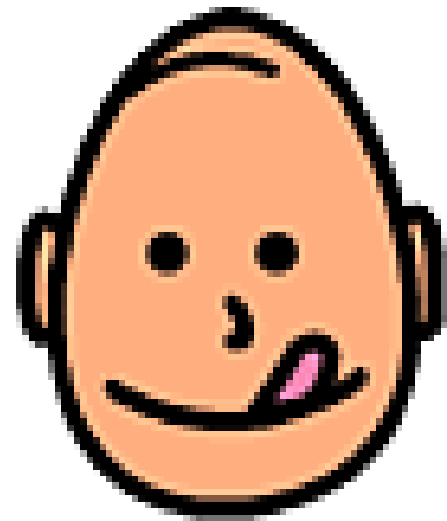


# Food Sensory Science

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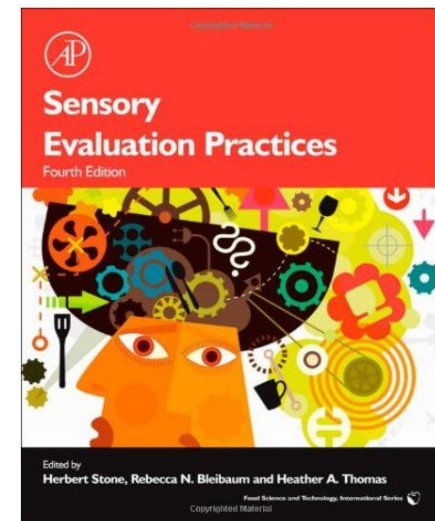
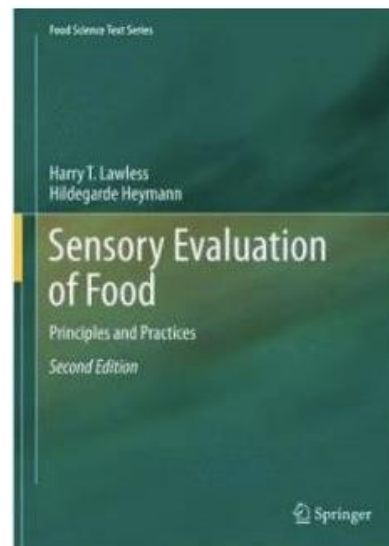
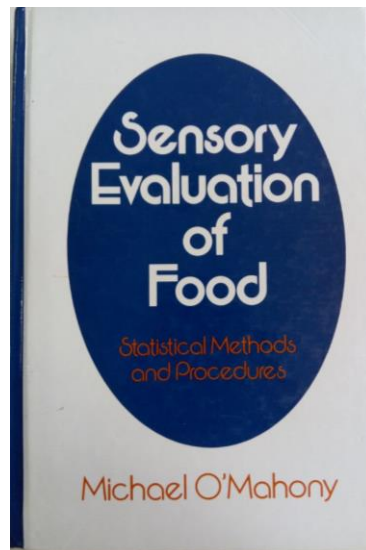
# References (recommended)

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I. Sensory Evaluation of Food: Statistics Methods and Procedures. Michael O'Mahony. Marcel Dekker Inc..1986.

II. Sensory Evaluation of Food. Principles and Practices. H. T. Lawless & H. Heymann. Springer (2nd ed.), New York, 2010.

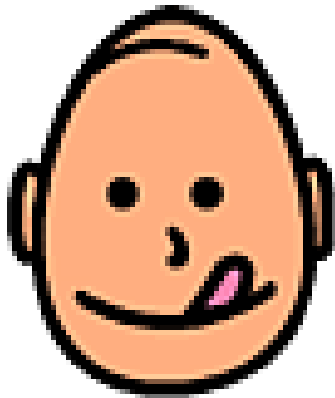
III. Sensory Evaluation Practices, H. Stone, R. Bleibaum, and H. A. Thomas. Elsevier/Academic Press (4th ed.), Amsterdam; Boston, 2012.



# Chapter 1.

## Introduction to Food Sensory Science

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**Sensory Science** comprises a set of techniques for accurate measurement of human responses to foods and minimizes the potentially biasing effects of brand identity and other information influences on consumer perception.”

- Lawless and Heymann  
(Sensory Evaluation of Food)

# Food Choice

- Effects of sensory properties
- Effects of society and culture
- Individual differences
- Food impression and Consumption behavior
- Marketing Guidance



Consumer Behavior Science



# 1.1 Why we need Sensory Evaluation ?

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## **Sensory science can...**

- find out what customers think about your products and services.
- find out if people can detect changes
- find out how your products perform compared to others

# 1.1 Why we need Sensory Evaluation ?

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**win in the market place**



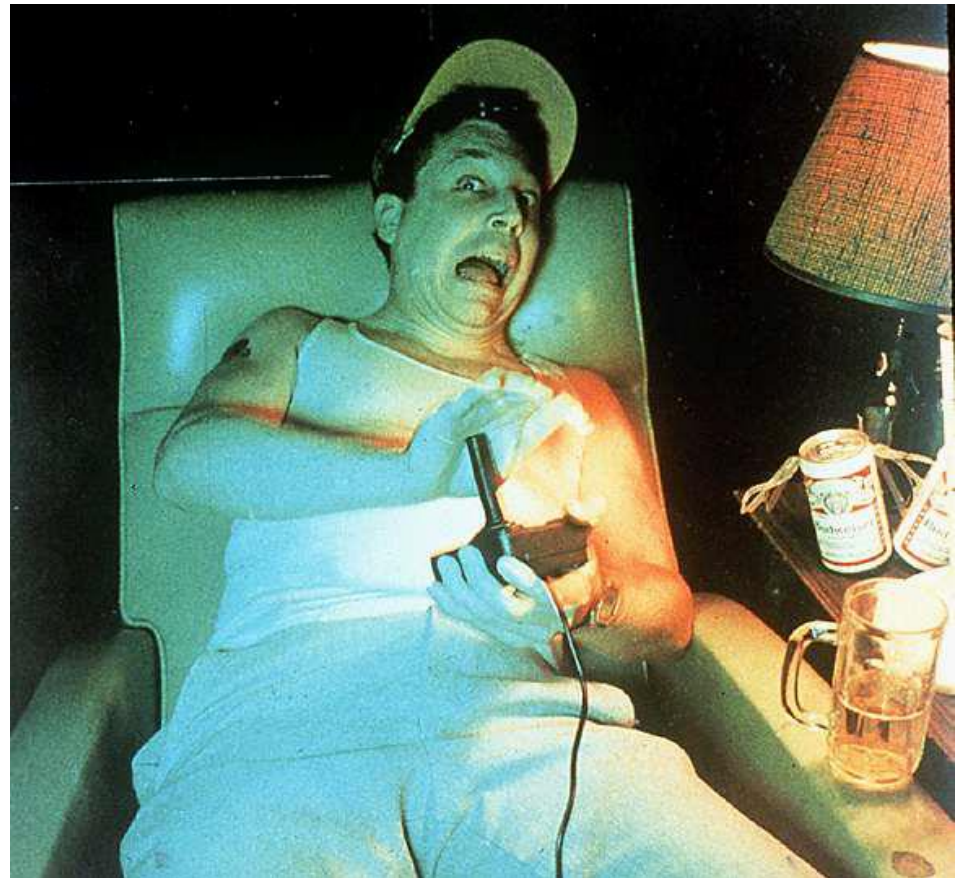


# Uses of Sensory Evaluation

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## ■ Consumer tests

- Do I like it?  
How pleasant is it?

