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# From Bench to Bedtime: Entraining Policy to Science

Day 3

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Instructors: Lucy Lai, Brittany Bush, Mikaili Abdullah

# Course Schedule

## Day One

- What are circadian rhythms, and why do they matter?
- Autoinhibitory transcriptional networks allow for temporal gene regulation
- How environmental stimuli like light can “entrain” the circadian clock
- How the brain coordinates circadian rhythms in the periphery

## Day Two

- How does circadian biology impact shift workers?
- Shift work as a historical phenomenon
- How to leverage circadian biology to improve health outcomes in shift workers
- Exploring the board ramifications of shift work

## Day Three

- How should future policies (DST, school start times) be informed by circadian biology?
- The current status of DST and school start times in the USA
- How to better support health and productivity outcomes using circadian biology

# Learning Objectives

At the end of Day 3, students can ...

- ❑ Students will be able to explain the reasoning behind policies, such as Daylight Savings Time (DST) and school start times, that intersect with circadian biology
- ❑ Students will be able to identify the effect of current policies on overall health.

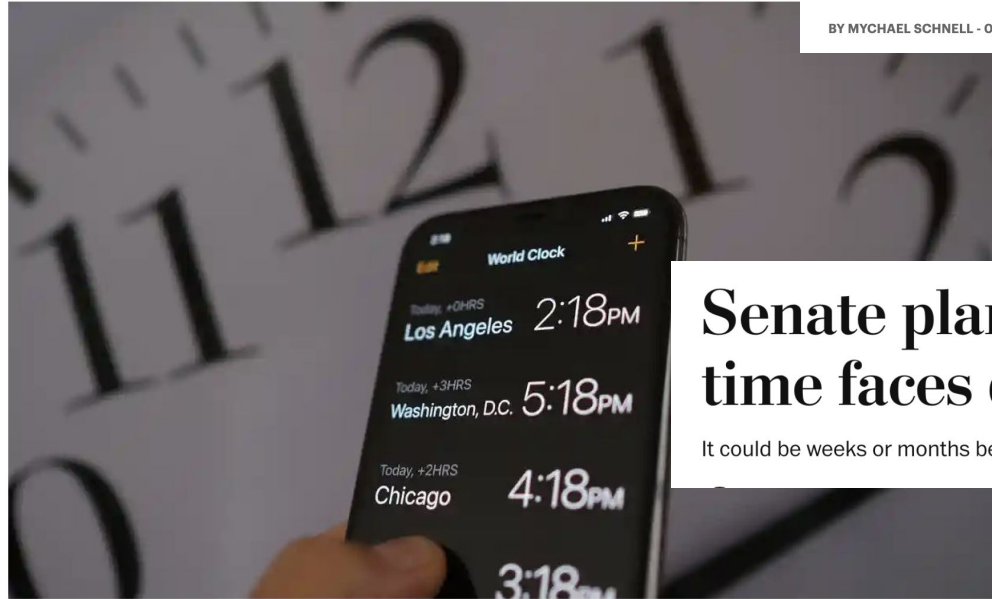
# 'No more switching clocks': Senate passes act to make daylight saving time permanent

**Sunshine Protection Act needs approval from the House, and signature of Joe Biden, to become law**

HOUSE

## Permanent daylight saving time hits brick wall in House

BY MICHAEL SCHNELL - 07/25/22 5:25 AM ET



## Senate plan for permanent daylight saving time faces doubts in the House

It could be weeks or months before Democrats decide whether to tee up a vote, Rep. Frank Pallone Jr. says

📷 Bill named the Sunshine Protection Act would ensure Americans no longer have to change their clocks twice a year. Photograph: Chris Delmas/AFP/Getty Images

