Why Can’t I Sleep: Melatonin
Student Information Page 4A

Activity Introduction:
Ever wonder why you are so tired, even though you got 7 hours of sleep? It could be because you left the bedroom light on or drank a soda before bed. The foods we eat and the misuse of light are major contributors to the interruption of melatonin release. In this activity, you will explore factors influencing the release of melatonin, “walk the walk” leading to the release or suppression of melatonin, and correlate circadian rhythms with melatonin patterns.

Activity Background:
Melatonin is a beneficial substance produced in the pineal gland. The pineal gland is a small organ located in the brain behind the hypothalamus. (Figure 1 Anatomy of the Brain). The pineal gland is home to a very important organic substance called melatonin. Melatonin, is a powerful, protective antioxidant, it helps establish circadian rhythms and it helps you fall asleep.

How is melatonin released or not released? Light and food are two major factors influencing whether or not melatonin is released from the pineal gland. Have you ever considered light to be a pollutant? Well, it can be. NASA has compiled light usage on earth at night and has posted a picture on their website (http://www.nasa.gov/multimedia/image-gallery/image_feature_2403.html). That is a lot of light! Considering that all of this light can affect melatonin levels, it can have a profound effect on humans. Light inhibits the release of melatonin. When melatonin is not released, circadian rhythms are disrupted and the body doesn’t reset its biological clock. Your body is not reenergized and ready for a full day.
Let’s look at how light enters the body and acts as a stimulus to the pineal gland. Figure 2 Light that Regulates Melatonin illustrates a road map for light to enter the eye and end up in the pineal gland.

**Figure 2 How Light Regulates Melatonin**

*Light as a Stimulus:* Our body responds to light along a specific pathway. As light enters the eye, it passes through the retina. Special cells inside the retina respond to specific types of light. These special cells in the retina are nicknamed RGC (their real name is retinal ganglion cells). The light response (message or signal) continues to the hypothalamus. Inside the hypothalamus is the biological clock. (This is what we need to reset daily). The light message cannot travel directly to the pineal gland. Notice the “Detour, Do Not Enter”. That’s ok, because there is an alternate route. Can you spot the other route? **Hint: Go down the spinal cord and then up to the pineal gland.**

Visible light comes in various wavelengths; see Figure 3 Visible Light Spectrum. Melatonin release is most sensitive to light in the blue to blue-green range (450-550nm). At this particular wavelength, melatonin will not be released. How do we know what type of lighting is not good for us? Take a look at the graphic organizer. **Figure 4 How Types of Light Affect**
Melatonin. Notice the key to the maximum melatonin release is NO LIGHT.

**Figure 4 How Types of Light Affect Melatonin**

*Food as a Stimulus:* Food also plays a role in the release of melatonin. When you think melatonin release, there are two categories of food. One group increases the release of melatonin and for simplicity; we will call them “Snoozers”. The other group decreases the release of melatonin and for simplicity; we will call them “Zingers”. What happens to the food and how does it travel from the stomach to the brain? Just like light, food sets up responses that follow a road map from the mouth to the stomach and finally the brain. *(Note: the food itself does not go from the stomach to the brain).*

Food enters the mouth and travels to the stomach by way of the esophagus. Food is broken down in the digestive system. In some of our foods, there is an amino acid called tryptophan, which our body must have. *Tryptophan* is transformed to
**melatonin** in the pineal gland through a series of chemical reactions. **Tryptophan** travels from the stomach to pineal gland through the bloodstream. Which foods are “**Snoozers**”? **Snoozers** are foods rich in tryptophan such as: dairy products, seafood, poultry, whole grains, and eggs. Zingers include caffeinated foods: coffee, tea, and some sodas. Now we know something about the role of foods, let’s examine how more tryptophan can be produced as a result of foods we eat (Figure 5 **Tryptophan and Melatonin**).

