Ceres ended up among the leftover debris of planetary
formation in the main asteroid belt between Mars and Jupiter." [Emphasis mine.][https://solarsystem.nasa.gov/planets/profile.cfm?Object=Dwa_Ceres]

k) **planetoid**

"The term **dwarf planet** has itself been somewhat controversial, as it implies that these bodies are planets, much as dwarf stars are stars. [35] This is the conception of the Solar System that Stern promoted when he coined the phrase. The older word **planetoid** ("having the form of a planet") has no such connotation, and is also used by astronomers for bodies that fit the IAU definition.... Brown states that planetoid is "a perfectly good word" that has been used for these bodies for years, and that the use of the term dwarf planet for a non-planet is "dumb", but that it was motivated by an attempt by the IAU division III plenary session to reinstate Pluto as a planet in a second resolution.... Indeed, the draught of Resolution 5A had called these median bodies **planetoids**, ... but the plenary session voted unanimously to change the name to dwarf planet. The second resolution, 5B, **defined dwarf planets as a subtype of planet**, as Stern had originally intended, distinguished from the other eight that were to be called "**classical planets**". Under this arrangement, the twelve planets of the rejected proposal were to be preserved in a **distinction between eight classical planets and four dwarf planets**. However, Resolution 5B was defeated in the same session that 5A was passed.... Because of the semantic inconsistency of a dwarf planet not being a planet due to the failure of Resolution 5B, alternative terms such as **nanoplanet** and **subplanet** were discussed, but there was no consensus among the CSBN to change it...."

[www.wikipedia.com; Emphasis mine.]

l) **classical planet**

m) **planemo**

"The term **planemo** ("planetary-mass object") covers both dwarf planets and such moons, as well as planets.... Alan Stern considers them a special category of planets, "**satellite planets**"...."

[www.wikipedia.com "Clearing the neighborhood". Emphasis mine.]

"Nineteen moons are known to be **massive enough** to have relaxed into a rounded shape under their own gravity, and **seven of them are more massive than either Eris or Pluto. They are not physically distinct from the dwarf planets, but are not members of that class because they do not directly orbit the Sun. ... The term **planemo** ("planetary-mass object") covers both dwarf planets and such moons, as well as planets.... Alan Stern considers them a special category of planets, "**satellite planets**"...." [www.wikipedia.com Clearing the neighborhood". Fair use. Emphasis mine.]

n) **satellite planet**

Mike Brown: "It is hard to make a consistent argument that a 400 km **iceball** should count as a planet because it might have interesting geology, while a 5000 km **satellite** with a massive atmosphere, methane lakes, and dramatic
storms [Titan] shouldn't be put into the same category, whatever you call it." [www.wikipedia.com "Clearing the neighborhood". Emphasis mine.]

o) unterplanets

"Several years before the IAU definition, he [Allen Stern, the Director of NASA's mission to Pluto] used orbital characteristics to separate "überplanets" (the dominant eight) from "unterplanets" (the dwarf planets), considering both types "planets"..."[www.wikipedia.com "Clearing the neighborhood". Fair use. Emphasis mine.]

p) moon-sized protoplanets.

"A widely accepted theory of planet formation, the so-called planetesimal hypotheses, the Chamberlin–Moulton planetesimal hypothesis and that of Viktor Safronov, states that planets form out of cosmic dust grains that collide and stick to form larger and larger bodies. When the bodies reach sizes of approximately one kilometer, then they can attract each other directly through their mutual gravity, enormously aiding further growth into moon-sized protoplanets. This is how planetesimals are often defined." [www.wikipedia.com "Planetesimals". Emphasis mine.]

q) Prototype ..."The dwarf planet Pluto is recognized as an important prototype of a new class of Trans-Neptunian Objects. The IAU has given a new denomination for these objects: plutoids." [Emphasis mine; Ibid.]

r) asteroids,
s) populations centaurus,
t) Neptune trojans,
u) nanoplanet,
v) subplanet,
and, the like, infinitely so.

From the previous list, one may conclude that the definitions of word-concepts regarding the size of massive bodies in the solar system have their theoretical and practical issues concerning classification methodologies.

Further, besides considering the definition of "planet" in relation to the previous categories, one must take into consideration word-concepts such as "moon" and "satellite". Astronomers speak about a "cutting off point" for a planet, which also may be implied for the other categories cited with their own respective "cutting off points". Consideration the Cain|Gay interview once again:

Pamela: The debate’s been around for a while: what do we do, do we call Ceres a planet? How do we lump everything together? It all starts to come down to what makes one object different from another object, and how do the orbits play into all of this, and where do we put the cutting off point for a planet?
Fraser: How could you make Pluto and Charon a planet? Isn’t one a moon of the other?
Pamela: They both orbit a point that’s between them. Pluto goes in a small circle around a point outside of its body, and Charon also goes around the same point, but at a larger distance. So it’s more of a binary system. Just like we have binary stars, we also have Pluto and Charon which are binary to one another. They co-orbit a central point that is outside of Pluto.

Fraser: Oh okay, so the central point between, say, the Earth and the Moon, is actually inside the Earth?

Pamela: Inside the Earth. The Moon is clearly going around and around the Earth [!], whereas Charon and Pluto go around a point external to both of them. It’s a binary system, so they can be binary planets. But are they planets?

[-Fraser Cain, Why Pluto is No Longer a Planet, January 5, 2012; (http://www.space.com/2791-pluto-demoted-longer-planet-highly-controversial-definition.html ). Emphasis mine.]

Q: Is that all, only eight planets?

A: No. In addition to the eight planets, there are also five known dwarf planets. Many more dwarf planets are likely to be discovered soon. [IAU-Ibid]

Q: What new terms are used in the official IAU definition?

A: There are three new terms adopted as official definitions by the IAU. The terms are: planet, dwarf planet and small Solar System body. [IAU-Ibid; Emphasis mine.]

The word-concept 'planet' as a term is obviously not a "new term". The definitions of these three chosen word-concepts may be considered to be 'new' in a way. What stands out immediately is that two of the 'new' word-concepts appear to be redundant and/or synonymous, without clarification. The use of the word-concepts 'dwarf' and 'small' immediately strike one as attempting to distinguish, non-scientifically a difference in 'size' of the mass of a planetary body. Elsewhere it has been noted that the word-concept "minor planet" is employed instead of "small solar system body".

The three 'new' word-concepts appear to suggest the idea of "biggest, bigger, big" or, "large-medium- small", or something of that sort related to size of mass alone. Size-wise, from small to large, the sequence would be: small solar system body; dwarf planet; and planet.

There are two ways to view the three proposed word-concepts:

small solar system body; dwarf planet; and [none given] planet, [as an adjective] and/or,
small solar system body; dwarf planet; and planet. [noun]

In either case, the three word-concepts reflect inconsistencies among themselves as in neither case (as an adjective or as a noun) are the three objects specified consistently. A final perspective might consider "solar system" being an adjectival stand-alone category, not represented in the other two word-concepts.
small solar system body; dwarf [not given] planet; and [not given] planet. For consistency these should read:
small solar system body; dwarf [solar system] planet; and [solar system] planet. Further, one may understand the implied meaning as:
small solar system body; [~ small] dwarf solar system planet; and [~ medium] solar system planet. [~ large]

The characteristics of large|medium|small are not identified consistently as of the word-concepts defined by the IAU, but rather are deduced from the sketchy explanations of those vague word-concepts. Initially, for example, I thought that 'dwarf' and 'small' were synonymous. But not so within the IAU context; they mean 'medium' and 'small' respectively.

In order to derive a consistency in theoretical thinking for the three supposedly "new word-concepts", according to their own apparent internal logic, each would have to cover the three cited aspects: size [small- medium-large]; type [body-planet]; and placement [solar system & extra-solar system]. However, deriving a theoretical set of word-concepts for defining 'planets and their satellites' would require additional criteria from the three suggested in the cited word-concepts. Such a proposal is not the mission of this essay at this time.

I am only questioning the internal logic of the three "new" word-concepts being proposed by the IAU-2006. Defining the nature of planetary bodies and their satellites in our solar system requires an additional effort not to be based upon the one demonstrated by the IAU resolution.

It is in spite of the IAU-2006 definition commonly found that the concept dwarf planet is redundantly defined as being a 'small planet'. 'Dwarf' and 'small' become synonymous and redundant concepts, although never made precise as to how much mass they contain. A Google definition for dwarf planet appears as: "dwarf planet, a celestial body resembling a small planet but lacking certain technical criteria that are required for it to be classed as such." Confusion of this sort exists among different authorities.

A: Pluto now falls into the dwarf planet category on account of its size and the fact that it resides within a zone of other similarly-sized objects known as the transneptunian region. [IAU-Ibid]

Popular definitions derive from the IAU-2006 resolution. Consider a few random examples:

a) dwarf planet, noun, Astronomy
   a celestial body resembling a small planet but lacking certain technical criteria that are required for it to be classed as such. [google] [A synonym, small, explains the concept to be defined.]
b) *dwarf planet*, noun
a spherical celestial body revolving about the sun, similar to a *planet but not large enough* to gravitationally clear its orbital region of most or all other celestial bodies. Pluto is a dwarf planet.

c) The actual definition of "dwarf planet" is *kind of technical*:
a celestial body that is in orbit around the Sun, has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, has not cleared the neighbourhood around its orbit, and is not a satellite. In short, *something that looks like a planet but isn't a planet*. [http://nineplanets.org/dwarf.html]

I also find it unfortunate that the astronomers have employed a culturally charged word-concept, such as 'dwarf', as an identifier for scientific explanation. The word-concept 'medium' may not be accepted because it is not scientifically based, in that it receives its meaning relationally vis-a-vis the two other word-concepts (large|small). Yet, some implicitly suggest it to be opposite to large. The need to distinguish between 'dwarf' and 'small' has been forced upon the discussion, with no material need for their existence.