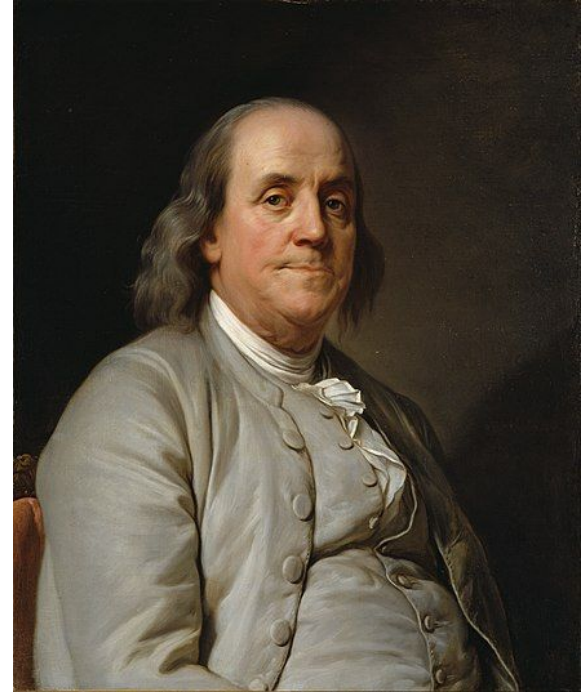
# What is **Daylight Savings Time**?

## **One working definition:**

Daylight Saving Time (DST) is to have darkness fall at a **later clock time during the spring and summer**, which gives people an **extra hour of daylight while the weather is warm.**

# Some history about Daylight Savings Time

- The idea of of **aligning waking hours to daylight hours** to conserve candles was first proposed in 1784 by **Benjamin Franklin**.
- *"An immense sum! That the city of Paris might save every year, by the economy of using sunshine instead of candles."*
- He calculated the savings that would result from waking up earlier in the summer to reduce candle usage...



# Some history about Daylight Savings Time

In the six months between the 20th of March and the 20th of September, there are

Nights 183

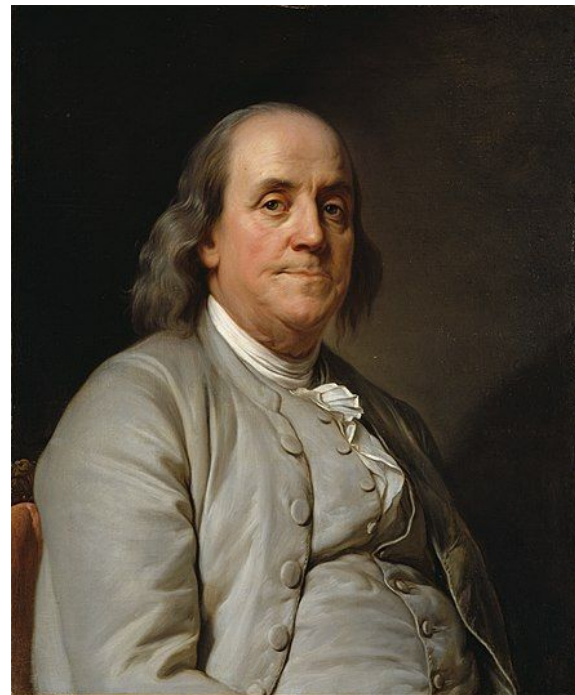
Hours of each night in which we burn candles 7

Multiplication gives for the total number of hours 1,281

These 1,281 hours multiplied by 100,000, the number of  
inhabitants, give 128,100,000

One hundred twenty-eight millions and one hundred  
thousand hours, spent at Paris by candle-light, which, at half  
a pound of wax and tallow per hour, gives the weight of 64,050,000

Sixty-four millions and fifty thousand of pounds, which,  
estimating the whole at the medium price of thirty sols the  
pound, makes the sum of ninety-six millions and seventy-five  
thousand livres tournois 96,075,000