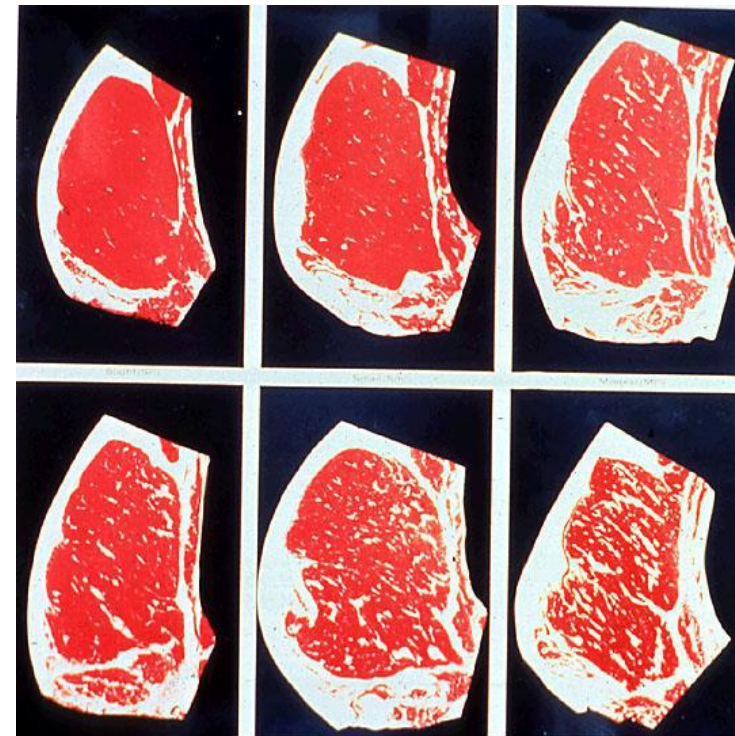


# Uses of Sensory Evaluation

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## Grading

- Quality grading systems are used to determine the value of a product, and subsequently the final grade has a large impact on the selling price
- Eg. Eggs and Meat (degree of marbling)

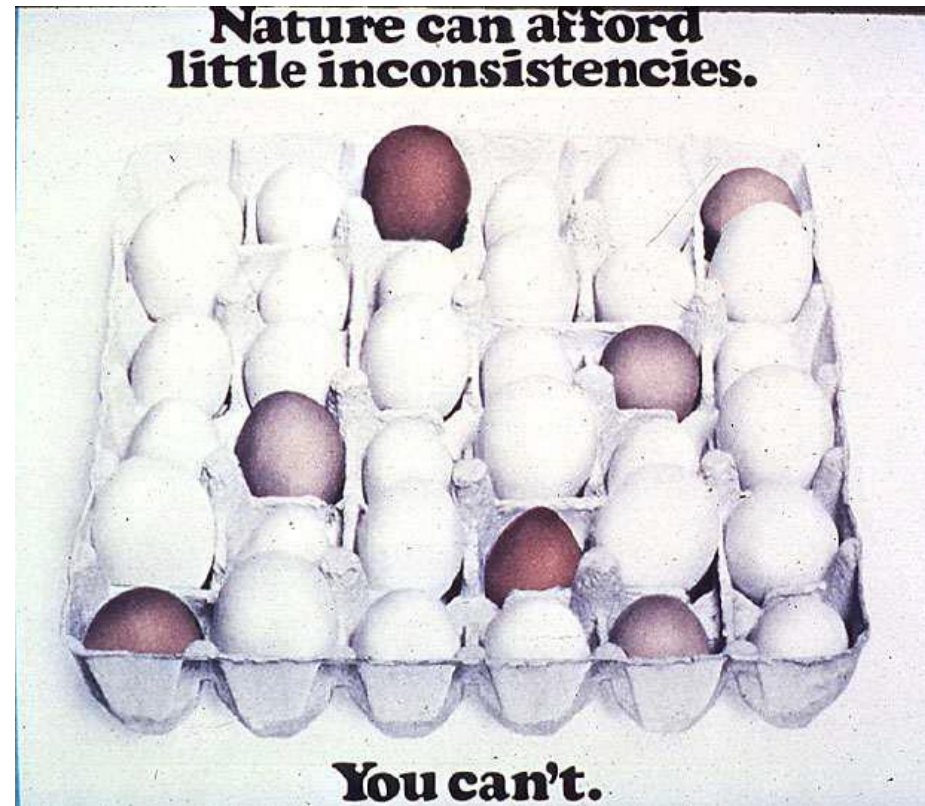




# Uses of Sensory Evaluation

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- **Quality Assurance**
- Quality Assurance (QA) and Quality Control (QC) are responsible for identifying products outside of specifications.



The picture shows standards for buns and fries at MacDonald's R&D facility.





# Uses of Sensory Evaluation

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## **Correlate sensory and instrumental measurements**

Trained sensory panels are expensive tools. Instrumental means of sensory properties can be advantageous in the long run.

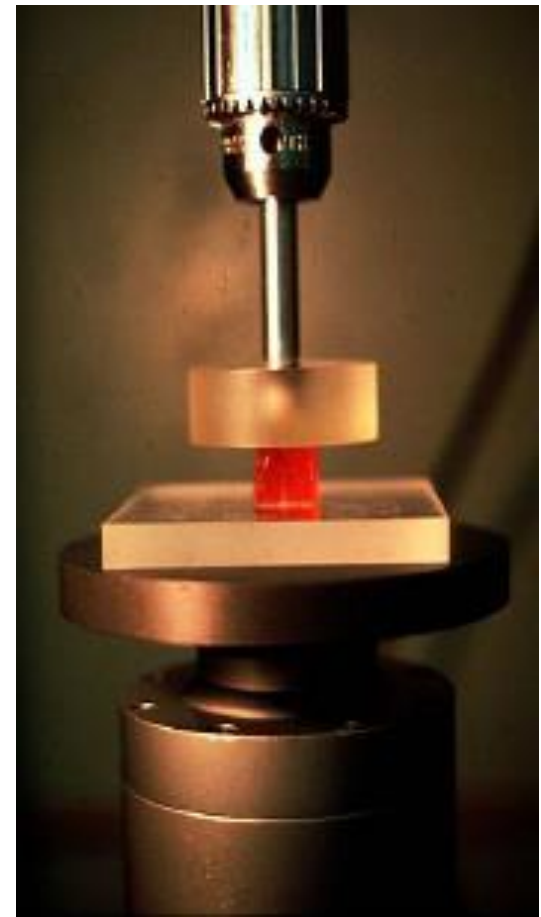
Complex combination of compounds (e.g. smell of strawberry consist of over 200 different volatile compounds)



# Uses of Sensory Evaluation

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- **Correlate sensory and physical properties**
  - Texture



# Uses of Sensory Evaluation

## Correlate sensory and instrumental measurements

Flavor chemistry (GC-sniff)



A strawberry-shaped box, resembling a strawberry with a green stem and leaves at the top and a red body with yellow seeds at the bottom. The box is open, revealing a list of chemical compounds printed on a white background. The list is organized into three columns and includes various chemical names and their corresponding numbers.

