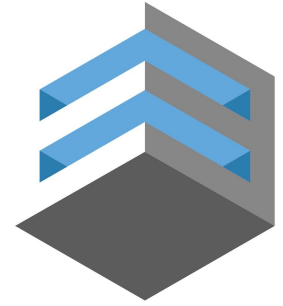


# Englist.me



## Vocabulary Builder Reference from...

Li-Huei Tsai: Could we treat Alzheimer's with light and sound? | TED Talk

[https://www.ted.com/talks/li\\_huei\\_tsai\\_could\\_we\\_treat\\_alzheimer\\_s\\_with\\_light\\_and\\_sound](https://www.ted.com/talks/li_huei_tsai_could_we_treat_alzheimer_s_with_light_and_sound)

### Advanced Words Only

#### IMPORTANT

This material is a commentary and does not contain any copyrighted material of the reference source. We strongly recommend accessing/buying the reference source at the same time.

## Session 1: Word List

### brainwave

*n.* a sudden idea or inspiration; a moment of great insight or creativity

*synonym*: inspiration, brainstorm, revelation

(1) **brainwave** idea, (2) sudden **brainwave**

The engineer had a **brainwave** and redesigned the product to be more efficient.

### neuroscience

*n.* the scientific study of the function, structure, and disorder of the brain and the nervous system

(1) the branch of **neuroscience**, (2) a theoretical concept in **neuroscience**

Our university is famous for its professors, who are well-versed in behavioral **neuroscience**.

### baton

*n.* a thin stick or rod used as a conductor's wand, a symbol of authority, or a tool for specific sports or activities; a short, straight, light stick that is passed from runner to runner in a relay race

*synonym*: staff, stick, wand

(1) conducting **baton**, (2) twirl the **baton**

The police officer used his **baton** to disperse the crowd.

## synchronize

*v.* to happen or cause to happen at the same time or rate  
*synonym*: coordinate, accompany, harmonize

(1) **synchronize** movements, (2) **synchronize** our watches  
The ball speed will increase when the lower body movements are perfectly **synchronized**.

## hertz

*n.* the unit of frequency, equal to one cycle per second, often used to describe the frequency of electromagnetic waves or electronic signals

*synonym*: frequency, cycles per second

(1) audio **hertz**, (2) tera- **hertz** radiation

The human ear can detect sounds with frequencies ranging from 20 to 20,000 **hertz**.

## dementia

*n.* a severe decline in cognitive function, especially memory, as a result of disease or injury

*synonym*: cognitive decline, memory loss, Alzheimer's disease

(1) **dementia** patients, (2) probably have **dementia**

The study found that regular exercise can help to prevent the onset of **dementia** in older age.

## entrain

*v.* to synchronize, or bring into a line, with a particular process or rhythm; to board a train or other means of transportation

*synonym*: board, embark, load

(1) **entrain** at the station, (2) **entrain** the heart rate

The rhythm of the music made me want to **entrain** my movements with the beats.

## flickering

*adj.* shining or flashing in an unsteady or irregular way; fluctuating or wavering, often with regards to light or flame

*synonym*: shining, flashing, twinkling

(1) **flickering** flames, (2) **flickering** hope

The **flickering** candlelight added a cozy ambiance to the room.

## discotheque

*n.* a nightclub or restaurant where recorded music is played, and people dance

*synonym* : nightclub, dance club, disco

(1) **discotheque** party, (2) **discotheque** scene

He couldn't wait to hit the **discotheque** and dance the night away.

## prefrontal

*adj.* in or about the foremost part of the frontal lobe of the brain

(1) **prefrontal** bone, (2) **prefrontal** region

Research shows that damage to the **prefrontal** cortex leads to increased aggression.

## hippocampus

*n.* a major component of the brain of humans and other vertebrates that is part of the limbic system and is vital for memory

(1) involvement of the **hippocampus**, (2) neurons in the **hippocampus**

The **hippocampus** is crucial for learning and memory storage.

## flashy

*adj.* attractive or impressive by being bright, expensive, large, etc.; (used especially of clothes) marked by conspicuous display

*synonym* : gaudy, ostentatious, dazzling

(1) **flashy** cars, (2) **flashy** graphics

I want to buy a reliable car rather than a **flashy** one.