Q: What is a *dwarf planet*?
A: A dwarf planet is an object in orbit around the Sun that is large enough (massive enough) to have its own gravity pull itself into a round (or nearly round) shape. Generally, a dwarf planet is smaller than Mercury. A dwarf planet may also orbit in a zone that has many other objects in it. For example, an orbit within the asteroid belt is in a zone with lots of other objects. [IAU-Ibid]

Q: Why is Pluto now called a dwarf planet?
So, how do astronomers define the level of mass required for a massive body to be classified as a planet? How do they define "large enough"? They don't in fact. The word-concepts are vague and undefined in this regard. Consider a few randomly selected examples from the science literature regarding a planet and a dwarf planet. A definite classification of a planet is not proposed as may be observed in the following selected common citations: A planet:

- "has to have sufficient mass";
- has to be "large enough" to have cleared its path;
- "large enough (massive enough)"
- "similar to a planet but not large enough";
- "not massive enough to be rounded by their own gravity";
- "generally, dwarf planet is smaller than Mercury"; etc.
- "bodies that are large enough to have cleared their orbit of planetesimals";
- "object too small to be either a planet or dwarf planet";
- "too small (not massive enough)";
"too small (not sufficiently massive)";
"sufficient mass for their self-gravity to overcome rigid body forces so that they assume a hydrostatic equilibrium";
"massive enough that their shape is dictated by self-gravity";
"a dwarf planet cannot be a satellite, even if they are massive enough that their shape is dictated by self-gravity";
"definite planets...nice, fairly large objects";
"a large planet" [Earth];
"a smaller planet [Mars]"
"giant moons that are in fact much bigger than Pluto";
etc.

One may validly ask how does the word-concept "giant" relate to the implicit large|medium|small scale related to the "dwarf" concept. Remember my initial statement about how paradigm shifts affect related word-concepts, at times overlooked by theoreticians, until the need arrives to define those concepts. How might one define giant|large|medium|small in terms of celestial bodies; by massive size alone?

It matters not to offer citation data regarding the previously quoted word-concepts, as their vagueness is nothing to commit to memory. The final impression is that "a planet has to be large enough to be considered a planet". Such a statement similar to geography might be: "a continent has to be large enough to be considered a continent".

"The new classification systems says that bodies that are large enough to have cleared their orbit of planetismals are defined as planets. On the other end of the spectrum, those bodies that are not massive enough to be rounded by their own gravity are defined as small solar system bodies. Dwarf planets are in between. There is some controversy about the system that is mainly based on a lack of observation of a few of the dwarf planets. ["What Is A Dwarf Planet", by Jerry Coffey on September 2, 2010]

Consider "giant" planets as a word-concept identifier in this regard:

... "giant planets (particularly Jupiter and Neptune). A few planetesimals may have been captured as moons, such as Phobos and Deimos (the moons of Mars), and many of the small high-inclination moons of the giant planets." [www.wikipedia.com "Planetesimal". Emphasis mine of the size-related word-concepts.]

In other words, giant planets have giant moons; large breeds large. It is no wonder that ill-defined word-concepts lead to statements such as the following:

"The definition [of a planet] should stand, but we need to recognize that what may be a planet today, tomorrow we may realize is not really a planet". [Pamela
A Spacetime/motion Analysis of the Word-concept "Planet"


The theoretical issue is to understand "what we realize". In terms of spacetime/motion [not in terms of definitions] Pluto is what it is, no matter how we define it; so it was, is and always shall be as long as it exists as a spacetime/motion event.

And, based upon the following exchange alone, the word-concept "dwarf" planet should not be employed due to its culturally negative connotations as illustrated by Dr. Gay's following comment.

Begin quote:
Fraser: Walt Disney's going to be mad".
Pamela: That poor pseudo-dog!
Fraser: Yeah.
Pamela: He's never been given any respect, and now he's not even named after a planet, he's named after a dwarf planet". [Emphasis mine.]
End quote.

The previous exchange confirmed my initial fear upon hearing the word-concept of a "dwarf planet" that the cultural negative connotation of the word "dwarf" was an unfortunate word choice by astronomers. Historically, the word-concept as in "dwarf star" is historically documented, but it is time to become more sensitive towards certain cultural connotations in specific word-concepts that do not merit any scientific usage especially through a weak analogy based on size alone.

An anonymous critical reply to the Cain|Gay interview is posted in strong language at the end of the full transcript cited above:

"Reply; " Passingby; "May 1, 2014 at 1:37 pm
"Demoting Pluto was the dumbest decision ever from the IAU.
"Firstly, the 2006 definition is highly controversial, Dr. Pamela Gay is falsely representing the facts (also known as lying) when she says the "astronomical community" decided to demote Pluto. As NASA lead researchers have pointed out less than 5% of IAU voted on Pluto's demotion. 5% of a community can not be qualified as "the community". (http://www.space.com/2791-pluto-demoted-longer-planet-highly-controversial-definition.html).

"Secondly, on a more practical level for scientists, the demotion of Pluto has hurt the public's interest and support in planetary studies. When we're at the point where scientists seem to be busy not discovering anything new, but actually "bureaucratically" undiscovering popularly regarded things (for controversial
... it’s little wonder the public becomes uninterested in planetary studies. For the general public, it gives the false impression that everything worth knowing about has already been discovered.

"If the issue was really the handful of IAU members itching for a redefinition of the word “planet” at the time (there are always a number of bureaucrats in any “community”), the right decision at the time would have been to include Pluto and anything larger. It would have only bumped the number of planets to 10. And would have actually increased the public’s interest in planetary studies instead of decreasing it.

"We’re STILL paying the price for this demotion today. Apart from that, yeah, great job 5%, thank you again. [Transcript, "Pluto’s Planetary Identity Crisis"; (http://www.space.com/2791-pluto-demoted-longer-planet-highly-controversial-definition.html). Emphasis mine.]"
Part Two

A Spacetime/motion Analysis of the IAU-2006 Definition of a "Planet"

Behind the purported "official definitions" there lies an essential problem of a theoretical and practical

The issue at hand is whether to assume the definition defines reality or, whether reality defines the definition. At times, as in the case of the IAU-2006 definition, the discussion surrounding its origin appears to reflect positions that emphasize the definition defines reality. One may suggest that this is a problem of wording, when in reality it appears to be a conceptual problem as to what constitutes reality.

"There are currently five dwarf planets: Pluto, Eris, Makemake, Haumea, and Ceres. Only Ceres and Pluto have been observed enough to indisputably fit into the category. The IAU decided that unnamed TNOs with an absolute magnitude brighter than +1 (and a mathematically delimited minimum diameter of 838 km) are to be named as dwarf planets. It is possible that there at least another 40 known objects in the solar system are dwarf planets. Once the Kuiper belt and the scattered disc are fully explored, there may be as many as 2,250 dwarf planets. That does not even take into account the Oort cloud.
Understanding what is a dwarf planet according to the IAU is easy enough, but making the solar system fit into a three tiered classification system will prove increasingly difficult as our understanding of the universe increases and we are able to see farther and farther into space."
[" What Is A Dwarf Planet", by Jerry Coffey on September 2, 2010, Source: NASA]

Remember it appeared that astronomers were fearful the number of planets in our solar system might multiply and that was one apparent reason to inventing the definition of a dwarf planet. Now that the definition of a dwarf planet has been taken seriously in official terms, there is a fear that there may be thousands of dwarf planets. The lesson to be learned is that scientists must recognize reality as they apprehend it, and strive to attain systematic thought in their analyses.

The previous commentary and review should be sufficient to reconsider abandoning the use of the word- concept "dwarf planet" by astronomers. The negative cultural connotation linked historically to the word-concept 'dwarf', as exemplified in some of the previous comments is reason enough.
Obviously, there is nothing wrong with creating word-concepts based on large-medium-small. These word-concepts are employed profusely throughout all sciences. There is something wrong with using a planet/dwarf planet/small solar system body to merely represent the idea of size as in large/medium/small. The issue at hand is to physically represent exactly what does large-medium-small mean, in this case, in terms of massive bodies in the solar system. The apparent "logic" of a range from large to small may not have the same implications in terms of massive bodies. But, one must classify the bodies according to their mass if not for any other reason than to indicate their size.

Instead of using "large planet", "medium planet" and "small planet", for some unknown reason astronomers use respectively the confusing word-concepts of "planet", "dwarf planet" and "small solar system body". Plus, they avoid defining exactly in terms of mass what determines the three selected categories, other than themselves using at times "large enough", "sufficiently massive", etc.

From the perspective of size alone, the IAU-2006 definition of the word-concept "planet" is therefore non-systematic and partial. With regard to other variables in its analysis of the features of a massive body in our solar system, which it calls a "planet", that same non-systematic approach is present.

**Spacetime/motion Analysis**

In order to counter that random analysis, the three cited characteristics in the definition of a planet require a spacetime/motion analysis. What are the different aspects/levels [space], moments/processes [time], and relations/systems [motion] of the three cited features in the IAU-2006 definition.

Let us recall the text of the IAU-2006 definition here once again:

"A celestial body that (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, and (c) has cleared the neighbourhood around its orbit." [IAU website. http://www.iau.org/public/themes/pluto/]

Now, consider each one of the word-concepts employed in the IAU-2006 definition of a planet in terms of and as representative of spacetime/motion. In the following commentary I consider the word-concepts in the definition and which feature of spacetime/motion each one portrays. I present each word-concept in the definition and indicate which spatial, temporal and relational coordinates it represents. A spacetime/motion analysis consists of identifying each word-concept in the IAU-2006 definition and indicating which spatial, temporal, relational coordinates it represents.
A Spacetime/motion Analysis of the Word-concept "Planet"

Spatial Coordinates:

Space-aspects/levels:
Body | Sun | Mass | Forces | Neighborhood | Orbit

"A celestial body that (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, and (c) has cleared the neighbourhood around its orbit." [Source: IAU website. http://www.iau.org/public/themes/pluto/; emphasis mine]

Temporal Coordinates:

Time-moments/processes:
Is-present | Has-present | To overcome-future | Assumes-present | Has Cleared-present/past

"A celestial body that (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, and (c) has cleared the neighbourhood around its orbit." [Source: IAU website. http://www.iau.org/public/themes/pluto/; emphasis mine]

Relational Coordinates:

Motion-relations/systems:
Celestial | Orbit around the Sun | Self-gravity | Rigid | Forces | Assumes | Hydrostatic equilibrium | Nearly round shape | Cleared the neighborhood | Around its orbit

"A celestial body that (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, and (c) has cleared the neighbourhood around its orbit." [Source: IAU website. http://www.iau.org/public/themes/pluto/; emphasis mine]

I have placed in bold letters certain word-concepts employed in the IAU-2006 definition that suffer from vagueness, since they themselves require a definition or, are simply deficient, inexact. One could list others (such as 'cleared'), but for now the emphasis merely points out certain vagueness in the definition.