Table 1	Table 2	Table 3
Volatile constituents of strawberry	Pentane	Pentyl acetate
1-Pentanol	2-Methyl-2-butanone	6-Pentyl acetate
2-Pentanol	3-Pentanol	2-Hexyl acetate
3-Pentanol	4-Pentanol	Hex-2-en-1-yl acetate
4-Pentanol	5-Pentanol	Butyl propionate
5-Pentanol	6-Pentanol	Methyl isobutyrate
6-Pentanol	7-Pentanol	Ethyl isobutyrate
7-Pentanol	8-Pentanol	3-Pentyl isobutyrate
8-Pentanol	9-Pentanol	4-Pentyl isobutyrate
9-Pentanol	10-Pentanol	5-Pentyl isobutyrate
10-Pentanol	11-Pentanol	6-Pentyl isobutyrate
11-Pentanol	12-Pentanol	7-Pentyl isobutyrate
12-Pentanol	13-Pentanol	8-Pentyl isobutyrate
13-Pentanol	14-Pentanol	9-Pentyl isobutyrate
14-Pentanol	15-Pentanol	10-Pentyl isobutyrate
15-Pentanol	16-Pentanol	11-Pentyl isobutyrate
16-Pentanol	17-Pentanol	12-Pentyl isobutyrate
17-Pentanol	18-Pentanol	13-Pentyl isobutyrate
18-Pentanol	19-Pentanol	14-Pentyl isobutyrate
19-Pentanol	20-Pentanol	15-Pentyl isobutyrate
20-Pentanol	21-Pentanol	16-Pentyl isobutyrate
21-Pentanol	22-Pentanol	17-Pentyl isobutyrate
22-Pentanol	23-Pentanol	18-Pentyl isobutyrate
23-Pentanol	24-Pentanol	19-Pentyl isobutyrate
24-Pentanol	25-Pentanol	20-Pentyl isobutyrate
25-Pentanol	26-Pentanol	21-Pentyl isobutyrate
26-Pentanol	27-Pentanol	22-Pentyl isobutyrate
27-Pentanol	28-Pentanol	23-Pentyl isobutyrate
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44-Pentanol	45-Pentanol	40-Pentyl isobutyrate
45-Pentanol	46-Pentanol	41-Pentyl isobutyrate
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94-Pentanol	95-Pentanol	90-Pentyl isobutyrate
95-Pentanol	96-Pentanol	91-Pentyl isobutyrate
96-Pentanol	97-Pentanol	92-Pentyl isobutyrate
97-Pentanol	98-Pentanol	93-Pentyl isobutyrate
98-Pentanol	99-Pentanol	94-Pentyl isobutyrate
99-Pentanol	100-Pentanol	95-Pentyl isobutyrate



# Uses of Sensory Evaluation

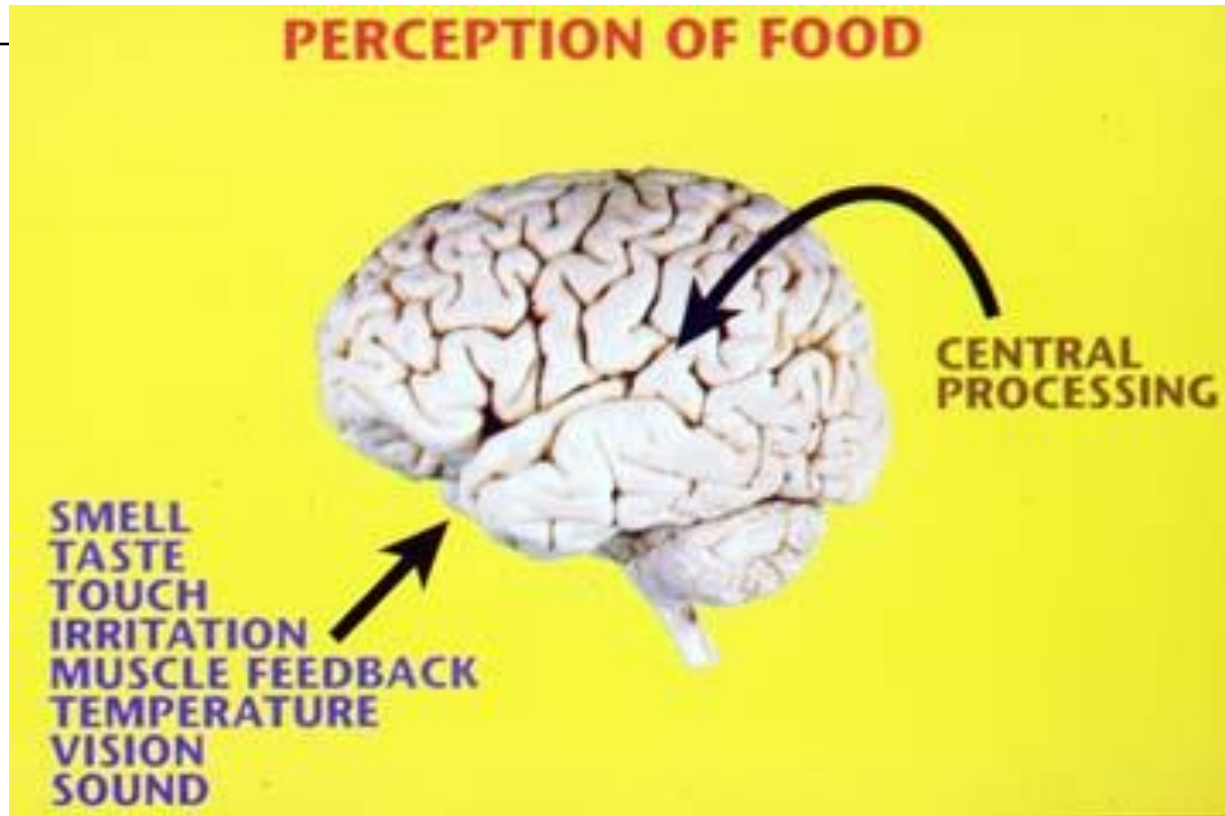
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- **Product reformulation**
- **New product Development**
- **Marketing**

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## 1.2 Factors affected Perception of Food



**physiological factors & psychological factors**

## 1.2.1 Physiological Factors:

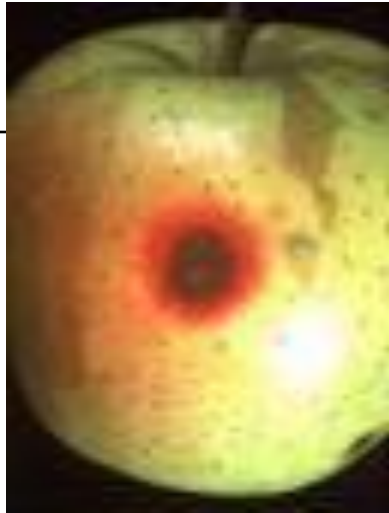
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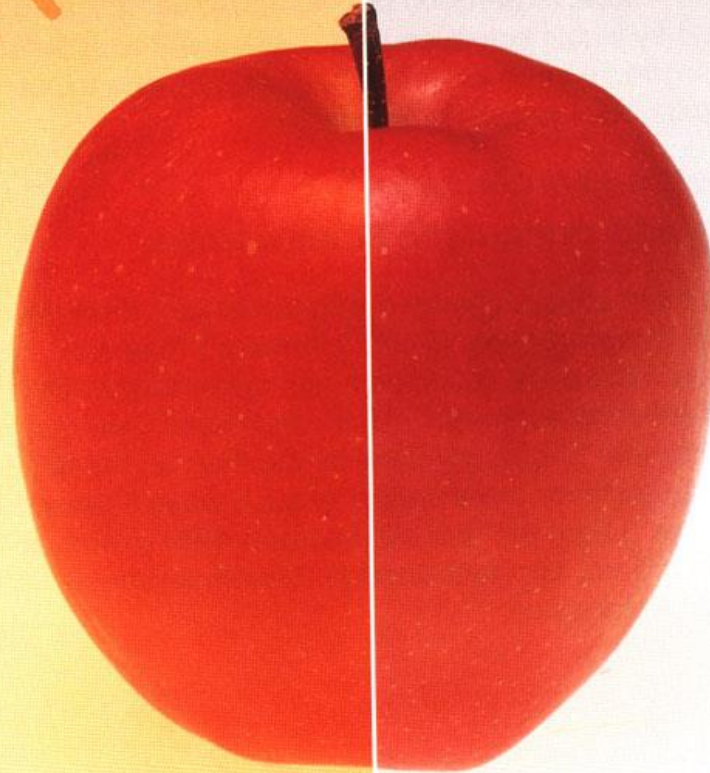
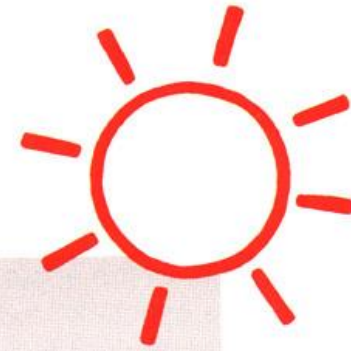
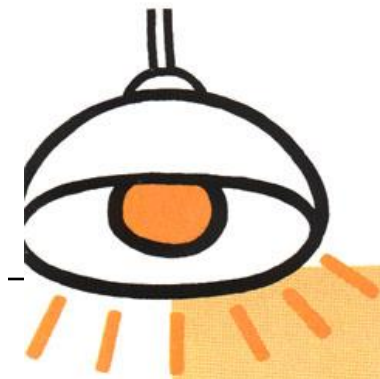
- ❖ **Vision**
  - ❖ **Olfaction**
  - ❖ **Gustation**
  - ❖ **Tactile sense**
  - ❖ **Audition**
- } **Chemo-reception**