## amaze

*v.* to fill with wonder, surprise, or admiration

*synonym* : astound, surprise, stagger

(1) **amaze** and entertain visitors, (2) **amaze** everyone

The magician's tricks **amazed** the audience.

## buildup

*n.* the accumulation or increase of something over time

*synonym* : accumulation, increase, growth

(1) lactic acid **buildup**, (2) huge military **buildup**

The **buildup** of stress over time can lead to health problems.

## amyloid

*n.* a type of protein that can accumulate abnormally in various tissues and organs in the body and is linked to various diseases, including Alzheimer's disease

*synonym* : protein deposit, plaque buildup

(1) **amyloid** beta, (2) **amyloid** accumulation

Alzheimer's disease is characterized by the buildup of **amyloid** plaques in the brain.

## tau

*n.* the 19th letter of the Greek alphabet, transliterated as "t"; (of physics, tau particle) a fundamental particle known as the tau lepton that is an elementary particle with a negative electric charge and a spin of 1/2

(1) **tau** particle, (2) the symbol of **tau**

The **tau** protein has been found to play a role in the development of Alzheimer's disease and other neurological disorders.

## tangle

*n.* a confused mass of something twisted together

*synonym* : knot, snarl, entanglement

(1) in a **tangle**, (2) **tangle** wires

The cords behind my computer were a **tangled** mess.

## hallmark

*n.* a distinctive characteristic or attribute of a person or thing

*synonym* : symbol, authentication, indication

(1) the **hallmark** of a good scientist, (2) the **hallmark** of modern life

A clear and simple expression is the **hallmark** of good writing.

## synapse

*n.* the fact or state of failing to finish an activity and of stopping using, making, or doing it

(1) **synapse** circuit, (2) end at a **synapse**

Animals transmit nerve impulses through **synapses**.

## ventricle

*n.* a chamber or cavity within an organ or structure, particularly the lower chamber of the heart that pumps blood to the lungs and other parts of the body

*synonym* : chamber, pumping heart muscle

(1) left **ventricle**, (2) **ventricle** in the brain

The heart's **ventricles** are responsible for pumping blood out to the body.

## untreated

*adj.* not given medical care or treatment; not subjected to chemical or physical treatment

*synonym* : raw, unprocessed, coarse

(1) an **untreated** disease, (2) dispose of **untreated** formalin solution

Heat stroke is the result of **untreated** heat exhaustion.

## microglia

*n.* a type of cell in the central nervous system that acts as part of the immune system, defending against invading pathogens and supporting healthy brain function

*synonym* : brain cell, neuron, glial cell

(1) **microglia** cells, (2) **microglia** activation

Alzheimer's disease is associated with abnormal activation of **microglia**, contributing to brain inflammation and neuronal damage.

## widen

*v.* to become or make something broader, wider, more extensive

*synonym* : broaden, enlarge, extend

(1) **widen** in excitement, (2) **widen** a narrowed heart valve

He **widened** his investigation into a medical clinic.

## improvisation

*n.* the act of making something up on the spot or creating or performing something without preparation

*synonym* : spontaneity, ad-lib, extemporization

(1) **improvisation** on stage, (2) jazz **improvisation**

He created a beautiful piece of music using only **improvisation**.

## cofounder

*n.* one of several people who establishes an organization or starts a business

(1) **cofounder** of the university, (2) late **cofounder**

He is the **cofounder** and chairman of this tech company.

## atrophy

*n.* a decrease in size of a muscle, organ, etc., caused by disease or disuse

*synonym*: disintegration, degeneration, wasting away

(1) weakness with **atrophy**, (2) **atrophy** of the muscles

Daily exercise and adequate sleep are necessary to prevent the progression of **atrophy**.

## determinant

*n.* a factor, circumstance, or condition that contributes to the shaping, influencing, or determining of a particular outcome or result

*synonym*: cause, factor, element

(1) environmental **determinant**, (2) a **determinant** of crop yields

One **determinant** of success is having a positive attitude and a strong work ethic.

## falloff

*n.* a decline or decrease in something, such as quantity or quality; a decrease in the intensity, brightness, or volume of something; (verb) to decrease in quantity, quality, or intensity; to slip or slide from a surface or support

*synonym*: decline, drop, decrease

(1) **falloff** in demand, (2) productivity **falloff**

The **falloff** in sales was attributed to the new competitor in the market.