As may be viewed from a spacetime/motion analysis of the IAU-2006 definition of the word "planet", the proposed definition includes numerous spacetime/motion events in past-present-future time in various relationships among those events.

For this reason alone [numerous events in past-present-future time in various relationships], it is no wonder that a single word-concept will have difficulty in reflecting or representing so many different aspects/moments/relations.

Generally the IAU-2006 definition is said to contain three aspects: size | self-gravity | clearing the neighborhood.
As may be observed in the spacetime/motion analysis of all of the word-concepts contained in the IAU-2006 definition, there are basically **21** (if not more) aspects/moments/relations referenced in said definition.

*Six [6] word-concepts reflect *spatial*-aspects/levels*

*Five [5] word-concepts reflect *temporal* moments/processes*

*Ten [10] word-concepts reflect *relational* relations/systems*

It may be excessive to expect that one word-concept (planet) might effectively reflect three distinguishing characteristics of spacetime/motion (size|self-gravity|clearing neighborhood).

But, to expect a single word-concept to effectively represent 21 distinguishing characteristics of a spacetime/motion event (planet) seems impossible.

From the previous analytical exercise, it is obvious that the IAU-2006 definition does not reference in any detail the **type of orbit** experienced by the massive bodies in our solar system. For example, the characteristic of a binary system and its **barycentric point** is not listed. When in fact, in my view, in order to define the relationships of massive bodies in the solar system, their orbital relation must be at the head of the list. Similar positions appear to have arisen during the debates around the definition of a planet within the IAU meeting, but those views did make it into the final resolution. However, such discussions regarding a binary system and the definition of a planet appear to be unclear as shown in the following comment:

"In a draft resolution for the IAU definition of planet, both Pluto and Charon would have been considered dwarf planets in a binary system, given that they both satisfied the mass and shape requirements for dwarf planets and revolved around a common center of mass located between the two bodies (rather than within one of the bodies).... The IAU currently states that Charon is not considered to be a dwarf planet and is just a satellite of Pluto, although the idea that Charon might qualify to be a dwarf planet in its own right may be considered at a later date. ... The location of the barycenter depends not only on the relative masses of the bodies, but also on the distance between them; the barycenter of the Sun–Jupiter orbit, for example, lies outside the Sun." ...

"For two or more objects comprising a multiple object system.... A secondary object satisfying these conditions i.e. that of mass, shape is also designated a planet if the system barycentre resides outside the primary. Secondary objects not satisfying these criteria are "satellites". Under this definition, Pluto's companion Charon is a planet, making Pluto–Charon a double planet." [www.wikipedia.com "Clearing the neighborhood". Emphasis mine.]

"Pluto has five known moons: Charon (the largest, with a diameter just over half that of Pluto), Nix, Hydra, Kerberos, and Styx.... Pluto and Charon are sometimes
described as a binary system because the barycenter of their orbits does not lie within either body. The IAU has yet to formalise a definition for binary dwarf planets, and Charon is officially classified as a moon of Pluto...."
[www.wikipedia.com "Pluto". Emphasis mine.]

"In astronomy, double planet and binary planet are informal terms used to describe a binary system where both objects are of planetary mass."... The now-abandoned co-accretion hypothesis of the origin of the Moon is also called the double-planet hypothesis. The idea is that two bodies should be considered a double planet if they accreted together directly from the proto-planetary disk, much as a double star typically forms together.
[www.wikipedia.com "Double planet". Emphasis mine.]

Further, there is no reference regarding the rotation of the planetary bodies.

From this previous spacetime/motion review of the definition's word-concepts, one may conclude that the definition of a "planet" as proposed by the IAU in 2006 contains various deficiencies. As we have examined before, some of these deficiencies are carried over into the secondary observations regarding the informal definition of a "dwarf planet" and what have been called "small solar system bodies" and "plutoids".

A spacetime/motion analysis of these secondary definitions dwarf planet and small solar system body would reveal similar deficiencies as those encountered in the IAU-2006 definition of a "planet". It is unnecessary to effect a comprehensive spacetime/motion analysis of the word-concepts proposed by the IAU-2006, as these have been identified more informally throughout the literature.

An initial observation for the word-concept "dwarf planet" would include all of the above-listed aspects/moments/relations for the word-concept "planet", plus the two main additional ideas cited for a "dwarf planet".

Space-aspects/levels:
Dwarf; Spherical shape (hydrostatic equilibrium)

Time-moments/processes:
Has not cleared - present/past

Motion-relations/systems:
Not cleared its orbital path; Hydrostatic equilibrium (spherical shape)

Supposedly, according to the subsequent literature, a "dwarf planet" references the idea of a planet of a smaller size than a "regularly large" planet, which is redundant in its statement. And, supposedly a "dwarf planet has not cleared its orbital path of other objects", whatever that means. I say whatever that means because some astronomers appear to split hairs when speaking about planets like Earth and Jupiter that still have objects in their orbital path that they continually have to clear our of their way on their path "around" the Sun [whatever that means as well].
"Consider this: Pluto crosses into Neptune's orbit, but Neptune is still classified a planet. This is because of the orbits of Pluto and Neptune and that they never get closer to each other than 17AU (AU=distance from Earth to the Sun). Pluto may cross orbits with many other Kuiper Belt Objects, but how close do these objects get to Pluto? How close do objects have to get to Pluto to be considered "in" Pluto's neighborhood?"

http://missionscience.nasa.gov/images/wiap/wiap_mainContent_img03.png

"A cis-Neptunian object is, literally, any astronomical body found within the orbit of Neptune. [...Neptune trojans, named by analogy to the Trojan asteroids of Jupiter, are a stable reservoir of small bodies sharing Neptune's orbit.... As of August 2012, all known Neptune trojans except two lie in an elongated region around the L4 Lagrangian point 60° ahead of Neptune.

[www.wikipedia.com "Cis-Neptunian. Emphasis mine.]

If there is a definition problem with Pluto passing through Neptune's orbit, the same applies inversely. Neptune must also be a dwarf planet in that it has not cleared it orbital path either, since Pluto crosses through Neptune's orbital path. In this sense, neither Pluto nor Neptune, nor Jupiter, have cleared their neighborhood completely. The "cleared-their-neighborhood" thesis or proposition, in my view, appears to be a theoretical word-concept forced upon Nature. For example, Jupiter shall never apparently clear its Lagrangian points of its Trojan asteroids occupying its orbit.

Then due to the asteroid belt between Mars and Jupiter, both Mars and Jupiter could be defined as dwarf planets since neither of them cleared completely their orbital paths that are adjacent and close to the asteroid belt between them.

And, given the fact that all known planets exist within the spherically all-encompassing Oort Cloud, all planets could be defined as dwarf planets since none of them have cleared completely the objects in the Oort Cloud.

"Because Eris appeared to be larger than Pluto, its discoverers... and NASA initially described it as the Solar System's tenth planet. This, along with the prospect of other similarly sized objects being discovered in the future, motivated the International Astronomical Union (IAU) to define the term planet for the first time. Under the IAU definition approved on August 24, 2006, Eris is a "dwarf planet", along with objects such as Pluto, Ceres, Haumea and Makemake.... However, observations of a stellar occultation by Eris in 2010 showed that its diameter was only 2326±12 km, not significantly different from the size of Pluto.... Given the uncertainties in their size estimates, there is a reasonable chance that Eris is actually smaller than Pluto.... However, Pluto's atmosphere makes determining its diameter difficult, and until the New Horizons probe arrives at Pluto the diameter is expected to remain unknown. Because of that, many scientists believe that the knowledge of whether Pluto or Eris is bigger will be unknown until then." [Source: www.wikipedia.com; emphasis in bold mine.]
A distinction may be made within the definition regarding internal|external relationships.

<table>
<thead>
<tr>
<th>Internal</th>
<th>External</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Subject)</td>
<td>(Object)</td>
</tr>
</tbody>
</table>

**Space-aspects/levels:**
- Body | Mass | Forces | Orbit

**Time-moments/processes:**
- Is-present | Has-present | To overcome-future | Assumes-present | Has Cleared-present/past

**Motion-relations/systems:**
- Celestial | Self-gravity | Rigid | Forces | Assumes | Hydrostatic equilibrium | Nearly round shape

<table>
<thead>
<tr>
<th>Motion-relations/systems:</th>
<th>Motion-relations/systems:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orbit around the Sun</td>
<td>Cleared the neighborhood</td>
</tr>
<tr>
<td>Around its orbit</td>
<td></td>
</tr>
</tbody>
</table>

**Observation:** the time-moments/processes of the objects referenced in the definition (Sun, neighborhood) depend directly upon the times listed for the subjects (planets), but have no individual expression.

The IAU-2006 definition of a "planet", then contains 4 internal spatial aspects; 2 external spatial aspects; 5 internal temporal events; no external temporal events; 6 internal relational events; and 2 external relational events.
It is not so much a question of defining a planet, but rather of differentiating one kind of massive body from another in the solar system. It is a question of listing shared characteristics in comparison to the unshared ones.

The internal|external dichotomy references whether the wording of the definition refers to the word- concept planet itself (internally) or to some other body outside and in relationship to the planet (externally).

Hence, there are characteristics of a planet contained in the IAU-2006 definition that refer to the internal composition and form of a planet, and others that refer to the planet in relationship to other objects outside of the planet. Imagine for a moment the definition of a "human being" relating not only to its internal composition but also to its sociological relationships with other human beings and/or aliens. Such an attempt at defining the human in this manner would result in equal deficiencies as those encountered in the IAU-2006 definition of a "planet". The analogy with a "dwarf human being" obviously enters the analytical picture here.

