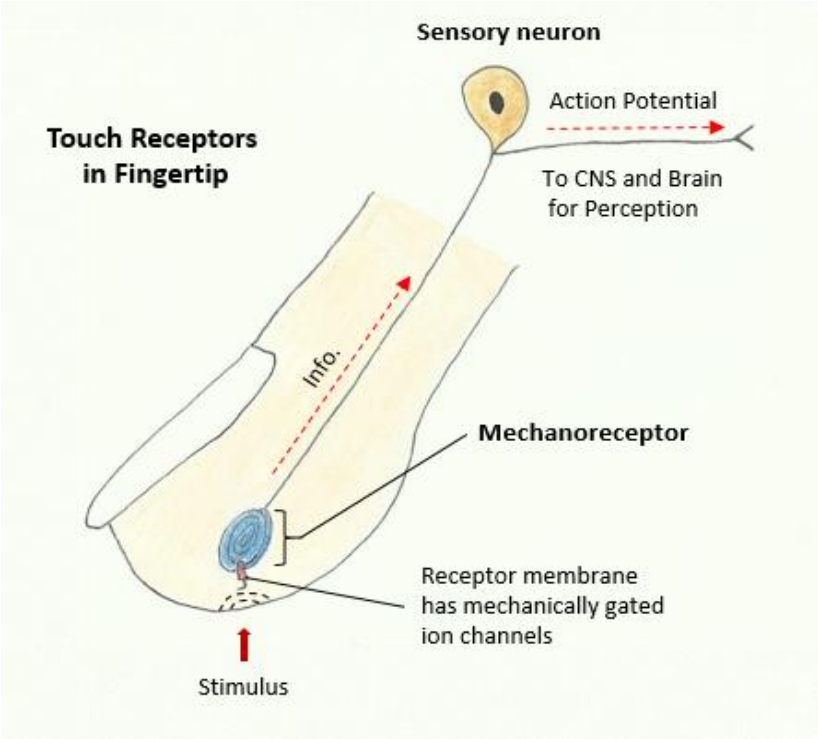
Name: _____

Physiology: Sensory Receptors

Directions: Write in and circle best answer on this sheet.

Sensory Receptors

A **sensory receptor** is a specialized ending of a sensory neuron (see diagram below) that detects a specific stimulus. Receptors can range from simple nerve endings of a sensory neuron (e.g., pain, touch), to a complex combination of nervous, epithelial, connective and muscular tissue (e.g., the eyes and ears).

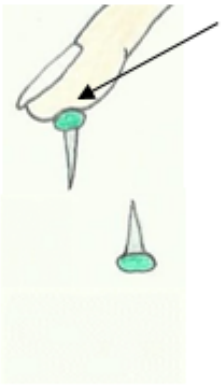


Sensory receptors function as **transducers**, converting one form of **energy** into another. They convert **stimulus energy** (red arrow in drawing at left) into electrical impulses called **action potentials** (dashed arrows at left). This conveys information to the central nervous system (CNS). **Sensation** involves detecting a stimulus, whereas **perception** is the interpretation of this to give it meaning and context. The frequency and duration of action potential firing also gives meaning to the information coming in from a specific receptor. The nervous system helps to maintain **homeostasis** in the body by monitoring the internal and external environments of the body using ***receptors*** to achieve this.

Stimulus Strength

In basic terms, the stronger the stimulus, the greater the sensation! The type and strength of a stimulus is critical when it comes to **pain perception**. Whether it is mechanical force or heat, if **tissue damage** ensues from excessive stimulus, pain receptors (**nociceptors**) will stimulated (see below).

a) Finger pushing a pin

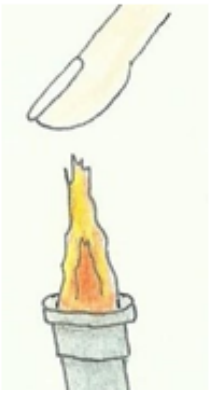


Distension of the surface of the finger

Deformation triggers **mechanoreceptors**

If the pin were this way, it may then involve **nociceptors**!

b) Finger over a flame



The surface of the finger exposed to heat

Excess heat triggers **thermoreceptors**

If the flame contacts finger directly, it may involve **nociceptors**!