**Activity Materials:**
- 1 set **Character Cards**
- String/yarn for **Character Cards**
- **Stimulus/Response Cards**
- “**Road Map**” to Sleep
- 1 Class Set of **Student Information Pages**
- 1 Copy **Student Data Page** (per student)

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**Figure 5**
**Tryptophan and Melatonin**

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Activity Instructions:

1. You will draw a Character Card to determine your role in this simulation activity. Hang the Character Card around your neck so everyone can see your role.

2. Sheet/shower curtain with road map is opened up onto the floor. You may need to arrange furniture to make space or your teacher may have you do the simulation outside.

3. Take your place on the road map (simulation sheet) as follows:
   a. Students who are Mel A. Tonin go to the pineal gland.
   b. Trip Tofan: go to the stomach
   c. Blood Vessel: stand as if you are playing “London Bridge” with hands locked to make the bridge and take positions on the road map.

4. Host/Hostess will draw a Stimulus/Response Card and read the stimulus out loud (Note: A stimulus is something that triggers a response in the body, such as bright light causing the pupils in your eyes to constrict (the constricting of the pupils is a response (or reaction) to the stimulus of light). In this activity, you will investigate various stimuli that affect the release of melatonin. The release of melatonin is a response. All characters involved will prepare to act out the response. Be sure to pause when reading to allow characters in the simulation to complete their tasks.

5. Characters involved with scenario will act out the response by walking on the road map.

6. Students decide if melatonin will be released or not based on the scenarios.
   a. If melatonin is released then all the Mel. A. Tonin characters stand. Their character card will be turned to a happy, sleepy face.
b. If melatonin is suppressed then all the Mel A. Tonin characters will sit inside the pineal gland. Their character cards will be turned to a frown face.

c. If melatonin is delayed then just a few Mel A. Tonin characters stand. Their character cards will be turned to a frown face.

7. You will do the first 3 scenarios together. Use “Freeze Action” to discuss, explain, and ask questions about what is happening. Be sure everyone around you knows how to do the simulation.

8. You are now ready to do the simulations without “Freeze Action”. The Host/Hostess will continue to draw Stimulus/Response Cards. As the class completes the road map, the teacher will help the class discuss the actions chosen by the players.

9. When activity is finished, students return materials.

10. Students will complete the Student Data Page.
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1. Fill in the following concept map by using the background reading material provided in this activity.
2. Using the *road map* below, trace the pathway using a colored pencil as described for each stimulus. Be sure to indicate whether melatonin is *released*, *delayed*, or *not released* in response to the stimulus.

a. **Stimulus:** You drink caffeinated soda 1 hour before going to bed. Use a *red* colored pencil to trace the pathway on the *road map* below.
Melatonin will be __________________________________________________________
__________________________________________________________________________.

b. **Stimulus:** You leave the lights on in your bedroom and fall asleep without turning them off. Use a *blue* colored pencil to trace the pathway on the *road map* below.
Melatonin will be __________________________________________________________
__________________________________________________________________________.

c. **Stimulus:** You eat a light carbohydrate snack and drink milk before going to bed – this snack is loaded with tryptophan. Use a *green* colored pencil to trace the pathway on the *Road Map* below.
Melatonin will be __________________________________________________________
__________________________________________________________________________.
Processing Out:

1. Why is it important to turn off all lights when going to bed?
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2. How can you help prevent light pollution?
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3. How is tryptophan involved with the release of melatonin?
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4. Describe the relationship between light and melatonin.
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5. Would blindness affect the ability to release melatonin?
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6. If the Biological Clock were damaged how would that affect melatonin release?
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7. What evidence would you use to persuade local politicians to enact programs that would help control light pollution in your neighborhood?
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8. How would you balance the need to control light pollution with the need to have neighborhoods safely lit at night?
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_______________________________________________________________________________
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9. Many families are not aware that turning on lights at night will stop melatonin release. Further, melatonin will not be released again that night when the lights are turned off. In fact, melatonin release will be stopped until the next night when the lights are off. If this pattern continues, over time, the body does not get the full amount of melatonin. Loss of melatonin speeds the aging process, disrupts sleep, interferes with normal function of the biological clock, etc. Describe how you would raise awareness of the consequences of “light abuse” in your community.
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