Understandably, composition and size do not alone define and/or describe a human being, just as they do not effectively define and/or describe massive bodies in our solar system.

At this point it is significant to note that the entire discussion regarding the IAU-2006 definition of a "planet" has occurred without extended deliberation about the concept of a satellite and/or moon of a planet.

In my view, it is impossible to define a planet|dwarf planet|small solar system body without explicitly incorporating the definition of their moons|satellites ---whether they are a binary system or not.

To this end, I simply list a basic reference to the planets' moon in our solar system. The mere reading of this list should awaken ideas about the definition of a planetary body.

"Our data have improved considerably in the last 20 years.
Mercury: no moons
Venus: no moons
Earth: 1 moon
Mars: 2 moons, Phobos, Deimos
Jupiter: 67 moons, some of which do not yet have proper names.
The most famous are the Galilean moons, Io, Europa, Ganymede and Callisto.
Saturn: 62 moons, some of which do not yet have proper names.
The most famous, by far, is Titan, which is significantly more massive than any other Saturnian moon.
Uranus: 27 moons, all of which are named after characters in the works of Shakespeare and Alexander Pope. Five are well known; Titania, Oberon, Miranda, Ariel, Umbriel."
Neptune: 14 moons, the most massive by far being Triton.
Pluto: 5 moons, Charon, Nix, Hydra, Kerberos, Styx

While Pluto, Eris, Haumea, Orcus and Quaoar are considered dwarf planets, they nevertheless have moons."

[http://www.enotes.com/homework-help/how-many-moons-does-each-planet-have-289486]

The previous list could be written as of the distinction between a large and small [dwarf] planet:

- Large planet Mercury: -
- Large planet Venus: -
- Large planet Earth: 1 moon
- Large planet Mars: 2 moons
- Large planet Jupiter: 67 moons
- Large planet Saturn: 62 moons
- Large planet Uranus: 27 moons
- Large planet Neptune: 14 moons
- Small planet Pluto: 5 moon
- Small planet Eris -
- Small planet Haumea 2 known moons
- Small planet Orcus 1 moon
- Small planet Quaoar 1 known moon
- Small planet Makemake No known satellites

[http://www.enotes.com/homework-help/how-many-moons-does-each-planet-have-289486]

I do not understand how one may modify the meaning or definition of a planet, but leave untouched the meaning or definition of a planet's moon. The IAU-2006 definition of a dwarf planet leaves intact the concept of the moons of planets, when a corresponding modification should be made for the moons of a planet and of a dwarf planet.

There appears to be a dubious aversion to calling "dwarf" planets small planets, while at the same time, as noted above throughout the discussion, astronomers make specific reference to "large" planets. In my view, the dichotomy "large|dwarf" confuses the naturally "large|medium" dichotomy referencing size [remember the word- concept dwarf is referencing being between large and small].

The fact remains, that by employing the word-concept "dwarf planet" and supposedly stripping Pluto of its status as a planet, in fact, that has not happened. There appears to be the statement that Pluto is no longer a planet, while at the same time calling it a "dwarf planet". This in itself demonstrates the lack of systematic spacetime analysis in the IAU-2006 definition.

"NASA has announced that it will use the new guidelines established by the IAU.... However, Alan Stern, the director of NASA's mission to Pluto, rejects the current
IAU definition of planet, both in terms of defining dwarf planets as something other than a type of planet, and in using orbital characteristics (rather than intrinsic characteristics) of objects to define them as dwarf planets…. Thus, as of 2011, he still referred to Pluto as a planet,… and accepted other dwarf planets such as Ceres and Eris, as well as the larger moons, as additional planets….

Several years before the IAU definition, he used orbital characteristics to separate "überplanets" (the dominant eight) from "unterplanets" (the dwarf planets), considering both types "planets"….

The final vote has come under much criticism because of the relatively small percentage of the 9000- strong membership who participated. Besides the fact that most members do not attend the General Assemblies, this lack was also due to the timing of the vote: the final vote was taken on the last day of the 10-day event, after many participants had left or were preparing to leave. The claim is that of over 2,700 astronomers attending the conference, only 424 votes were cast, which is less than 5% of the entire community of astronomers…. However, that number was for Resolution 6A, and not the pertinent Resolutions 5A and 5B, whose votes were sufficiently one- sided to not require counting…. Furthermore, polling statistics show that sampling 424 members out of a population of 9,000 yields a result with high accuracy (confidence interval better than 5%)…. There is also the issue of the many astronomers who were unable or who chose not to make the trip to Prague and, thus, cast no vote. Astronomer Marla Geha has clarified that not all members of the Union were needed to vote on the classification issue: only those whose work is directly related to planetary studies….

Finally, from a purely linguistic point of view, there is the dichotomy that the IAU created between 'planet' and 'dwarf planet'. The term 'dwarf planet' arguably contains two words, a noun (planet) and an adjective (dwarf). Thus, the term could suggest that a dwarf planet is a type of planet, even though the IAU explicitly defines a dwarf planet as not so being. By this formulation therefore, 'dwarf planet' and 'minor planet' are best considered compound nouns. Benjamin Zimmer of Language Log summarised the confusion: "The fact that the IAU would like us to think of dwarf planets as distinct from 'real' planets lumps the lexical item 'dwarf planet' in with such oddities as 'Welsh rabbit' (not really a rabbit) and 'Rocky Mountain oysters' (not really oysters)."… As Dava Sobel, the historian and popular science writer who participated in the IAU’s initial decision in October 2006, noted in an interview with National Public Radio, "A dwarf planet is not a planet, and in astronomy, there are dwarf stars, which are stars, and dwarf galaxies, which are galaxies, so it's a term no one can love, dwarf planet."… Mike Brown noted in an interview with the Smithsonian that, "Most of
the people in the dynamical camp really did not want the word "dwarf planet," but that was forced through by the pro-Pluto camp. So you're left with this ridiculous baggage of dwarf planets not being planets...."
[www.wikipedia.com "Double Planet". Emphasis mine.]

To state it mildly: if you know someone who accepts the statement, "Pluto is not a planet; it is a dwarf planet," then you might want to suggest their taking a refresher course in Logic 101. This kind of faulty reasoning definitely cannot serve as theoretical basis for defining word-concepts in science writing. A popular analogy might be: "It's not a car, it's a sports car." It may not be long before Australia becomes a dwarf continent if we are not careful.

With this, I have presented a spacetime/motion analysis of the word-concepts of the IAU-2006 definition.
Part Three

A Spacetime/motion Analysis of Massive Bodies in a Solar System

I am not going to effect a spacetime/motion analysis of a planet here, but merely demonstrate all of the aspects/levels, moments/processes, and relations/systems that intervene in the existence of a massive body called a planet.

The problem with debating definitions is that the so-called theoretical discussion appears to override the physical objects that require a spacetime/motion analysis. However, the so-called theoretical debates are insignificant in the final analysis ["You say tomato, I say tomâto…etc."]

In order to analyze the nature of massive bodies, specifically a "planet", in our solar system, one must consider the distinct aspects listed through a comprehensive spacetime/motion analysis. It is impossible to effect such an exhaustive and comprehensive analysis in this brief essay. This in fact is not the purpose of this brief commentary. My purpose here has been to simply distinguish the way in which the IAU has defined a "planet", and the manner in which a spacetime/motion analysis would be effected.

Consider then the distinct aspects/levels, moments/processes, and relations/systems of the massive bodies in our solar system. All of these distinct aspects/moments/relations must be filled in so as to carry out an exact spacetime/motion analysis. The list below is not exhaustive, but merely presents selected aspects/relationships for such an analysis.
Past/present/future tenses are complete regarding three main classifications of time. The specifics of the differentiation of times, temporal moment, of the relations/systems enter the analysis later.

"In 2003, the IAU officially released a statement to define what constitutes an extrasolar planet and what constitutes an orbiting star. To date, it remains the only official decision reached by the IAU on this issue. The 2006 committee did not attempt to challenge it, or to incorporate it into their definition, claiming that the issue of defining a planet was already difficult to resolve without also considering extrasolar planets...."

[www.wikipedia.com "Double Planet". Emphasis mine.]

### Characteristics of Massive Bodies in Solar Systems

<table>
<thead>
<tr>
<th>Space-aspects/levels:</th>
<th>Space-aspects/levels:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Massive body</td>
<td>Sun</td>
</tr>
<tr>
<td>Mass</td>
<td>Binary companion</td>
</tr>
<tr>
<td>Orbital trajectory</td>
<td>Other massive bodies</td>
</tr>
<tr>
<td>Composition</td>
<td>Quantifiable data sets</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>Qualitative data sets</td>
</tr>
<tr>
<td>Gravity</td>
<td>Etc.</td>
</tr>
<tr>
<td>Forces</td>
<td></td>
</tr>
<tr>
<td>Fields</td>
<td></td>
</tr>
<tr>
<td>Angular inclination</td>
<td></td>
</tr>
<tr>
<td>Temperatures</td>
<td></td>
</tr>
<tr>
<td>Quantitative data sets</td>
<td></td>
</tr>
<tr>
<td>Qualitative data sets</td>
<td></td>
</tr>
<tr>
<td>Etc.</td>
<td>Etc.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time-moments/processes:</th>
<th>Time-moments/processes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Past-Present-Future</td>
<td>Past-Present-Future</td>
</tr>
<tr>
<td>Orbital timing</td>
<td>Orbital timing</td>
</tr>
<tr>
<td>Periodic timing</td>
<td>Periodic timing</td>
</tr>
<tr>
<td>Periodicity patterns</td>
<td>Periodicity</td>
</tr>
<tr>
<td>Nutation</td>
<td>Nutation</td>
</tr>
<tr>
<td>Etc.</td>
<td>Etc.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Motion-relations/systems:</th>
<th>Motion-relations/systems:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placement within Solar system</td>
<td>Solar system placement in the galaxy</td>
</tr>
<tr>
<td>Celestial placement</td>
<td></td>
</tr>
<tr>
<td>Self/Extra gravity</td>
<td>Orbital trajectory</td>
</tr>
<tr>
<td>Rotation</td>
<td>Orbital</td>
</tr>
<tr>
<td>Development</td>
<td>path</td>
</tr>
<tr>
<td>Hydrostatic equilibrium</td>
<td></td>
</tr>
<tr>
<td>Shape</td>
<td></td>
</tr>
<tr>
<td>Rigid body forces</td>
<td></td>
</tr>
<tr>
<td>Orbital trajectory</td>
<td></td>
</tr>
<tr>
<td>Orbital path</td>
<td></td>
</tr>
<tr>
<td>Rotational axis</td>
<td></td>
</tr>
<tr>
<td>Angle of inclination</td>
<td></td>
</tr>
<tr>
<td>Etc.</td>
<td>Etc.</td>
</tr>
</tbody>
</table>
It is ludicrous to think that a single word-concept could describe or represent all of the cited relationships above that intervene to identify (define) a planet.