## allude

*v.* to suggest or make reference to something indirectly

*synonym*: imply, indicate, hint

(1) **allude** to his low origin, (2) **allude** to the planning

He **alluded** to the problem but did not mention it directly.

## impair

*v.* to damage something or make it weaker or worse

*synonym*: degrade, mar, deface

(1) **impair** my health, (2) **impair** insulin sensitivity

The accident made his vision **impaired**.

## pathophysiology

*n.* the study of the changes in normal bodily functions that occur as a result of disease or injury; the study of the functional changes that occur in an organism as a result of disease, injury, or abnormality

*synonym*: medical pathology, disease mechanism, physiological disorder

(1) explore the **pathophysiology**, (2) **pathophysiology** of heart disease

The study of **pathophysiology** examines the physiological processes that lead to disease.

## opportune

*adj.* suitable or happening at a time that is suitable or convenient for a particular purpose

*synonym*: suitable, timely, practical

(1) **opportune** occasion, (2) an **opportune** remark

The phone rang at the most **opportune** time.

## Session 2: Spelling

1. the symbol of t\_u *n.* the 19th letter of the Greek alphabet, transliterated as "t"; (of physics, tau particle) a fundamental particle known as the tau lepton that is an elementary particle with a negative electric charge and a spin of 1/2
2. am\_\_\_\_d beta *n.* a type of protein that can accumulate abnormally in various tissues and organs in the body and is linked to various diseases, including Alzheimer's disease
3. fl\_\_\_y graphics *adj.* attractive or impressive by being bright, expensive, large, etc.; (used especially of clothes) marked by conspicuous display
4. am\_\_\_\_d accumulation *n.* a type of protein that can accumulate abnormally in various tissues and organs in the body and is linked to various diseases, including Alzheimer's disease
5. fli\_\_\_\_\_ng flames *adj.* shining or flashing in an unsteady or irregular way; fluctuating or wavering, often with regards to light or flame
6. probably have de\_\_\_\_\_ia *n.* a severe decline in cognitive function, especially memory, as a result of disease or injury
7. twirl the ba\_\_n *n.* a thin stick or rod used as a conductor's wand, a symbol of authority, or a tool for specific sports or activities; a short, straight, light stick that is passed from runner to runner in a relay race

ANSWERS: 1. tau, 2. amyloid, 3. flashy, 4. amyloid, 5. flickering, 6. dementia, 7. baton



8. dis\_\_\_\_\_ue scene *n.* a nightclub or restaurant where recorded music is played, and people dance
9. tera-he\_\_z radiation *n.* the unit of frequency, equal to one cycle per second, often used to describe the frequency of electromagnetic waves or electronic signals
10. the branch of neu\_\_\_\_\_nce *n.* the scientific study of the function, structure, and disorder of the brain and the nervous system
11. at\_\_\_\_\_y of the muscles *n.* a decrease in size of a muscle, organ, etc., caused by disease or disuse
12. environmental det\_\_\_\_\_nt *n.* a factor, circumstance, or condition that contributes to the shaping, influencing, or determining of a particular outcome or result
13. dis\_\_\_\_\_ue party *n.* a nightclub or restaurant where recorded music is played, and people dance
14. left ve\_\_\_\_\_le *n.* a chamber or cavity within an organ or structure, particularly the lower chamber of the heart that pumps blood to the lungs and other parts of the body
15. mi\_\_\_\_\_ia activation *n.* a type of cell in the central nervous system that acts as part of the immune system, defending against invading pathogens and supporting healthy brain function
16. fli\_\_\_\_\_ng hope *adj.* shining or flashing in an unsteady or irregular way; fluctuating or wavering, often with regards to light or flame

ANSWERS: 8. discotheque, 9. hertz, 10. neuroscience, 11. atrophy, 12. determinant, 13. discotheque, 14. ventricle, 15. microglia, 16. flickering