# Some history about Daylight Savings Time

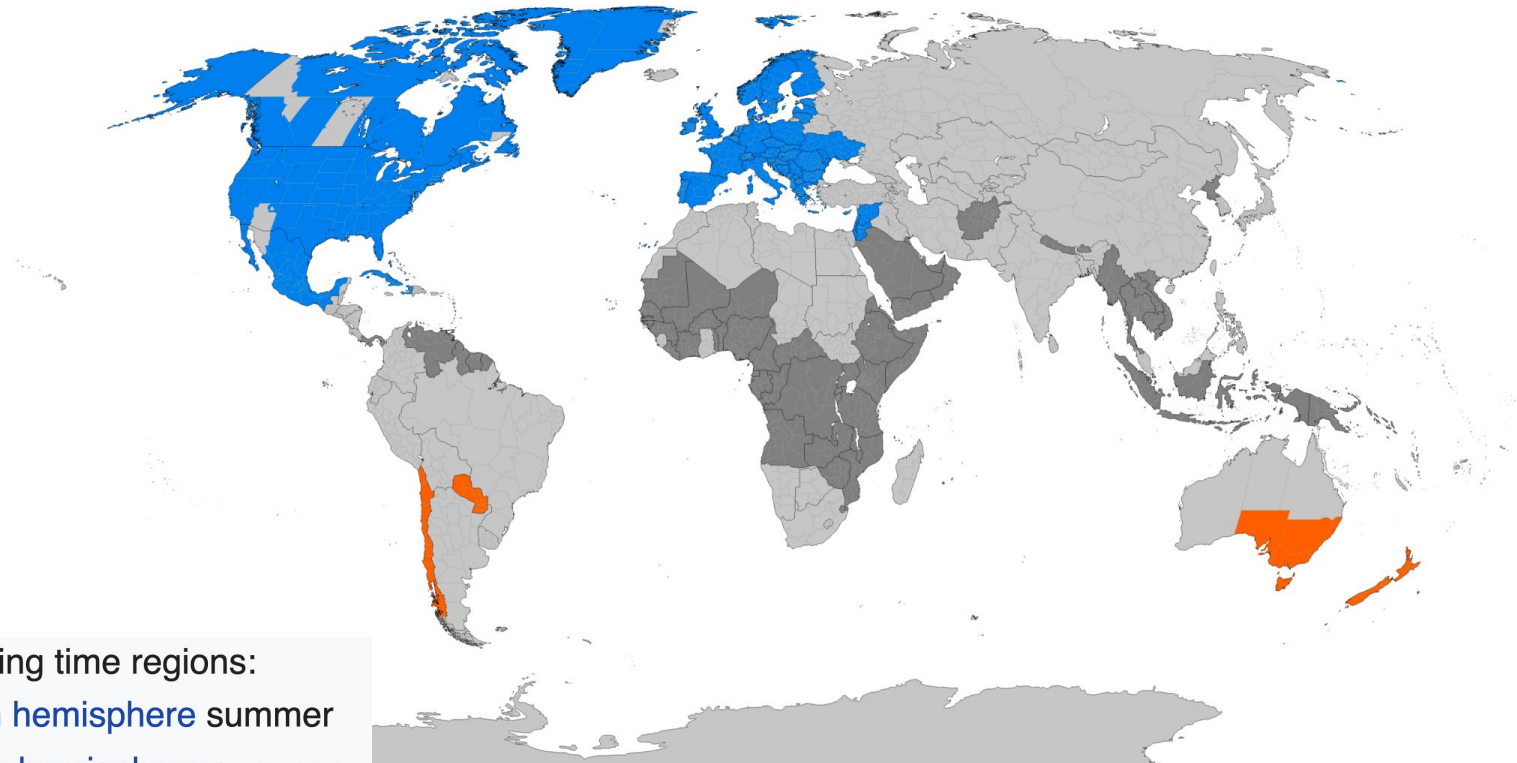
DST as we know it now was first put to use during **World War I**

- In 1916, the German Empire set clocks ahead one hour in an effort to use **less power for lighting** and to **save fuel** for the war effort.
- In World War II, the U.S. was on daylight saving time for more than **three years!**
- **Modern day:** According to a 2022 poll, **only 35% of Americans want to keep switching back and forth from ST to DST, and 59% wanted to see DST made permanent**