**Vision: appearance**  
**surface structure,color,shape**



Visual perception is the ability to interpret the surrounding environment by processing information that is contained in visible light.

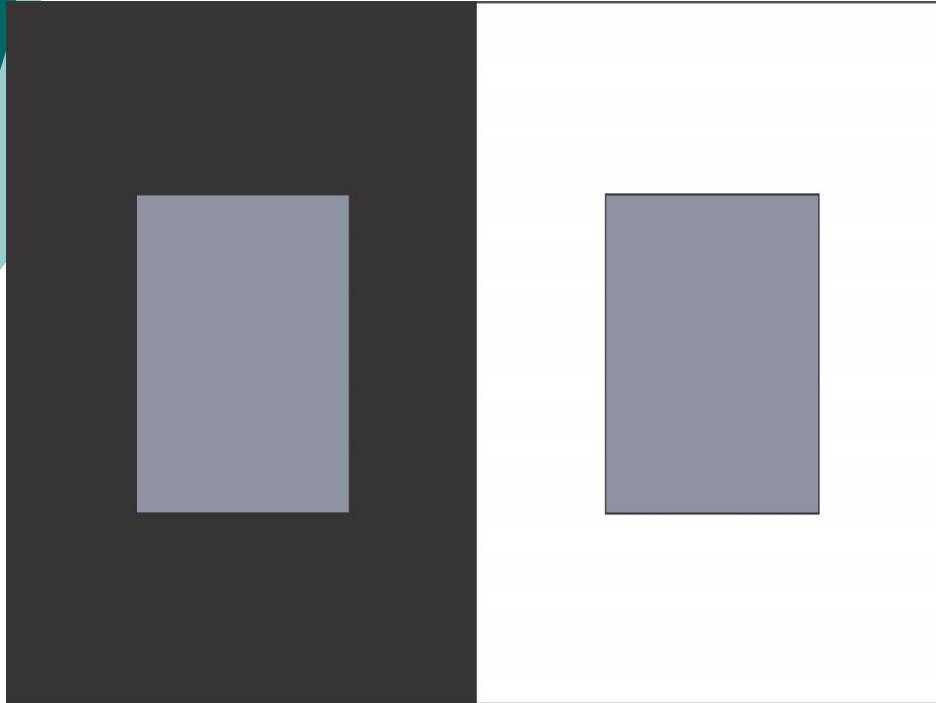


Source of Light



# Background

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to assess the appearance of a wine, look at it with a white surface behind it – a white table cloth, or just a piece of white paper will do you are looking for clarity, and at the colour



# Gustation:

## soluble taste substances

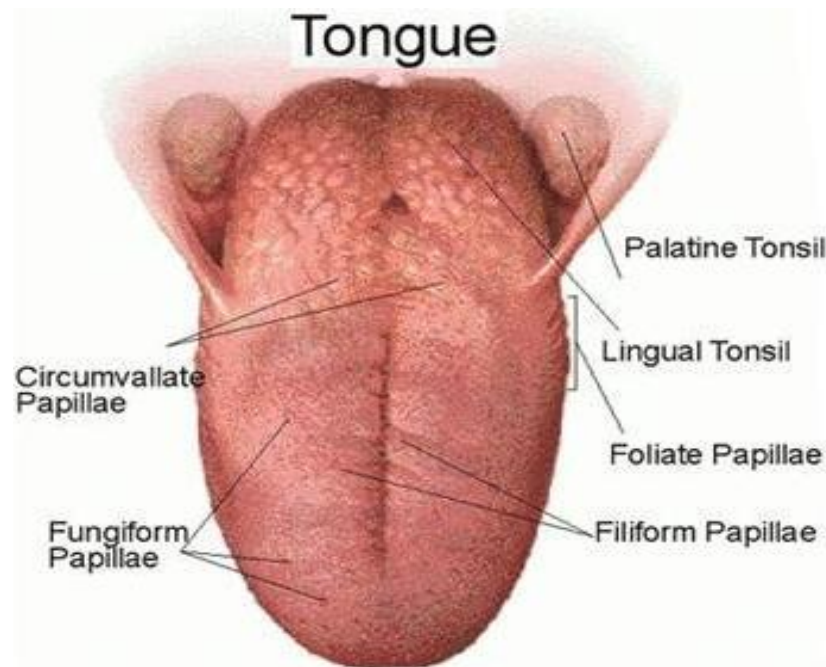
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# Gustation

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Taste is the sensation produced when a substance in the mouth reacts chemically with taste receptor cells located on taste buds.

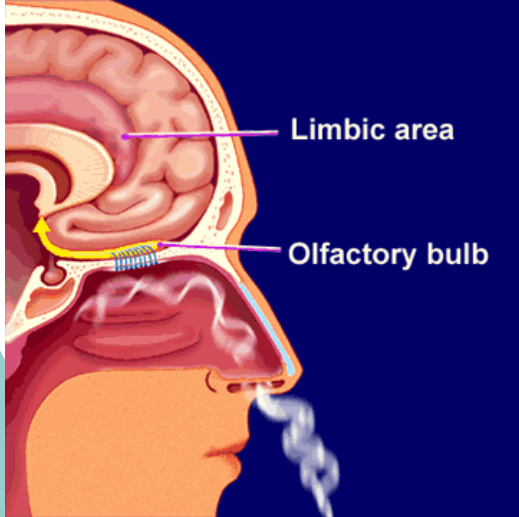




## 4 basic tastes

**Spicy** is a sensation by inducing a trigeminal nerve reaction together with normal taste reception. It is similar to **tactile sense** when considering stimulating nerve endings.