- |                             |           |   |
|-----------------------------|-----------|---|
| 17. br_____ve idea          | <i>n.</i> | a sudden idea or inspiration; a moment of great insight or creativity   |
| 18. sudden br_____ve        | <i>n.</i> | a sudden idea or inspiration; a moment of great insight or creativity   |
| 19. de_____ia patients      | <i>n.</i> | a severe decline in cognitive function, especially memory, as a result of disease or injury   |
| 20. conducting ba__n        | <i>n.</i> | a thin stick or rod used as a conductor's wand, a symbol of authority, or a tool for specific sports or activities; a short, straight, light stick that is passed from runner to runner in a relay race       |
| 21. en_____n the heart rate | <i>v.</i> | to synchronize, or bring into a line, with a particular process or rhythm; to board a train or other means of transportation  |
| 22. syn_____ze our watches  | <i>v.</i> | to happen or cause to happen at the same time or rate   |
| 23. in a ta___e             | <i>n.</i> | a confused mass of something twisted together   |
| 24. lactic acid bu_____p    | <i>n.</i> | the accumulation or increase of something over time   |
| 25. weakness with at_____y  | <i>n.</i> | a decrease in size of a muscle, organ, etc., caused by disease or disuse  |
| 26. explore the pat_____ogy | <i>n.</i> | the study of the changes in normal bodily functions that occur as a result of disease or injury; the study of the functional changes that occur in an organism as a result of disease, injury, or abnormality |

ANSWERS: 17. brainwave, 18. brainwave, 19. dementia, 20. baton, 21. entrain, 22. synchronize, 23. tangle, 24. buildup, 25. atrophy, 26. pathophysiology

27. ta\_\_\_e wires *n.* a confused mass of something twisted together
28. involvement of the hip\_\_\_\_\_us *n.* a major component of the brain of humans and other vertebrates that is part of the limbic system and is vital for memory
29. a det\_\_\_\_\_nt of crop yields *n.* a factor, circumstance, or condition that contributes to the shaping, influencing, or determining of a particular outcome or result
30. late co\_\_\_\_\_er *n.* one of several people who establishes an organization or starts a business
31. audio he\_\_z *n.* the unit of frequency, equal to one cycle per second, often used to describe the frequency of electromagnetic waves or electronic signals
32. neurons in the hip\_\_\_\_\_us *n.* a major component of the brain of humans and other vertebrates that is part of the limbic system and is vital for memory
33. end at a sy\_\_\_\_\_e *n.* the fact or state of failing to finish an activity and of stopping using, making, or doing it
34. syn\_\_\_\_\_ze movements *v.* to happen or cause to happen at the same time or rate
35. imp\_\_\_\_\_ion on stage *n.* the act of making something up on the spot or creating or performing something without preparation
36. al\_\_\_e to his low origin *v.* to suggest or make reference to something indirectly

ANSWERS: 27. tangle, 28. hippocampus, 29. determinant, 30. cofounder, 31. hertz, 32. hippocampus, 33. synapse, 34. synchronize, 35. improvisation, 36. allude

37. a theoretical concept in neu\_\_\_\_\_nce *n.* the scientific study of the function, structure, and disorder of the brain and the nervous system
38. wi\_\_n a narrowed heart valve *v.* to become or make something broader, wider, more extensive
39. pre\_\_\_\_\_al region *adj.* in or about the foremost part of the frontal lobe of the brain
40. the ha\_\_\_\_\_rk of a good scientist *n.* a distinctive characteristic or attribute of a person or thing
41. pre\_\_\_\_\_al bone *adj.* in or about the foremost part of the frontal lobe of the brain
42. im\_\_\_\_r my health *v.* to damage something or make it weaker or worse
43. ve\_\_\_\_\_le in the brain *n.* a chamber or cavity within an organ or structure, particularly the lower chamber of the heart that pumps blood to the lungs and other parts of the body
44. al\_\_\_\_e to the planning *v.* to suggest or make reference to something indirectly
45. productivity fa\_\_\_\_\_f *n.* a decline or decrease in something, such as quantity or quality; a decrease in the intensity, brightness, or volume of something; (verb) to decrease in quantity, quality, or intensity; to slip or slide from a surface or support
46. am\_\_e everyone *v.* to fill with wonder, surprise, or admiration
47. wi\_\_n in excitement *v.* to become or make something broader, wider, more extensive

ANSWERS: 37. neuroscience, 38. widen, 39. prefrontal, 40. hallmark, 41. prefrontal, 42. impair, 43. ventricle, 44. allude, 45. falloff, 46. amaze, 47. widen