<https://fivethirtyeight.com/features/do-americans-really-want-permanent-daylight-saving-time/>



# The use of DST around the world



Daylight saving time regions:

-  Northern hemisphere summer
-  Southern hemisphere summer
-  Formerly used daylight saving
-  Never used daylight saving

## Entering Standard Time (November)



**FALL**

We \_\_\_ 1 hour of sleep  
(gain / lose)

## Entering DST (March)



**SPRING**

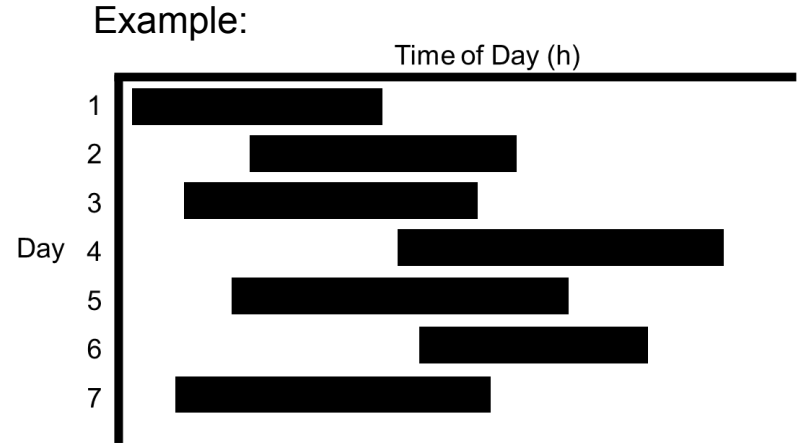
We \_\_\_ 1 hour of sleep  
(gain / lose)

# Group Activity:

Sketch a 7-day actogram of...

Scenario 1: “Fall Back” or the transition to Standard Time (November)

Scenario 2: “Spring Forward” or the transition to Daylight Savings Time (March)



## Entering Standard Time (November)



**FALL**

Phase \_\_\_\_\_? (advance / delay)