# Olfaction: volatile chemicals

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**olfaction occurs when  
odorant molecules bind  
to specific sites on the  
olfactory receptors.**



# Olfaction

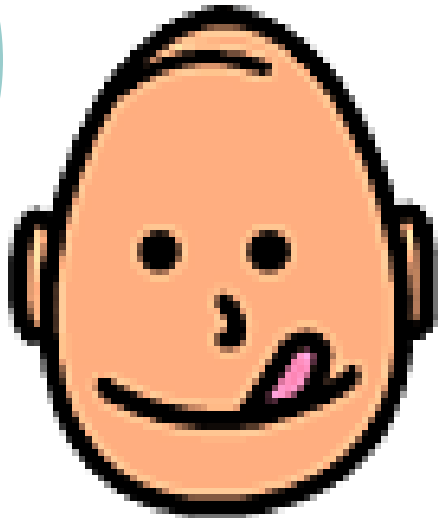
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- Olfaction is more complicated than gustation and the sensitivity of olfaction is much higher than gustation.
- One can discriminate 1000 billion different odors



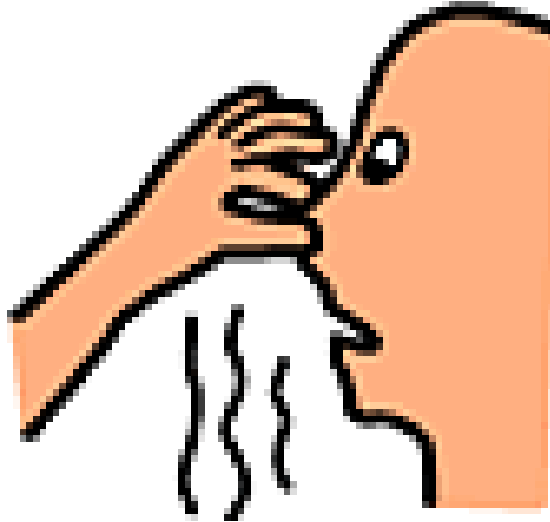
# Flavor

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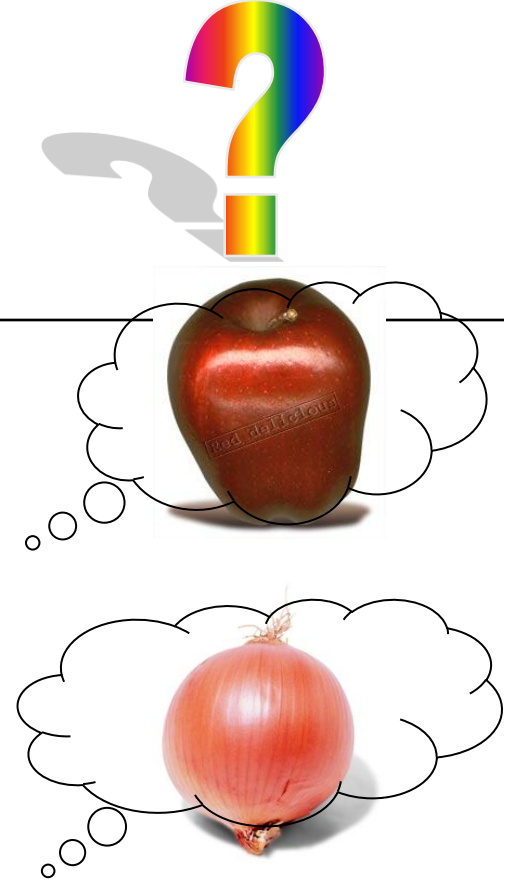


Smell + Taste

Flavor



Taste

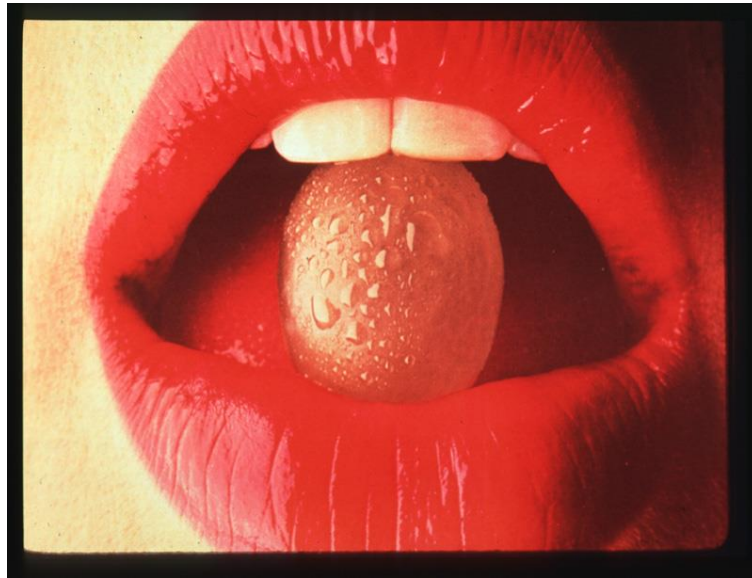




# Tactile sense – mouth feel and hand feel

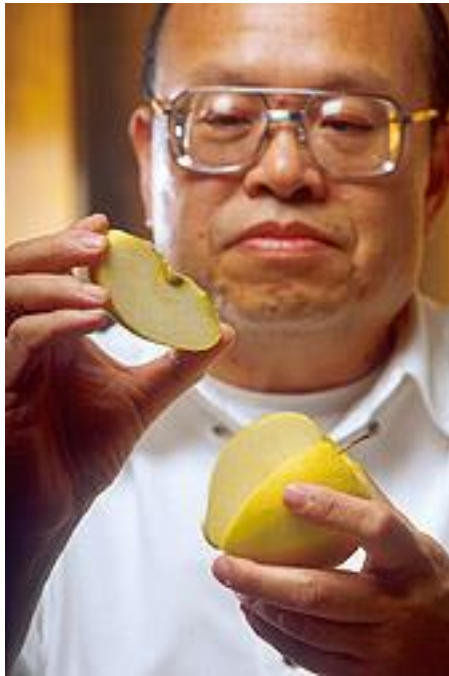
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**structure of food, texture**



# Audition – internal structure

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Juicy



Crisp

# Thermoreception

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- **Temperature:** the perception of 'hot' and 'cold'
- Temperature is also important because it has an effect on the other senses.



# Sense systems & sensory properties

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视觉	<b>Vision</b>	看	<b>seeing</b>	<b>Surface structure</b> <b>Color</b>
嗅觉	<b>Olfaction</b>	闻	<b>smell</b>	<b>Volatiles</b>
味觉	<b>Gustation</b>	尝	<b>taste</b>	<b>Water solubles</b>
触觉	<b>Tactile sense</b>	触摸	<b>touch</b>	<b>Surface structure</b>
本体感受	<b>Proprioception</b>	肌肉反应	<b>muscle feedback</b>	<b>Internal structure</b>
听觉	<b>Audition</b>	听	<b>hearing</b>	<b>Internal structure</b>
痛觉	<b>Nociception</b>	刺激	<b>irritation</b>	<b>Irritants</b>
温度觉	<b>Thermoreception</b>	热, 冷	<b>hot, cold</b>	<b>Temperature</b>

# General principles for senses:

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- Sense organs are **not reacting to all the changes**, only when the stimulation causing the change of senses is in a proper range. Over or under the proper range, any reaction from sense organs would not be occurring.
- **Sensory threshold**: the sensitivity to the strongest and weakest stimulus as well as the tiny change within the range.



# Two types of sensory thresholds

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- **Absolute threshold:** the range between the lowest level at which a stimulus can be detected and the highest level at which the sensation would be lost.
- **Differential threshold:** the level at which a change in a detected intensity can be perceived.



## Weber Law :

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$$K = \Delta I / I$$

$\Delta I$ : Intensity change ;  $I$ : starting intensity;  $K$ : Weber constant

Weber Law is only applicable for the moderate stimulation, otherwise,  $K$  is not constant.