48. co\_\_\_\_\_er of the university *n.* one of several people who establishes an organization or starts a business
49. im\_\_\_\_r insulin sensitivity *v.* to damage something or make it weaker or worse
50. fa\_\_\_\_\_f in demand *n.* a decline or decrease in something, such as quantity or quality; a decrease in the intensity, brightness, or volume of something; (verb) to decrease in quantity, quality, or intensity; to slip or slide from a surface or support
51. am\_\_\_\_e and entertain visitors *v.* to fill with wonder, surprise, or admiration
52. pat\_\_\_\_\_ogy of heart disease *n.* the study of the changes in normal bodily functions that occur as a result of disease or injury; the study of the functional changes that occur in an organism as a result of disease, injury, or abnormality
53. sy\_\_\_\_\_e circuit *n.* the fact or state of failing to finish an activity and of stopping using, making, or doing it
54. op\_\_\_\_\_ne occasion *adj.* suitable or happening at a time that is suitable or convenient for a particular purpose
55. huge military bu\_\_\_\_\_p *n.* the accumulation or increase of something over time
56. en\_\_\_\_\_n at the station *v.* to synchronize, or bring into a line, with a particular process or rhythm; to board a train or other means of transportation

ANSWERS: 48. cofounder, 49. impair, 50. falloff, 51. amaze, 52. pathophysiology, 53. synapse, 54. opportune, 55. buildup, 56. entrain

57. fl\_\_\_y cars *adj.* attractive or impressive by being bright, expensive, large, etc.; (used especially of clothes) marked by conspicuous display
58. mi\_\_\_\_\_ia cells *n.* a type of cell in the central nervous system that acts as part of the immune system, defending against invading pathogens and supporting healthy brain function
59. jazz imp\_\_\_\_\_ion *n.* the act of making something up on the spot or creating or performing something without preparation
60. dispose of un\_\_\_\_\_ed formalin solution *adj.* not given medical care or treatment; not subjected to chemical or physical treatment
61. an op\_\_\_\_\_ne remark *adj.* suitable or happening at a time that is suitable or convenient for a particular purpose
62. t\_u particle *n.* the 19th letter of the Greek alphabet, transliterated as "t"; (of physics, tau particle) a fundamental particle known as the tau lepton that is an elementary particle with a negative electric charge and a spin of 1/2
63. the ha\_\_\_\_\_rk of modern life *n.* a distinctive characteristic or attribute of a person or thing
64. an un\_\_\_\_\_ed disease *adj.* not given medical care or treatment; not subjected to chemical or physical treatment

ANSWERS: 57. flashy, 58. microglia, 59. improvisation, 60. untreated, 61. opportune, 62. tau, 63. hallmark, 64. untreated

## Session 3: Fill in the Blanks

1. Research shows that damage to the \_\_\_\_\_ cortex leads to increased aggression.  
*adj.* in or about the foremost part of the frontal lobe of the brain
2. He \_\_\_\_\_ to the problem but did not mention it directly.  
*v.* to suggest or make reference to something indirectly
3. The human ear can detect sounds with frequencies ranging from 20 to 20,000 \_\_\_\_\_.  
*n.* the unit of frequency, equal to one cycle per second, often used to describe the frequency of electromagnetic waves or electronic signals
4. Our university is famous for its professors, who are well-versed in behavioral \_\_\_\_\_.  
*n.* the scientific study of the function, structure, and disorder of the brain and the nervous system
5. The cords behind my computer were a \_\_\_\_\_ mess.  
*n.* a confused mass of something twisted together
6. The \_\_\_\_ protein has been found to play a role in the development of Alzheimer's disease and other neurological disorders.  
*n.* the 19th letter of the Greek alphabet, transliterated as "t"; (of physics, tau particle) a fundamental particle known as the tau lepton that is an elementary particle with a negative electric charge and a spin of 1/2
7. The police officer used his \_\_\_\_\_ to disperse the crowd.  
*n.* a thin stick or rod used as a conductor's wand, a symbol of authority, or a tool for specific sports or activities; a short, straight, light stick that is passed from runner to runner in a relay race

ANSWERS: 1. prefrontal, 2. alluded, 3. hertz, 4. neuroscience, 5. tangled, 6. tau, 7. baton

