

Medical Neuroscience | Tutorial Notes

Chemical Senses—Trigeminal Chemosensation

MAP TO NEUROSCIENCE CORE CONCEPTS¹

- NCC1. The brain is the body's most complex organ.
- NCC3. Genetically determined circuits are the foundation of the nervous system.

LEARNING OBJECTIVES

After study of the assigned learning materials, the student will:

1. Characterize the general organization of the trigeminal chemosensory system.
2. Discuss sensory transduction in polymodal C nociceptive neurons.

TUTORIAL OUTLINE

- I. Trigeminal chemoreception
 - A. polymodal nociceptive (C) fibers in the ophthalmic (e.g., corneas), maxillary and mandibular (e.g., mucous membranes in nose and mouth) branches of the trigeminal nerve that are activated by chemical irritants (e.g., air pollutants, ammonia, capsaicin) (see [Figure Box 10A²](#))
 1. irritants activate transient receptor potential (TRP) channels, most of which are cation-selective ion channels
 2. irritants can also activate olfactory and gustatory receptors at low concentration (non-irritating concentrations)
 3. at higher concentrations, they activate the polymodal nociceptive fibers of the trigeminal system, presumably via the activation of TRP channels (which are distinct from the channels that operate in olfaction and gustation)
 - B. the central processes of these fibers synapse in the spinal trigeminal nucleus and project along with this division of the trigeminal pain & temperature system (see [Figure 10.6B](#))
 - C. activation of these fibers can lead to a variety of protective physiological responses, including increased salivation, sweating, tearing, increased nasal secretions, vasodilation, bronchoconstriction
 1. these reactions are protective as they dilute irritant chemicals and help prevent inhalation or ingestion

¹ Visit [BrainFacts.org](https://www.brainfacts.org) for Neuroscience Core Concepts (©2012 Society for Neuroscience) that offer fundamental principles about the brain and nervous system, the most complex living structure known in the universe.

² Figure references to Purves et al., *Neuroscience*, 5th Ed., Sinauer Assoc., Inc., 2012. [[click here](#)]

STUDY QUESTION

If you choose to eat hot and spicy food (as I sometimes do), why does your mouth burn and your scalp sweat (among other visceral sensory and motor reactions)?

- A. Capsaicin and related compounds in spicy food activate transient receptor potential (TRP) channels on taste cells in taste buds.
- B. Capsaicin and related compounds in spicy food activate transient receptor potential (TRP) channels on free nerve endings of polymodal C nociceptive fibers in oral mucosa.
- C. Signals pertaining to the activation of TRP channels are integrated in the nucleus of the solitary tract in the dorsal tegmentum of the caudal pons and upper medulla.
- D. Signals pertaining to the activation of TRP channels are integrated in the spinal trigeminal nucleus in the lateral tegmentum of the caudal pons and medulla.
- E. Central processing of signals derived from TRP channel activation are distributed to integrative centers in the hypothalamus and brainstem where visceral motor commands are distributed to sweat-promoting preganglionic (sympathetic) neurons.
- F. Central processing of signals derived from TRP channel activation are distributed to higher brain centers where sensations are elaborated in cortical networks.
- G. All of the above.