When the intensity is low (close to the threshold),  $K$  is quickly increasing.



# Miller modified function:

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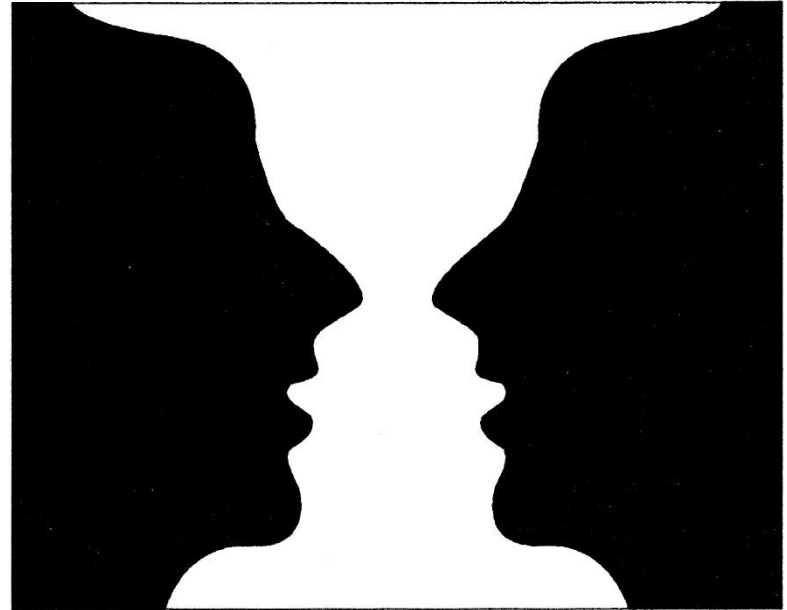
$$K = \Delta I / (I + I_r)$$

$I_r$ : the additional intensity caused by series of factors, such as the interaction among different stimulation, the change of sensitivities, different liking, etc..

## 1.2.2 Psychological Factors

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1. Humans' reaction to a particular stimulation is related to their previous experiences or other stimulation from the environment.








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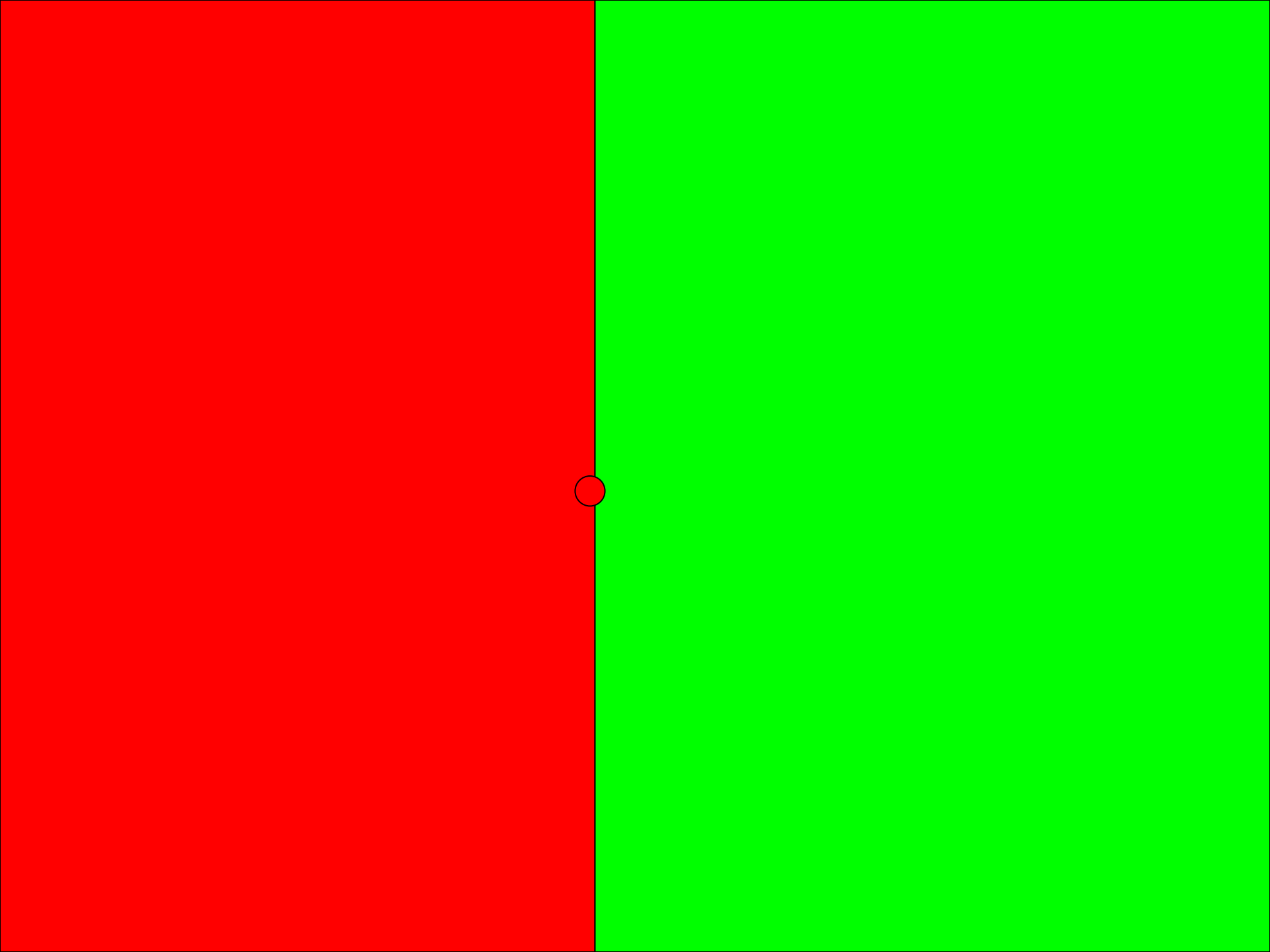
2. The differences between a sensory panel is unavoidable, which could be caused the differences with or within the individual physiological or psychological features.



**3. During the sensory evaluation, the system error caused by the different judges' reaction could distort the data, which is hard to detect.**