8. The engineer had a \_\_\_\_\_ and redesigned the product to be more efficient.  
*n.* a sudden idea or inspiration; a moment of great insight or creativity
9. The \_\_\_\_\_ is crucial for learning and memory storage.  
*n.* a major component of the brain of humans and other vertebrates that is part of the limbic system and is vital for memory
10. The \_\_\_\_\_ candlelight added a cozy ambiance to the room.  
*adj.* shining or flashing in an unsteady or irregular way; fluctuating or wavering, often with regards to light or flame
11. The \_\_\_\_\_ of stress over time can lead to health problems.  
*n.* the accumulation or increase of something over time
12. The \_\_\_\_\_ in sales was attributed to the new competitor in the market.  
*n.* a decline or decrease in something, such as quantity or quality; a decrease in the intensity, brightness, or volume of something; (verb) to decrease in quantity, quality, or intensity; to slip or slide from a surface or support
13. The ball speed will increase when the lower body movements are perfectly \_\_\_\_\_.  
*v.* to happen or cause to happen at the same time or rate
14. The rhythm of the music made me want to \_\_\_\_\_ my movements with the beats.  
*v.* to synchronize, or bring into a line, with a particular process or rhythm; to board a train or other means of transportation
15. A clear and simple expression is the \_\_\_\_\_ of good writing.  
*n.* a distinctive characteristic or attribute of a person or thing

ANSWERS: 8. brainwave, 9. hippocampus, 10. flickering, 11. buildup, 12. falloff, 13. synchronized, 14. entrain, 15. hallmark



16. He created a beautiful piece of music using only \_\_\_\_\_.
- n.* the act of making something up on the spot or creating or performing something without preparation
17. The accident made his vision \_\_\_\_\_.
- v.* to damage something or make it weaker or worse
18. Heat stroke is the result of \_\_\_\_\_ heat exhaustion.
- adj.* not given medical care or treatment; not subjected to chemical or physical treatment
19. The heart's \_\_\_\_\_ are responsible for pumping blood out to the body.
- n.* a chamber or cavity within an organ or structure, particularly the lower chamber of the heart that pumps blood to the lungs and other parts of the body
20. The magician's tricks \_\_\_\_\_ the audience.
- v.* to fill with wonder, surprise, or admiration
21. Alzheimer's disease is associated with abnormal activation of \_\_\_\_\_ contributing to brain inflammation and neuronal damage.
- n.* a type of cell in the central nervous system that acts as part of the immune system, defending against invading pathogens and supporting healthy brain function
22. He is the \_\_\_\_\_ and chairman of this tech company.
- n.* one of several people who establishes an organization or starts a business
23. Daily exercise and adequate sleep are necessary to prevent the progression of \_\_\_\_\_.
- n.* a decrease in size of a muscle, organ, etc., caused by disease or disuse

ANSWERS: 16. improvisation, 17. impaired, 18. untreated, 19. ventricles, 20. amazed, 21. microglia, 22. cofounder, 23. atrophy

24. One \_\_\_\_\_ of success is having a positive attitude and a strong work ethic.
- n.* a factor, circumstance, or condition that contributes to the shaping, influencing, or determining of a particular outcome or result
25. He couldn't wait to hit the \_\_\_\_\_ and dance the night away.
- n.* a nightclub or restaurant where recorded music is played, and people dance
26. I want to buy a reliable car rather than a \_\_\_\_\_ one.
- adj.* attractive or impressive by being bright, expensive, large, etc.; (used especially of clothes) marked by conspicuous display
27. The study found that regular exercise can help to prevent the onset of \_\_\_\_\_ in older age.
- n.* a severe decline in cognitive function, especially memory, as a result of disease or injury
28. Animals transmit nerve impulses through \_\_\_\_\_.
- n.* the fact or state of failing to finish an activity and of stopping using, making, or doing it
29. Alzheimer's disease is characterized by the buildup of \_\_\_\_\_ plaques in the brain.
- n.* a type of protein that can accumulate abnormally in various tissues and organs in the body and is linked to various diseases, including Alzheimer's disease
30. The phone rang at the most \_\_\_\_\_ time.
- adj.* suitable or happening at a time that is suitable or convenient for a particular purpose

ANSWERS: 24. determinant, 25. discotheque, 26. flashy, 27. dementia, 28. synapses, 29. amyloid, 30. opportune

31. The study of \_\_\_\_\_ examines the physiological processes that lead to disease.

- n.* the study of the changes in normal bodily functions that occur as a result of disease or injury; the study of the functional changes that occur in an organism as a result of disease, injury, or abnormality

32. He \_\_\_\_\_ his investigation into a medical clinic.

- v.* to become or make something broader, wider, more extensive

ANSWERS: 31. pathophysiology, 32. widened