Stimulus Energy and Location

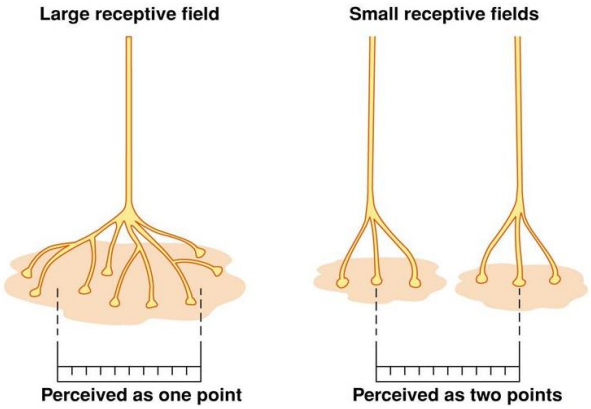
It is useful to know the function and location of important sensory receptors around the body. They also exhibit either fast (phasic) or slow (tonic) adaptation. Use the OER Physiology text (pages 233, 237, and 239) to fill in **Table 1** below.

Table 1. Briefly state what stimulates each receptor type is (the adequate stimulus). Also include specific examples discussed in class with their location and adaptation.

Sensory Receptor	**Stimulated By** (most sensitive to) and include an example of a specific **Location in the Body**	**Adaptation** (Phasic or Tonic)
Mechanoreceptors		
Thermoreceptors		
Nociceptors		
Photoreceptors		
Chemoreceptors		
Proprioceptors		
Osmoreceptors		
Baroreceptors		

<u>In Lab</u>: We measure the sensitivity of skin on different areas of the body using calipers to assess the 'Two-Point Sensitivity'.

In the picture of receptive fields (right), which area is more sensitive, the one with the **larger receptive field**, or the one with the **smaller receptive fields**?



Answer: _____.

From the results on the next page below, the **finger tips** have a _____ receptive field and the **inside forearm** has a _____ receptive field.

Table 2. Here are the results each area of the body tested in lab, showing the average smallest distance (mm) at which two points can be identified as separate.

	Palm	Fingertip	Back of Neck	Inside Forearm
Class Average:	**9.1**	**2.3**	**18.5**	**21.2**

From the class average data in **Table 2**, please answer the following questions:

a) Which of these areas is the least sensitive? _____.

b) Which of these areas is the most sensitive? ? _____.

c) For the most sensitive area, why was it so much more sensitive than the others? Suggests reasons.

Adaptation of Receptors

Many of our sensory receptors respond strongly to acute changes in our environment and then *they cease responding when these stimuli become constant* - this phenomenon is known as **sensory adaptation**. See page 241 of the OER text and answer the following questions.

What is a rapidly adapting or **phasic receptor? =**

Give two examples in the body that we tested in lab:
1)

2)

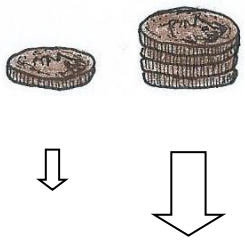
What is a slowly adapting or **tonic receptor? =**

Give two examples in the body: *[Hint: blood pressure and body position are constantly assessed]*
1)

2)

Table 3. Results for the adaptation of touch receptors using coins on forearm.

Trial (time in sec)	One Coin	Four Coins
Class Average:	**19.6**	**36.8**



From the lab data gathered in Table 3 (above) regarding the experiment with the **coins:**

a) The *general* receptors that detect touch in the skin are: _____.

b) Which stimulus took longer to ignore: One coin or four coins? _____.

c) Why? Briefly explain: _____.

d) What kind of receptors are these in terms of *adaptation*? _____.

d) The *specific* type of receptors cutaneous light touch (vibration) _____.

e) The *specific* type of receptors cutaneous touch (pressure) _____.