Further, astronomers appear to be resisting an obvious fact. There are different barycentric points to the solar system and these are the result of solar system multi-gravitational relations with all massive bodies, including Pluto and those bodies yet to be discovered in the solar system.

**One group** [inner planets] entails the Sun|Mercury|Venus|Earth|Mars multi-gravitational relationship. [www.earthmatrix.com/bi-gravitational_solar_system.pdf]


A **third group** consists of the Sun|Trans-Neptunian multi-gravitational relationship.

The **fourth group** entails the Oort Cloud of spherical shape in a sense that enshrouds the entire solar system.

There may be reason to believe that undetermined groups exist beyond these cited groups in the science literature.

With the asteroid belt bodies it can be said that analogy, the solar system itself has not cleared its path of other objects.

**Further, the solar system that we live in entails the**
Sun|Mercury|Venus|Earth|Mars|Jupiter|Saturn|Uranus|Neptune|Pluto|Trans-Neptunian | Oort Cloud

relationship on another level of multi-gravitational existence and analysis.

And, so, and so on, infinitely so…, with as many variations as massive bodies exist in the solar system --- irrespective of their assigned nomenclature [given names].

Some astronomers recognize the existence of scores of planets in our solar system. Consider the following image illustrating "The New Solar System":

"Some scientists believe that if Pluto remains classified as a planet, then the dozens of Kuiper Belt Objects (KBO's) orbiting our Sun would also be classified as planets. Our solar system would have the 9 original planets, an additional 43 KBO's, and more as they are cataloged.." Fair use.
http://missionscience.nasa.gov/images/wiap/wiap_mainContent_img03.png

Still, planets do not exist as such; massive bodies exist in gravitational relations to themselves.
The complexity of the multi-gravitational relationships of all of the identified massive bodies in the solar system (including the Sun of course) represents our solar system. It matters not what we call all of these massive bodies, but rather that we know the nature of their existence and their multi-gravitational relationships. All of the massive bodies in the solar system exist multi-gravitationally to one another.

Some relationships, such as a binary system [Earth|Moon], appear to be more readily identifiable. However, the multi-gravitational relationship of equilibrium for Jupiter|67-Moons reflects the same spacetime/motion laws that determine the binary system or, any isolated bi-gravitational relationship.

Whether the barycentric point of a bi-gravitational system or multi-gravitational lies within a particular massive body or outside of both bodies or multiple bodies concerns the laws of physics in terms of mass and motion in relation to orbital timing of massive bodies.

In the terms of the solar system, our solar system specifically, the existence of planets without moons, and planets with moons, represents together the quantitative and qualitative characteristics of a multi-gravitational system, all of which reflect relations of existential equilibrium [gravity] among the planets and their moons.

It is possible to discard Pluto for noy being a "real" planet, but one cannot discard the analysis of its multi-gravitational relationships to its moons and to the other planets|moons in the solar system in which it exists. Pluto and its 5 moons are relationally as significant as Jupiter and its 67 moons are to the entire solar system. They cannot exist without the others in the state of orbital equilibrium and balance in which they now co-exist.

If you could somehow remove Pluto from the solar system then the multi-gravitational relations would change in the solar system. Whether Pluto is called a planet or a dwarf planet causes no change in any of the multi-gravitational relations of the solar system.

To suggest that Pluto is distinct [dwarf planet] from Jupiter [large planet] is to suggest that its relationship to its moons is distinct from that of Jupiter to its moons; and, so forth with every planet|moon relationship within the solar system.

For these reasons, the recent attempt to defrock Pluto of its status as a "real planet" totally misses the existential and analytical point regarding how forms of matter-energy in spacetime/motion in turn exist and are analyzed. You can say that Pluto is not a planet, but it is what it is, and that state of being is what requires analysis: call it what you will.

One must know what are the relationships among Pluto and its 5 moons, the relationships among the other planets and their moons, and so forth; all in relationship to one another ---as they exist all in relationship with one another. All of the massive bodies in the solar system "orbit the Sun" so to speak. All have cleared their orbital paths to a lesser and
greater degree; even Pluto has done this. All of the massive bodies have attained hydrostatic equilibrium to a lesser or greater degree ---with the known exceptions. All fulfill the IAU-2006 definition ---but, this fulfillment is of little significance.

The definition of a particular massive body cannot be limited, given the multitudinous nature of its characteristics, to a single feature of that massive body or, even to three selected features, per the IAU-2006 definition. Many other considerations must be analyzed.

The problem with the IAU-2006 definition is that it represents the search for a single-word definition for a multi-faceted spacetime/motion event. For example, it is impossible to define the Earth without referencing its relationship to its Moon, or to the Sun, or to the other planetary bodies in the solar system, etc.

Any illustration of the solar system then must show the different massive bodies and their orbital paths/trajectories in relation to one another.

Sun | Planet (singular/binary) | Moon (singular/binary/multi) | Next orbital level | Etc.

Size may vary according to each level of orbital motion. The size alone of a massive body, then, cannot define a particular massive body's nature. Placement, orbital trajectory and timing intervene to define in detail specific massive bodies in the solar system.

Given the varied nature of massive bodies in the solar system, it may be impossible to invent a single word-concept [or various single word-concepts] that identifies specific categories of massive bodies.

The solar system, i.e., reality, is richer than our language system. The infinite features of a planet are beyond the confines of a single word-concept definition.

"The definition may be difficult to apply outside the Solar System. Techniques for identifying extrasolar objects generally cannot determine if an object has "cleared its orbit", except indirectly via Stern and Levison's Λ parameter, and provide limited information about when the objects were formed. The wording of the new definition is heliocentric in its use of the word Sun instead of star or stars, and is thus not applicable to the numerous objects that have been identified in orbit around other stars. However, a separate "working" definition for extrasolar planets was established by the IAU in 2001 and includes the criterion "the minimum mass/size required for an extrasolar object to be considered a planet should be the same as that used in the Solar System."...

[www.wikipedia.com "IAU definition of planet" Emphasis mine].

Instead of the IAU redefining the word-concept of a "planet" based on three selected characteristics, it may make more sense to retain the historical definition or meaning of a planet. But, one may suggest a system of classification for this different characteristics and composition of a planet. This could follow the lines of the classification for size and types of galaxies as proposed by Hubble.
Part Four

A Selective Review of the Ruling Nomenclature of the Bodies of Mass in Our Solar System

Undoubtedly, the nomenclature regarding size of massive celestial bodies in astronomy in this regard has become somewhat confusing. To date, then, various word-concepts exist with shades of meaning proposed regarding the size of certain massive bodies in our solar system.

The popular science literature today shows even additional types of planets. Consider the following ones found in today's literature. The following is a list of planet types, from Wikipedia, the free encyclopedia:

A second list is also given which has additional types as follows:

It is significant to note that the entry “Planet” does not form part of the second list. The IAU was so bent on excluding Pluto that they did not consider the relationship of the definition of a “planet” to the already existing types of planets identified.

Further, add-on word-concepts are referenced in the definitions of the types on the two lists:

Let us consider a possible compiled list of the types of planets cited in today's popular science literature. The following list of types of planets does not pretend to be exhaustive of the types found in today's science literature, it is merely a selective listing. I have included the "dwarf planet" range as in the final analysis, it is a "planet", only considered to be of 'medium' size by astronomers.
Selected Popular Word-Concepts for Planet Types

- Alien Earth
- Asteroids
- Binary asteroids
- Binary planet
- Chthonian planet
- Carbon planet
- Circumbinary planet
- Classical planet
- Coreless planet
- Desert planet
- Dominant planets
- Double minor planets
- Double planet
- Dwarf Planets
- Earth
- Earth 2
- Earth analog
- Earth-like planet
- Earth-sized Goldilocks planets
- Earth Twin
- Eccentric Jupiter
- Embryonic planet
- Epistellar jovians
- Exoplanet
- Extragalactic exoplanet
- Extragalactic planet
- Extrasolar gas giants
- Extrasolar mesoplanet
- Extrasolar planet
- Free-floating
- Free-floating planetary mass object
- Gas dwarfs Gas
giant Gaseous
planets Giant
Giant planet
Goldilocks planet
Helium planet
- Hydrogen planet
- Host planet
- Hot Jupiter
- Hot Neptune
- Ice dwarf
- Ice giant Ice
planet Inner
planet
- Interstellar planet
- Iron planet
- Jovian planet
- Lava planet
- Large Neptune
- Lower-mass gassy planets
- Mesoplanet
- Mini-Earth
- Mini-Neptune
- Minor Planets
- Moon-sized protoplanets
- Neptune Trojans
- Nomad planet
- Ocean planet
- Orphan planet
- Outer planet
- Pegasean planets
Pegasids
Planemo
Planet
Planatar
Planetary embryos
Planetary-mass object
Planetesimals
Planetoid
Plutinos
Plutoids
Protoplanet
Protoplanetary discs
- Prototype
- Puffy planet
- Pulsar planet
- Pure carbon monoxide planet
- Pure hydrogen planet
- Pure iron Planet
- Pure water planet
- Roaster planet
- Rocky planet
- Rogue planet
- Satellite planet
- Second Earth
- Silicate planet
- Small solar system bodies
- Sub-brown dwarfs
- Sub-Earth
- Sub-Earth exoplanets
- Subplanet
- Super-Earth
- Super-Jupiter
- Telluric planet
- Terrestrial-mass planets
- Terrestrial planet
- "Too massive to be a planet"
- Transitional planet
- Trans-Neptunian Objects
- Trans-Neptunian Dwarf Planet
- Trojan
- Trojan planet
- Twin Earth
- Unterplanets
- Water planet
In order to derive a definition of the word-concept planet, one would have to examine all of the features and conditions stipulated in the previous list of "planet types". The previous list of selected word-concepts for planet comes from the long-standing historical development of science writing in astronomy. In other words, these identifiers come from astronomers analyzing the planets and their characteristics and deriving all of these so-called definitions.