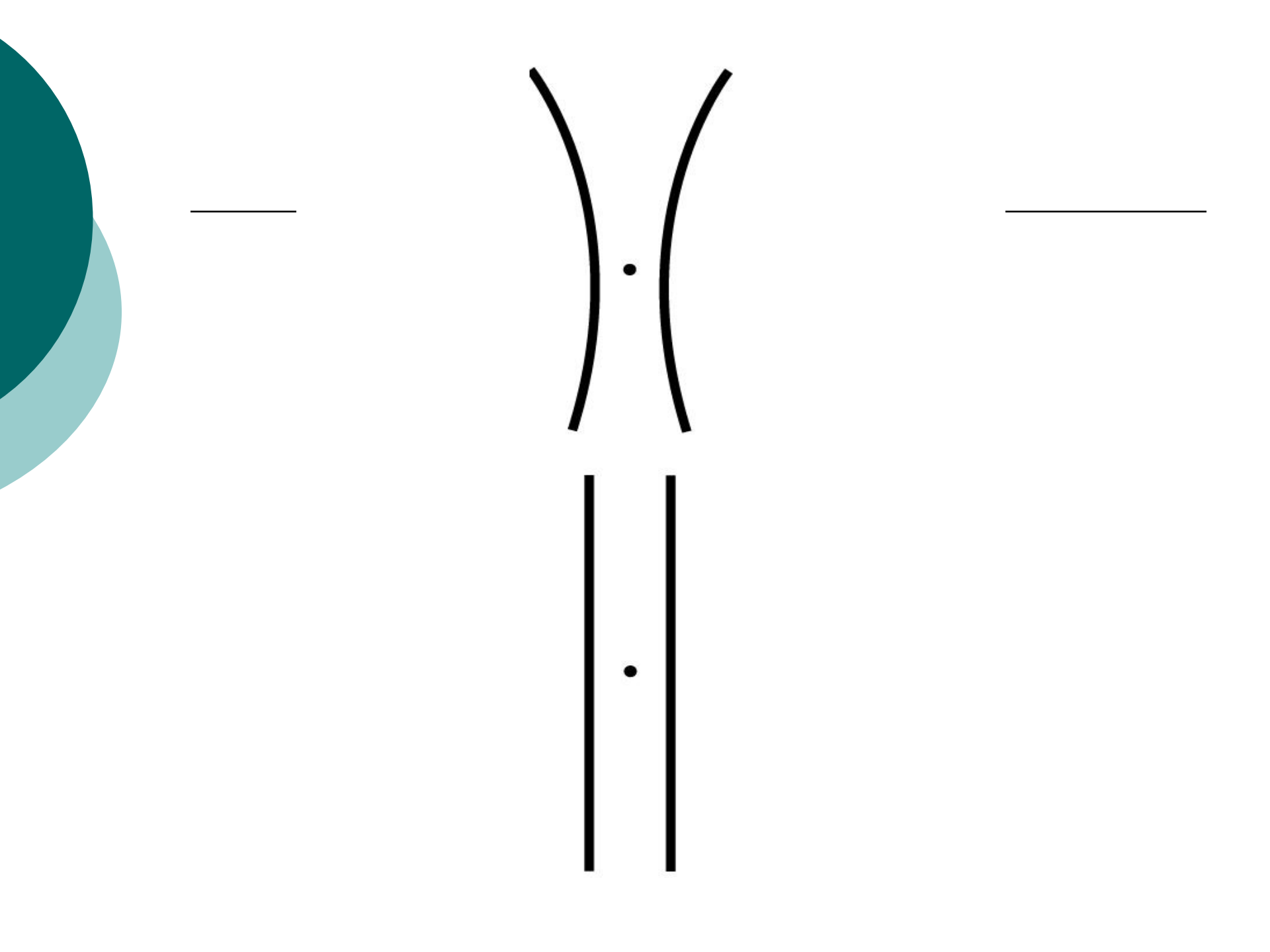
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- **E.g. sensory adaption: the brain would not process the information from a constant stimulation, only there is a change happening to the stimulation.**











# Design of a Sensory Test

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- **Human subjects are:**

- Variable over time
- Variable among themselves
- Prone to bias
- Prone to fatigue and attention drift

- **To minimize these pitfalls:**

- Measurements must be repeated
- Number of judges or consumers must be high enough (power analysis)
- Biases (psychological and physiological) must be avoided or reduced

The validity of sensory evaluation depends on the explored testing methods and the testing procedures !

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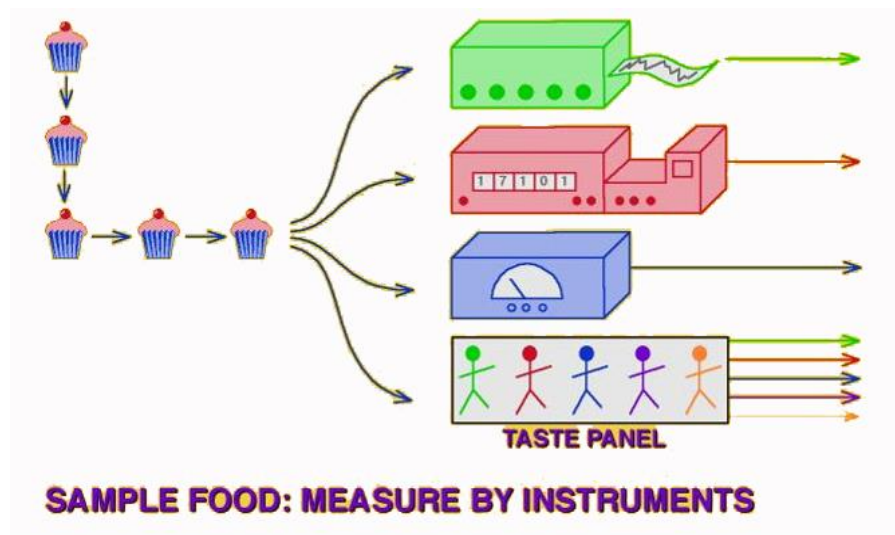
# Sensory Methodology

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- The focus of this course
- Analytical methods
  - Thresholds
  - **Discrimination tests**
  - Scaling
  - **Descriptive analysis**
- Consumer testing methods
  - **Quantitative methods**
  - **Qualitative methods**

# Sensory Methodology

- **Sensory Evaluation -Analytical Tests**
  - Human sensations are considered as analytical instrument to measure sensory properties of food
  - Trained judges, controlled testing condition and standardized procedures for preparation samples







# Sensory Methodology

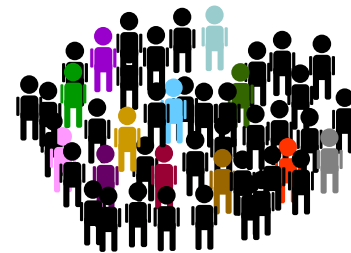
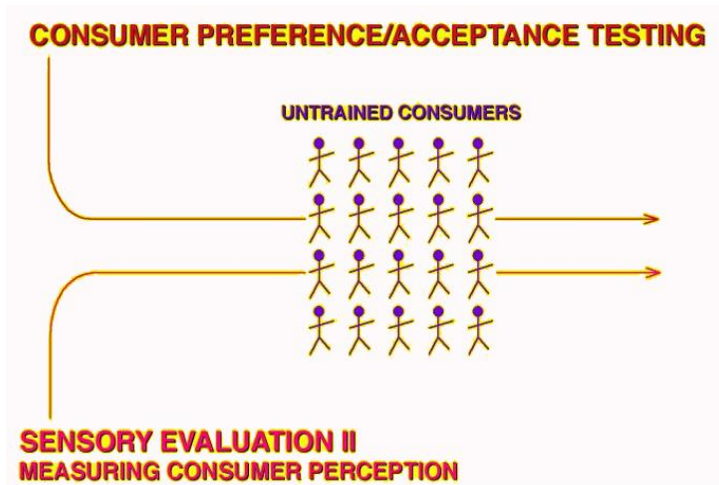
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- Examples of descriptive analysis methods:
  - Flavor Profile
  - Texture Profile
  - Quantitative Descriptive Analysis
  - Deviation from Reference
  - Spectrum Method
  - Free-Choice Profiling
  - Time-Intensity / Dynamic Flavor Profile

# Sensory Methodology

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- **Consumer testing methods (Affective Tests)**
  - Measure consumers' likings
  - Untrained consumers, ordinary conditions