Sound Perception and Hearing

Hearing is the ability to perceive sound by detecting vibrations – which are changes in the pressure of the surrounding medium through time. The **ear** is our organ of **sound**. Sounds waves hit the ear drum (tympanic membrane) and cause it to vibrate at a certain rate in accordance with the frequency (pitch) and amplitude (loudness) of the sound. The inability to hear is called **deafness**; it can be mild or profound, temporary or permanent. Normal hearing ranges from **0 to 20** dB in all frequencies. Use various resources to find the answers to these 'sound' questions. At what decibel threshold does **damage to your ears and your hearing** typically occur? _____.

Search for information to **match** environmental noises with their typical decibel levels (loudness).

Environmental Noise

A. Telephone dial tone
B. Subway train
C. Jet engine
D. Softest sounds heard
E. Normal conversation
F. City traffic (in car)
G. Loud rock concert
H. Whisper quiet library

Decibel Level (dB) (place the letter for each estimation of sound level)

0-20 dB = ____; 30 dB = ____; 60 dB = ____; 80 dB = ____; 85 dB = ____; 95 dB = ____; 115 dB= ____; 140 dB= ____

Reflex & Voluntary Reactions

Use information from page 281 to 283 of OER text.

a) Define a Reflex: _____.

b) In the pupillary reflex:

i. The _____ muscle when contracted closes down (**constricts**) the pupil.

ii. The _____ muscle when contracted pulls the pupil open (**dilates**) the pupil.

c) The "corneal reflex" is also known as the _____. It is triggered by stimulation of the _____, and can also be stimulated by loud sounds, greater than _____ dB.

Multiple Choice Questions

1. Which of the following components or examples belong to a polysynaptic spinal reflex?
1. thalamus **2.** inferior colliculi **3.** patellar reflex **4.** interneurons **5.** withdrawal reflex
a) 1 only **b)** 4 and 2 **c)** 3 only **d)** 2, 5 and 4 **e)** 5 and 4

2. In lab, during voluntary reflex catching the reaction time ruler, what was the **receptor** being used?
a) skeletal muscle **b)** sensory neurons **c)** photoreceptors **d)** proprioceptor **e)** the brain

3. In terms of **adaptation**, baroreceptors that detect blood pressure _____.
a) detect pressure **b)** are tonic **c)** are phasic **d)** are fast to adapt **e)** mechanoreceptors

4. What type of sensory receptors will respond to changes in pressure, distention, or movement?
a) mechanoreceptors **b)** thermoreceptors **c)** chemoreceptors **d)** photoreceptors

5. Chemical senses include _____.
a) olfaction **b)** receptors for pH **c)** gustation **d)** oxygen levels in blood **e)** all of these

6. You would expect that your pupils would be **smallest** when you are:
a) Watching TV in a dimly lit room.
b) Reading a book in a moderately lit room.
c) Sitting on the beach on a very sunny day.
d) Navigating through a dark forest at night.
e) Suddenly seeing someone you like.

7. The sensory receptors in skin specialized to report information about changes in **temperature** are:
a) Nociceptors
b) Hair follicle receptors
c) Meissner's corpuscles
d) Pacinian corpuscles
e) Free nerve endings

8. Receptors that help maintain, body position, equilibrium, and posture are:
a) nociceptors **b)** mechanoreceptors **c)** free nerve endings **d)** proprioceptors

9. All sensory signals except _____ travel to the _____ in the brain before the cerebral cortex.
a) vision; thalamus
b) olfaction; thalamus
c) vision; cranial nerves
d) olfaction; cranial nerves

10. What is the **adequate stimulus**?
a) The type of stimulus needed to activate a particular sensory receptor.
b) The type of stimulus that triggers all sensory receptors.
c) The strength of the stimulus needed to activate any sensory receptor.
d) The type of sensory receptor activated by a sensory experience.