In order to define the word-concept planet, one would necessarily have to examine each one of the features reflected in the previous word-concepts and eliminate repetitions and redundancies, and derive a single-word descriptive word-concept. That task is beyond the scope of this critical essay.

Consider some of the isolated features pointed out with regard to a few of the word-concepts employed to identify particularities in the planets. The following paraphrases merely represent a few of the many word-concepts in use to identify different types of planets. The following citations are not exhaustive in any way, nor systematically presented.

A spacetime analysis of the above-cited word-concepts goes beyond the boundaries of this essay. For now, I present the idea of deriving a systematic definition of word-concepts. From the previous lists of popular word-concepts in today's science literature, it appears that the word-concepts were developed spontaneously throughout the development of the field of astronomy. There appears to be the complete absence of a theoretically based fundamental conceptualization of the definitions.

As may observed from the list of word-concepts related to the definition of planets in the field of astronomy, the IAU-2006 definition of a planet and dwarf planet only touches the tip of the iceberg. Many more considerations must be made before attempting to isolate three select features as determining the classification of all the word-concepts surrounding the definitions of planet types.

The following list may be considered a summary inventory of word-concepts for planet types found in today's science literature on astronomy. I have compiled a selected list of word-concepts taken from different public-domain sources on the Internet [especially www.wikipedia.com]. An effort like the IAU-2006 definition for planet, dwarf planet and small solar system object, would necessarily have to review and take into consideration the following entries and their related features and characteristics ---plus, no doubt, many more examples in today's science literature on astronomy, physics and cosmology, etc.

I apologize beforehand if the list omits a particular word-concept about a planet that the reader considers should have been included. Just include it and make the corresponding adjustments in the analysis. Please, keep in mind that I am not an astronomer by trade. I am not responsible for the content of the following list, its content comes from today's science literature in astronomy.
### Planet Type

<table>
<thead>
<tr>
<th>Planet Type</th>
<th>Defining Features, Characteristics, Criteria Often Cited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alien Earth</td>
<td>Whether or not it falls into what's called the <strong>habitable zone</strong></td>
</tr>
<tr>
<td>Asteroids</td>
<td>Meaning 'starlike'. Binary asteroids: <strong>double minor planets asteroids</strong> and other minor planets. The thousands of tiny 'minor' planets <strong>found between the orbits of Mars and Jupiter</strong>. In writing about these bodies, the word-concepts 'star', 'minor planet', 'planet', 'asteroid' are interchangeably used. &quot;During the early 19th century, asteroids were considered to be planets. Jupiter became the sixth planet with the discovery of Ceres in 1801. Following the reclassification of the asteroids in their own group, Jupiter became the fifth planet once again. With the redefinition of the term planet in 2006, Ceres is now considered a dwarf planet.&quot; [<a href="http://www.wikipedia.com">www.wikipedia.com</a>; emphasis mine]</td>
</tr>
<tr>
<td>Binary asteroid</td>
<td>A system of two asteroids <strong>orbiting their common center of mass</strong>.</td>
</tr>
<tr>
<td>Binary planets</td>
<td>A binary system of <strong>two astronomical objects</strong> that each satisfy the definition of planet</td>
</tr>
<tr>
<td>Chthonian planet</td>
<td>Hypothetical class of celestial objects <strong>resulting from the stripping away of a Gas giant's hydrogen and helium atmosphere and outer layers</strong>.</td>
</tr>
<tr>
<td>Carbon planet</td>
<td>Theoretical type of planet <strong>that contains more carbon than oxygen</strong>.</td>
</tr>
<tr>
<td>Circumbinary planet</td>
<td>Planet that <strong>orbits two stars</strong> instead of one</td>
</tr>
<tr>
<td>Classical planet</td>
<td><strong>The Sun and Moon</strong> and the five planets Mercury, Venus, Mars, Jupiter, and Saturn.</td>
</tr>
<tr>
<td>[Comet]</td>
<td>Mass of gas, dust and ice that <strong>revolves like a planet</strong> under the sun's gravitational pull. The important difference between a comet and a planet is the very eccentric orbit of the former</td>
</tr>
<tr>
<td>Contact binary (asteroid)</td>
<td>When two asteroids gravitate toward each other until they touch, forming an <strong>oddly-shaped single body</strong>.</td>
</tr>
<tr>
<td>Coreless planet</td>
<td>Theoretical type of terrestrial planet that has <strong>no metallic core</strong>, i.e. the planet is effectively a giant rocky mantle.</td>
</tr>
<tr>
<td>Desert planet</td>
<td><strong>Or dry planet</strong> is a hypothetical type of terrestrial planet with very little water.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Dominant planets</td>
<td>Binary asteroids</td>
</tr>
<tr>
<td>Double minor planets</td>
<td>Above 13 Jupiter masses for solar composition</td>
</tr>
<tr>
<td>Double planet</td>
<td>Or desert planet is a hypothetical type of terrestrial planet with very little water.</td>
</tr>
<tr>
<td>Dry planet</td>
<td>A celestial body resembling a small planet but lacking certain technical Criteria that are required for it to be classed as such. Unterplanet.</td>
</tr>
<tr>
<td>Dwarf Planets</td>
<td>Earth is a terrestrial planet, meaning that it is a rocky body, rather than a gas; used as a geo-centric typology for defining certain planets.</td>
</tr>
<tr>
<td>Earth</td>
<td>Dwarf Planets</td>
</tr>
<tr>
<td>Earth analog</td>
<td>An Earth analog (also referred to as a Twin Earth, Earth Twin, Second Earth, Alien Earth, Earth 2 or Earth-like planet)</td>
</tr>
<tr>
<td>Earth-like planet</td>
<td>Another planet (or world) with environmental conditions similar to those found on the planet Earth. They could be constrained in size to between one-half to twice Earth's mass or to between 0.8 to 1.3 times Earth's diameter.</td>
</tr>
<tr>
<td>Earth-sized Goldilocks planets</td>
<td>Another planet (or world) with environmental conditions similar to those found on the planet Earth.</td>
</tr>
<tr>
<td>Earth Twin</td>
<td>An eccentric Jupiter is a Jovian planet that orbits its star in an eccentric orbit.</td>
</tr>
<tr>
<td>Eccentric Jupiter</td>
<td>Scientists describe Ceres as an &quot;embryonic planet.&quot;</td>
</tr>
<tr>
<td>Embryonic planet</td>
<td>Any of various extrasolar planets that are large and gaseous like Jupiter, but are much hotter and in a very close orbit with a star.</td>
</tr>
<tr>
<td>Epistellar jovians</td>
<td>Eris planet Minor-planet designation, is the most massive known dwarf planet in the Solar System; it has one known moon, Dysnomia. Eris and Dysnomia are currently the most distant known natural objects in the Solar System.</td>
</tr>
<tr>
<td>Exoplanet</td>
<td>Exoplanet Planet outside our solar system To define an Extrasolar planet we must first define a planet.</td>
</tr>
<tr>
<td>Extragalactic exoplanet</td>
<td>An extragalactic planet, also known as an extragalactic extrasolar planet or exoplanet, is a planet that is outside the Milky Way.</td>
</tr>
<tr>
<td><strong>Extragalactic planet</strong></td>
<td>An extragalactic planet, also known as an extragalactic exoplanet, is a planet that is outside the Milky Way.</td>
</tr>
<tr>
<td><strong>Extrasolar gas giants</strong></td>
<td>A gas giant is a large planet that is not primarily composed of rock or other solid matter outside the solar system.</td>
</tr>
<tr>
<td><strong>Extrasolar mesoplanet</strong></td>
<td>Smaller than Mercury but larger than Ceres outside the solar system.</td>
</tr>
<tr>
<td><strong>Extrasolar planet</strong></td>
<td>An exoplanet or extrasolar planet is a planet outside the Solar System.</td>
</tr>
<tr>
<td><strong>Fifth planet</strong></td>
<td>Identity varies over time, today it is Jupiter.</td>
</tr>
<tr>
<td><strong>Free-floating</strong></td>
<td>Objects large enough to start deuterium fusion some of the extrasolar planets recently discovered are linked to no star at all.</td>
</tr>
<tr>
<td><strong>Free-floating planetary mass object</strong></td>
<td>&quot;If you're going to call something a planet, you should be sure it formed like a planet.&quot;</td>
</tr>
<tr>
<td><strong>Gas dwarfs</strong></td>
<td>A mini-Neptune is a planet smaller than Uranus and Neptune, up to 10 Earth masses. Those planets have thick hydrogen-helium atmospheres, probably with deep layers of ice, rock or liquid oceans. Mini-Neptunes have small cores made of low-density volatiles. In 2014, &quot;scientists identified a third class of exoplanets, called &quot;gas dwarfs,&quot; that fall in between rocky and gas planets. These gas-dwarf alien planets have thick atmospheres like their larger gas-giant cousins but never quite made it to the size of the planetary behemoths found in the Earth's the outer solar system.&quot; [<a href="http://www.wikipedia.com">www.wikipedia.com</a>]</td>
</tr>
<tr>
<td><strong>Gas giant</strong></td>
<td>A gas giant is a large planet that is not primarily composed of rock or other solid matter.</td>
</tr>
<tr>
<td><strong>Gas planet</strong></td>
<td>One of the four planets in our solar system that are composed chiefly of hydrogen and helium, namely Jupiter, Saturn, Uranus, and Neptune.</td>
</tr>
<tr>
<td><strong>Gaseous planets</strong></td>
<td>Although the gaseous planet isn't expected to be habitable, its atmosphere Could contain water vapor.</td>
</tr>
<tr>
<td><strong>Giant planet</strong></td>
<td>Any of the planets Jupiter, Saturn, Uranus, and Neptune, characterized by large mass, low density, and an extensive atmosphere, chemical composition more similar to that of the Sun than that of the Earth; hydrogen and helium are their main constituents.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Goldilocks planet</td>
<td>Planets close to the size of Earth; Earth itself.</td>
</tr>
<tr>
<td>Helium planet</td>
<td>A helium planet is a theoretical type of planet that may form via mass loss from a low-mass white dwarf.</td>
</tr>
<tr>
<td>Host planet</td>
<td>All satellites of planets in the Solar System have masses less than 0.00025 (1/4000) the mass of the host planet.</td>
</tr>
<tr>
<td>Hot Jupiter</td>
<td>Hot Jupiter is a planet that has a mass and radius of the order of that of our own Jupiter, but orbits the host star at distance that is less (often much less) than the Earth-Sun distance.</td>
</tr>
<tr>
<td>Hot Neptune</td>
<td>A hot Neptune is an extrasolar planet in an orbit close to its star, with a mass similar to that of Uranus or Neptune. Recent observations have revealed a larger potential population of hot Neptunes than previously thought.</td>
</tr>
<tr>
<td>Ice dwarf</td>
<td>A plutoid or ice dwarf is a trans-Neptunian dwarf planet: that is a body orbiting beyond Neptune that is large enough to be rounded in shape.</td>
</tr>
<tr>
<td>Ice giant</td>
<td>A giant planet composed largely of materials less volatile than hydrogen and helium. It became known in the 1990s that Uranus and Neptune were really a distinct class of giant planet, composed of about 20% hydrogen, compared to the heavier gas giant's 90%.</td>
</tr>
<tr>
<td>Ice planet</td>
<td>A type of planet with an icy surface</td>
</tr>
<tr>
<td>Inferior planets</td>
<td>Mercury and Venus, whose orbits lie inside that of the Earth, called as such solely because of their relative position to Earth.</td>
</tr>
<tr>
<td>Inner planet</td>
<td>A planet whose orbit lies within the asteroid belt, i.e., Mercury, Venus, Earth, or Mars.</td>
</tr>
<tr>
<td>Interstellar planet</td>
<td>A rogue planet, also known as an interstellar planet, nomad planet, free-floating planet or orphan planet, is a planetary-mass object that orbits the galaxy directly. They have either been ejected from the planetary system in which they formed or were never gravitationally bound to any star or brown dwarf.</td>
</tr>
<tr>
<td>Iron planet</td>
<td>An iron-rich core with little or no mantle.</td>
</tr>
<tr>
<td>Jovian planet</td>
<td>Any of the four large outer planets: Jupiter, Saturn, Uranus, and Neptune.</td>
</tr>
<tr>
<td>Lava planet</td>
<td>Hypothetical mostly/entirely covered by molten lava</td>
</tr>
</tbody>
</table>
### Large Neptune