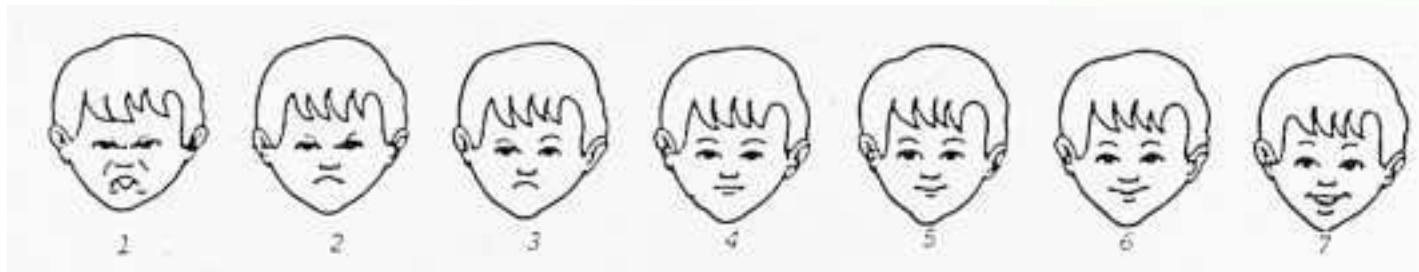


# Sensory Methodology

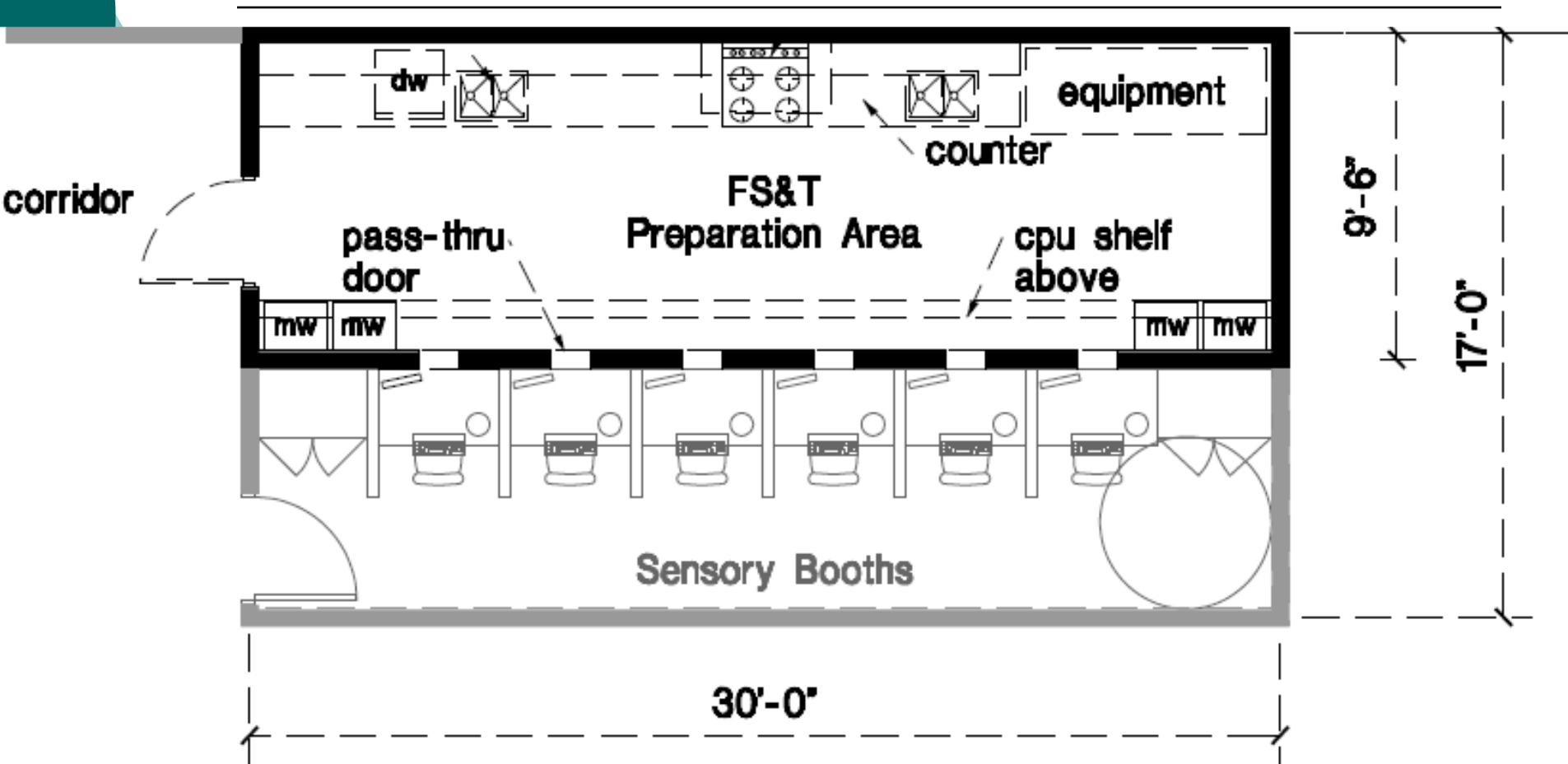
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- Consumer tests
  - Hedonic ratings
  - Just-right scaling
  - Preference test
  - Purchase intent scaling

- 9 — Like extremely
- 8 — Like very much
- 7 — Like moderately
- 6 — like slightly
- 5 — Neither like nor dislike
- 4 — Dislike slightly
- 3 — Dislike moderately
- 2 — Dislike very much
- 1 — Dislike extremely



# Analytical Sensory Facility





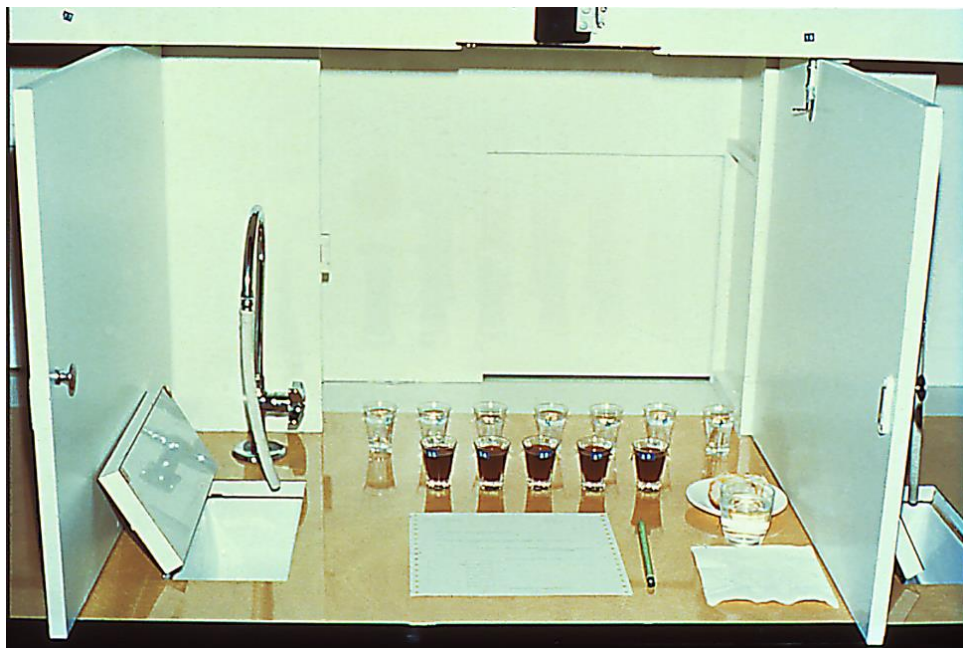
# Sensory Booth Components

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- Space for trays/samples, monitor, laptops, etc.
- Ventilation
- Temperature/humidity control
- Adjustable chairs
- Electrical outlets
- Booth divides
- Product delivery (hatches)
- Signaling system
- Spittoon/sink and faucet







The National Food Labs



Michigan State University



Purdue University



University of Minnesota





# Consumer Test



# Consumer Test

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## Focus Group Facilities



# Consumer testing





# Consumer Testing

