Nowadays the concept of cell assembly is used loosely to describe a group of neurons that perform a given action or represent a given percept or concept in the brain. Typically, one thinks of the group as having strong internal synaptic interactions which set them apart from other groups of neurons. Different users may use this concept with more or less permissive definitions.

-Moshe Abeles, Scholarpedia / Cell Assembly

According to the ‘cell assembly’ hypothesis, transient synchrony of anatomically distributed groups of neurons underlies processing of both external sensory input and internal cognitive mechanisms. A second postulated signature is that, although individual neurons may participate in many cell assemblies, not every possible combination of cells comprises a cell assembly.

-Harris et al., Nature, 2003
activation of any particular assembly can be favored by ‘external’ as opposed to ‘local’ inputs

the strength of ‘local’ inputs may vary relative to ‘external’ inputs

if the strength of ‘local’ inputs is high, then the local connections will favor continued activation of the currently active assembly

if ‘local’ input strength is low, cell assemblies may be more likely to be activated by ‘external’ sources or, in the absence of strong ‘external’ inputs, there may be more spontaneous movement between assemblies
Cell assemblies / attractors are, most simply put, combinations of neurons that are active together.

Cell assembly activation may be triggered by ‘external’ inputs (including environmental stimuli).

Any single neuron may participate in more than one pattern.

The number of actual assemblies in a population of neurons is thought to be less than the total possible number of combinations of active/inactive cells.

Any particular cell assembly may arise as a result of interconnectivity among its members.

Excitatory cells of the group of active cells may synapse upon each other, keeping each other depolarized / active.

They may also keep inactive cells inactive indirectly by exciting inhibitory neurons.

Interconnections may keep particular assemblies active in the absence of the ‘external’ stimulus responsible for activating them (as in working memory).
according to Hebb, cell assemblies may also present as sequences of patterns that repeat.

in the figure above, each nexus point corresponds to a particular pattern of activity among a population of neurons.

arrows denote movement between patterns and numbers indicate the ordering of movement between patterns (e.g., movement from the ‘west’ pattern to the center initiates the sequence and repeats on step 4)
above: schematic of an attractor network where each square corresponds to a specific activity pattern among a population of neurons – red dots denote ‘basins’ into which activity patterns are more likely to fall – moving out of such attractors demands a ‘push’ to get over the hills separating different attractors