### Lower-mass gassy planets

**Mesoplanet**
- Smaller than Mercury but larger than Ceres

**Mini-Earth**
- The interesting thing is that it is a planet smaller than Earth

**Mini-Neptune**
- A mini-Neptune (sometimes known as a Gas dwarf or transitional planet) is a planet smaller than Uranus and Neptune, up to 10 Earth masses

### Major planets
- Called as such in order to distinguish them from the thousands of tiny 'minor' planets found between the orbits of Mars and Jupiter.

### Minor Planets
- An asteroid [meaning 'starlike']. The thousands of tiny 'minor' planets found between the orbits of Mars and Jupiter. In writing about these bodies, the word-concepts 'star', 'minor planet', 'planet', 'asteroid' are interchangeably used.

### Moon-sized protoplanets
- Apparent descriptive identifier.

### Neptune Trojans
- Bodies in orbit around the Sun that orbit near one of the stable Lagrangian points of Neptune. They therefore have approximately the same orbital period as Neptune and follow roughly the same orbital path.

### Nomad planet
- A rogue planet — also known as an interstellar planet, nomad planet, free-floating planet or orphan planet — is a planetary-mass object which has either been ejected from its system or was never gravitationally bound to any star, brown dwarf or other such object, and that therefore orbits the ...

### Ocean planet
- Planets ranging from super-Earths to those smaller than Earth that may have deep oceans but little, if any, habitable land. The extrasolar planet GJ 1214 b is the most likely known candidate for an ocean planet.

### Oligarch [planet]
- Theory of planet formation states proposed hundreds of planet-sized objects, called 'oligarchs', becoming the planets of today,

### Orphan planet
- A rogue planet — also known as an interstellar planet, nomad planet, free-floating planet or orphan planet — is a planetary-mass object which has either been ejected from its system or was never gravitationally bound to any star, brown dwarf or other such object, and that therefore orbits the ...
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer planet</td>
<td>A planet whose orbit lies outside the asteroid belt, i.e., Jupiter, Saturn, Uranus, or Neptune.</td>
</tr>
<tr>
<td>Pegasean planets</td>
<td>Hot Jupiter are a class of extrasolar planets whose characteristics are similar to Jupiter, but which have high surface temperatures because they orbit very close—between approximately 0.015 and 0.5 astronomical units—to their parent stars, while Jupiter orbits its parent star at 5.</td>
</tr>
<tr>
<td>Pegasids</td>
<td>Hypothetical planet which supposedly occupied the space where the asteroid belt is located today.</td>
</tr>
<tr>
<td>Phaeton</td>
<td>A planetary-mass object (PMO), planemo, or planetary body is a celestial object with a mass that falls within the range of the definition of a planet: massive enough to achieve hydrostatic equilibrium (to be rounded under its own gravity), but not enough to sustain core fusion like a star.</td>
</tr>
<tr>
<td>Planemo</td>
<td>Currently, the International Astronomical Union considers an object with a mass above the limiting mass for thermonuclear fusion of deuterium (currently calculated to be 13 Jupiter masses for objects of solar metallicity) to be a brown dwarf, whereas an object under that mass (and orbiting a star or stellar remnant) is considered a planet.</td>
</tr>
<tr>
<td>Planetar</td>
<td>Exactly what a planetar is has not been fully defined.</td>
</tr>
<tr>
<td>Planetary embryos</td>
<td>Protoplanets are large planetary embryos that originate within protoplanetary discs and have undergone internal melting to produce differentiated interiors.</td>
</tr>
<tr>
<td>Planetary mass brown dwarf</td>
<td>A sub-brown dwarf or planetary-mass brown dwarf is an astronomical object formed in the same manner as stars and brown dwarfs (i.e. through the collapse of a gas cloud) but that has a mass below the limiting mass for thermonuclear fusion of deuterium (about 13 Jupiter masses).[17] Some researchers call them free floating planets[18] while others call them planetary-mass brown dwarfs.</td>
</tr>
<tr>
<td>Planetary-mass object</td>
<td>By definition, all planets are planetary-mass objects.</td>
</tr>
<tr>
<td>Planetary nebula</td>
<td>A nebula where planets can form; extremely complex and varied morphologies.</td>
</tr>
</tbody>
</table>
Planetesimals  
A rocky and/or icy body, a few kilometers to several tens of kilometers in size, that was produced in the solar nebula. According to the planetesimal theory, the solar system formed from the collisional aggregation of a great many of these objects; small congealed solid lumps.

Planetoid  
Another term for asteroids, which are also called minor planets. Planetoids are small celestial bodies that orbit the Sun. Planets are simply defined as asteroids, but the term asteroid is not well defined either.

Planet V  
"A planet between Mars and the asteroid belt, going in a successively eccentric and unstable orbit, 4 billion years ago. Unlike the Disruption Theory's fifth planet, "Planet V" is not credited with creating the asteroid belt." [www.wikipedia.com]

Planet X  
Does not exist as theorized originally; explains some anomalies observed in the outer Solar System.

Plutinos  
A small planetlike body orbiting the sun in the region of the Kuiper belt and in Resonance with Neptune.

Plutoids  
Or ice dwarf is a trans-Neptunian dwarf planet: that is a body orbiting beyond Neptune that is large enough to be rounded in shape.

Protoplanet  
Large planetary embryos that originate within protoplanetary discs and have undergone internal melting to produce differentiated interiors. Potential planets [Laplace's nebular hypothesis]. Planetesimals [in the Planetesimal hypothesis.]

Protoplanetary discs  
A circumstellar disk of matter, including gas and dust, from which planets may eventually form or be in the process of forming.[Laplace's nebular hypothesis; Planetesimal hypothesis.]  

Prototype  
Pluto would have been the prototype for this class [IAU].

Puffy planet  
The idea is that as a result of having an eccentric orbit, the planet is ... puffy planets, other means for inflating planets have been explored.

Pulsar planet  
Orbiting pulsars, or rapidly rotating neutron stars.

Pure carbon monoxide Planet  
These could form in discs around stars stealing material from nearby white dwarfs, dense embers of Sun-like stars made mostly of carbon and oxygen.
Pure hydrogen planet
A large, massive, low-density planet composed primarily of hydrogen.

Pure Iron Planet
An iron planet is a type of planet that consists primarily of an iron-rich core with little or no mantle.

Pure water planet
Hypothetical

Roaster planet
It may be more suitable as a planet class name ("Roaster" was used occasionally for Hot Jupiters for ex.)

Rocky planet
A terrestrial planet, telluric planet or rocky planet is a planet that is composed primarily of silicate rocks or metals. Within the Solar System, the terrestrial planets are the inner planets closest to the Sun.

Rocky inner planets
The four innermost planets in the Solar System (Mercury, Venus, Earth, and Mars) are sometimes called the "terrestrial" planets because of their proximity to Earth ("Terra" in Latin) and their similarity as compact solid bodies with rocky surfaces.

Rogue planet
Also an interstellar planet, nomad planet, free-floating planet or orphan planet, is a planetary-mass object that orbits the galaxy directly. They have either been ejected from the planetary system in which they formed or were never gravitationally bound to any star or brown dwarf.

Satellite planet
A natural satellite, or moon, is a celestial body that orbits another body, e.g. a planet, which is called its primary. There are 173 known natural satellites orbiting planets in the Solar System, as well as at least eight orbiting IAU-listed dwarf planets. The phrase satellite planet was used for a few centuries after the Galilean and other moons were discovered, before the word "moon" was extended in use from Earth's moon to the satellites of other planets.

Second Earth
Another planet (or world) with environmental conditions similar to those found on the planet Earth.

Silicate planet
A terrestrial planet, telluric planet or rocky planet is a planet that is composed primarily of silicate rocks or metals. Within the Solar System, the terrestrial planets are the inner planets closest to the Sun ...

Small planetlike body
Plutino orbiting the sun in the region of the Kuiper belt, in Resonance with Neptune.
Small solar system bodies

A small Solar System body (SSSB) is an object in the Solar System that is neither a planet, nor a dwarf planet, nor a satellite. The term was first defined in 2006 by the International Astronomical Union. [CWJ: Negative definition]

Sub-brown dwarfs

A sub-brown dwarf or planetary-mass brown dwarf is an astronomical object formed in the same manner as stars and brown dwarfs (i.e. through the collapse of a gas cloud) but that has a mass below the limiting mass for thermonuclear fusion of deuterium (about 13 Jupiter masses). Some researchers call them free floating planets while others call them planetary-mass brown dwarfs.

Sub-Earth

"Substantially less massive" than Earth and Venus

Sub-Earth exoplanets

Two nearby sub-Earth-sized exoplanet candidates in the GJ 436 system

Subplanet

Describing bodies smaller than a planet.

Super-Earth

An extrasolar planet with a mass higher than Earth's, Bigger than two Earths, but not as massive (and hopefully not as gaseous) as Uranus. ; an extrasolar planet with a mass higher than Earth's, but substantially below the mass of the Solar System's smaller gas giants Uranus and Neptune; alternative term "gas dwarfs" for those at the higher end of the mass scale. Mini-Neptunes also commonly used.

Super-Jupiter

More massive than the planet Jupiter

Superior planets

Mars and other bodies with orbits outside that of the Earth are called as such due to their relative positioning vis-a-vis the Earth.

Telluric planet

A terrestrial planet, telluric planet or rocky planet is a planet that is composed primarily of silicate rocks or metals. Within the Solar System, the terrestrial planets are the inner planets closest to the Sun.

Terrestrial-mass planets

Earth's Solar System has four terrestrial planets: Mercury, Venus, Earth, and Mars. Only one terrestrial planet, Earth, is known to have an active hydrosphere.

Terrestrial planet

In terms of composition, "Earth-like". A terrestrial planet, telluric planet or rocky planet is a planet that is composed primarily of silicate rocks or metals. Within the Solar
System, the terrestrial planets are the inner planets closest to the Sun. At time the larger satellites of the solar system, such as the four large moons of Jupiter...the largest satellite of Saturn and that of Neptune, bodies which are about the size of Mercury are referred to as terrestrial planets.

Too massive to be a Planet

[CWJ: One would expect here the definition word-concept Super-planet.] Transitional planet A mini-Neptune is a planet smaller than Uranus and Neptune, up to 10 Earth masses. Those planets have thick hydrogen-helium atmospheres, probably with deep layers of ice, rock or liquid oceans. Mini-Neptunes have small cores made of low-density volatiles. ...

Trans-Neptunian Objects

TNO; also written transneptunian object is any minor planet in the Solar System that orbits the Sun at a greater average distance (semi-major axis) than Neptune. The first trans-Neptunian object to be discovered was Pluto in 1930.

Trans-Neptunian Dwarf Planet

Plutoids or ice dwarf that is a body orbiting beyond Neptune that is large enough to be rounded in shape.

Trojan planet

In astronomy, a trojan is a minor planet or natural satellite (moon) that shares an orbit with a planet or larger moon, but does not collide with it because it orbits around one of the two Lagrangian points of stability (trojan points), L4 and L5, which lie approximately 60° ahead of and behind the larger body, respectively. Trojan objects are also sometimes called Lagrangian objects. They are one type of co-orbital object. In this arrangement, the massive star and the smaller planet orbit about their common barycenter. A much smaller mass located at one of the Lagrangian points is subject to a combined gravitational force that acts through this barycenter. Hence the object can orbit around the barycenter with the same orbital period as the planet, and the arrangement can remain stable over time.

Twin Earth

Another planet (or world) with environmental conditions similar to those found on the planet Earth.

Unterplanets

Not much difference between "unterplanet" and "dwarfplanet".

Vulcan planet

A small planet proposed to exist in an orbit between Mercury and the Sun. "Attempting to explain peculiarities of
Mercury’s orbit, the 19th-century French mathematician Urbain Le Verrier hypothesized that they were the result of another planet, which he named ‘Vulcan’.[www.wikipedia.com]

Volcanoids
It is doubtful that there are any volcanoids larger than 5.7 kilometres (3.5 mi) in Diameter [Ibid]

Waterworld
An ocean planet (also termed a waterworld) is a hypothetical type of planet which has a substantial fraction of its mass made of water. The surface on such planets would be completely covered with an ocean of water hundreds of kilometers deep, much deeper than the oceans of Earth.

Xena
The International Astronomical Union (IAU) today announced that the dwarf planet known as Xena since its 2005 discovery has been named Eris, after the Greek goddess of discord.

And so on, infinitely so...

After examining the myriad of word-concepts that reference the features of different planets, I marvel at the suggested IAU-2006 definitions for a planet and a dwarf planet. To think that the practical historical knowledge listed in the previous word-concepts and their corresponding features might be reduced to three features in order to derive an overarching definition appears to me to represent an improbable task.

For any definition, necessarily the features in the previous word-concepts for planet types would have to be taken into consideration. A systematic spacetime/motion analysis must be made taking account such features as: size of mass, placement, orbital timing, relationship to a star (or not), relationships to other planets, to their moons, relationships of proportion in size, atmosphere, etc. An exhaustive list of features and characteristics of all planet types would undoubtedly be much longer than the previous inventory of word-concepts.

It should be noted that each entry on the previous list is isolated and taken out of context, meaning that there are yet other relationships and features that intervene to completely explain each entry. Consider the previous list-inventory as a basic summary, a starting point. One may further consider the inherent complexity of the task of defining word-concepts in this regard as one contemplates a sub-specific list presented in the Addendum.

This brief essay is not the place to effect a spacetime/motion analysis all of the cited word-concepts and their corresponding features. This brief essay limits itself to a commentary of the methodology followed in the IAU-
2006 proposed definitions for planet, dwarf planet and small solar system body. There is no effort on my part to offer here a counter definition in this regard.

A definition of the word-concept *planet* would have to examine the spacetime/motion analysis represented by those word-concepts. The definition would have to address a massive body, spherical in shape and rotating / spiraling in spacetime [thus seeking to cover all of its spatial-temporal-relational features]. Obviously, such a procedure represents more of an explanation-definition based on various word-concepts than a single word-concept identifier. The analysis presented in this essay demonstrates the futility of attempting to reduce multi-faceted spacetime/motion events of matter-energy [a massive body] to the confines of a one-word conceptual definition [*planet*] or even to two word-concepts [*dwarf planet*] and, much less to four word-concepts [*small solar system body*].

Should one carry the IAU-2006 methodology of definition into the field of geography, one might contemplate the following analogy in the analysis:

- **Continent** [Example, Africa]
- **Dwarf Continent** [Example, Australia]
- **Small Geographical Body** [Example, Iceland]

As in the science of astronomy so it be in the science of geography; size alone does not describe or determine the nature of the beast ---nor even one, two or three selected features. Geographers have avoided such temptations at definite, categorical definitions in this sense at least. In other senses, maybe not: consider word-concepts such as super-continents. [www.earthmatrix.com/cosmogeography].

Possibly astronomers may wish to reconsider their methodology in defining a most significant object of study in their field. This brief analysis of the IAU-2006 definitions for word-concepts of a planet, dwarf planet and small solar system body is offered as a distinct analytical approach in their quest for clarification and systematic analysis in their field.
A Spacetime/motion Analysis of the Word-concept "Planet"

ADDENDUM

Stars and Habitable Planets

Asteroids and Other Minor Planets --- Types and Groups

- Alexandra family
- Alinda group
- Amor group
- apohele
- Apollo group
- asteroid
- asteroid belt
- asteroid spectral types
- Aten group
- A-type asteroid
- B-type asteroid
- binary asteroid
- centaur
- C-type asteroid
- cubewano
- Cybele group
- Damocloid family
- D-type asteroid
- Earth-crossing asteroid
- Earth-grazer
- Eos family
- E-type asteroid
- Eunomia family
- Flora family
- F-type asteroid
- G-type asteroid
- Hilda group
- Hirayama family
- Hungaria group
- Karin Cluster
- Kirkwood gaps
- Koronis family
- Kuiper belt
- Kuiper belt object (KBO)
- Maria family
- Mars Trojan
- Mars-crosser
- Mars-crosser
- M-type asteroid
- near-Earth asteroid (NEA)
- near-Earth object (NEO)
- Neptune Trojan
- Nysa-Polana family
- Phocaea group
- planetesimal
- plutino
- potentially hazardous asteroid
- P-type asteroid
- Q-type asteroid
- red Centaur
- R-type asteroid
- rubble-pile asteroid
- Scattered Disk
- S-type asteroid
- Themis family
- Torino scale
- trans-Neptunian object (TNO)
- trojan
- T-type asteroid
- V-type asteroid
- vulcanoid

Sources:
http://www.solstation.com/habitable.htm
http://www.daviddarling.info/encyclopedia/A/asteroids_types.html
Encyclopedia of Science
Planemo, Planet, Planetar, Planetary Mass, Planetesimals, Planetoid, Plutino, Pluto, Plutoids, Protoplanet, Puffy Planet, Pulsar Planet and, Dwarf Planets, Among Others:

A Commentary on the International Astronomical Union's Definition of a Planet

By

Charles William Johnson

Earth/matrix Editions
ISBN 1-58616-485-6
P.O. Box 231126, New Orleans, Louisiana USA 70183-1126
©2014-2017 Copyrighted by Charles William Johnson

All rights reserved. Reproduction prohibited.

www.earthmatrix.com, charles@earthmatrix.com