## Entering DST (March)

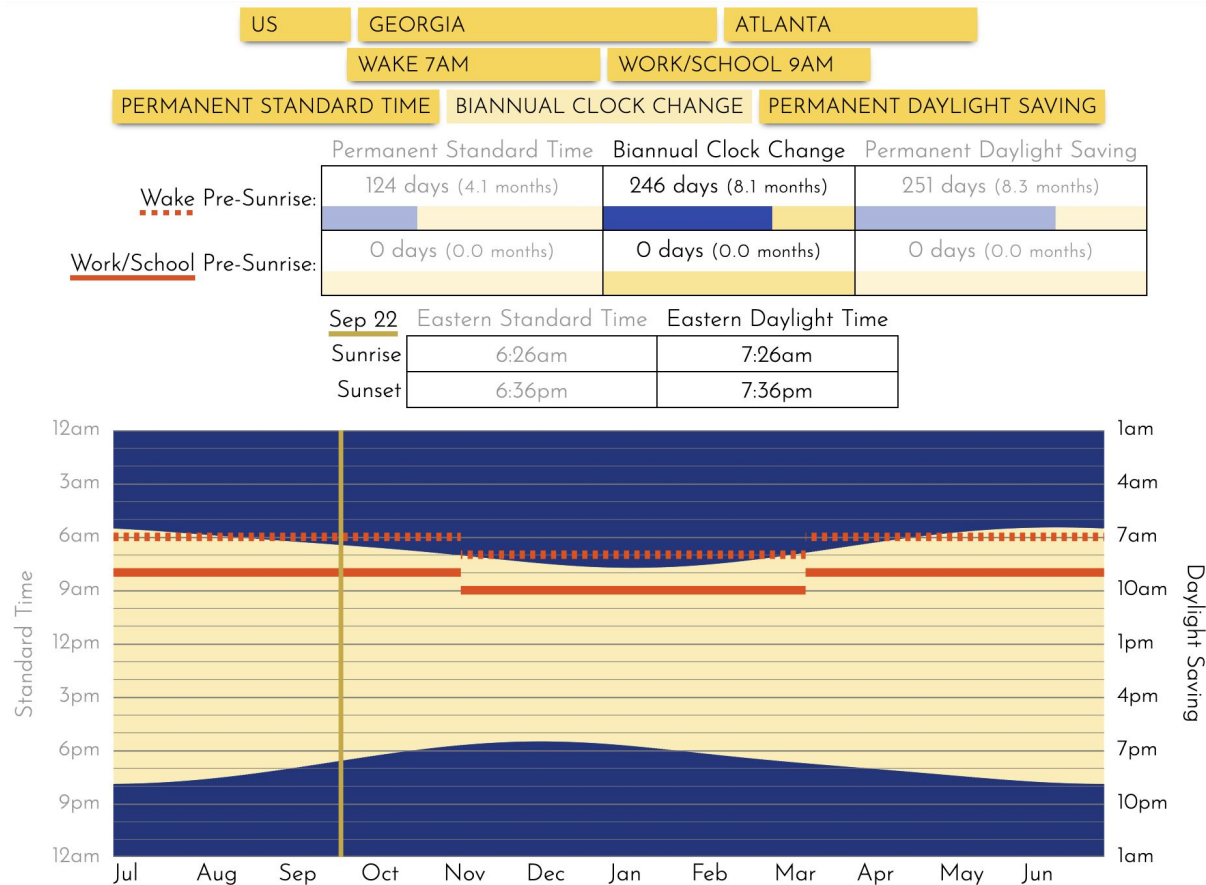


**SPRING**

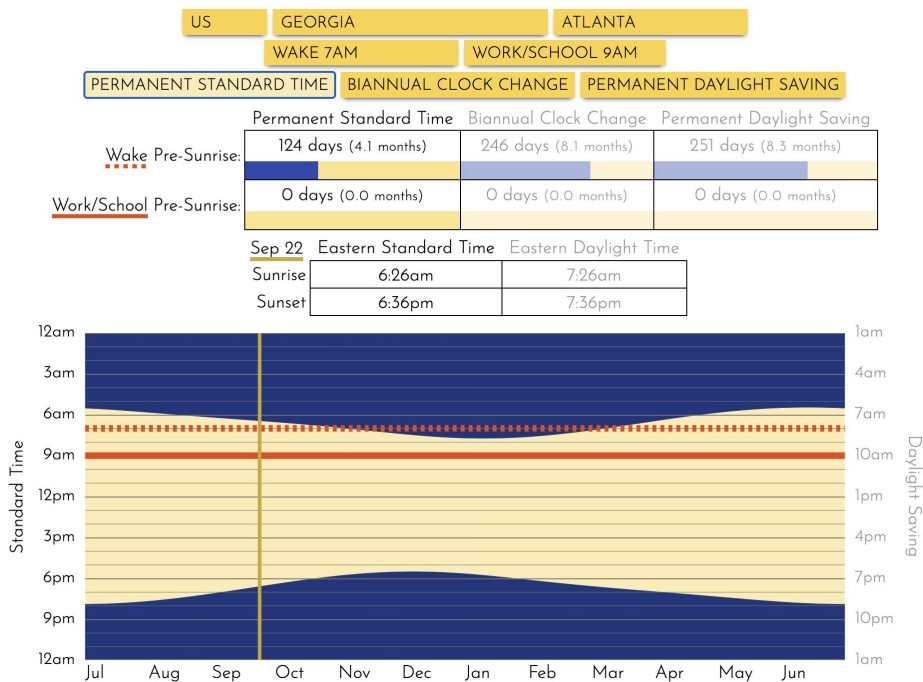
Phase \_\_\_\_\_? (advance / delay)

**If the natural human circadian rhythm is >24hrs, which transition would naturally be easier for us?**

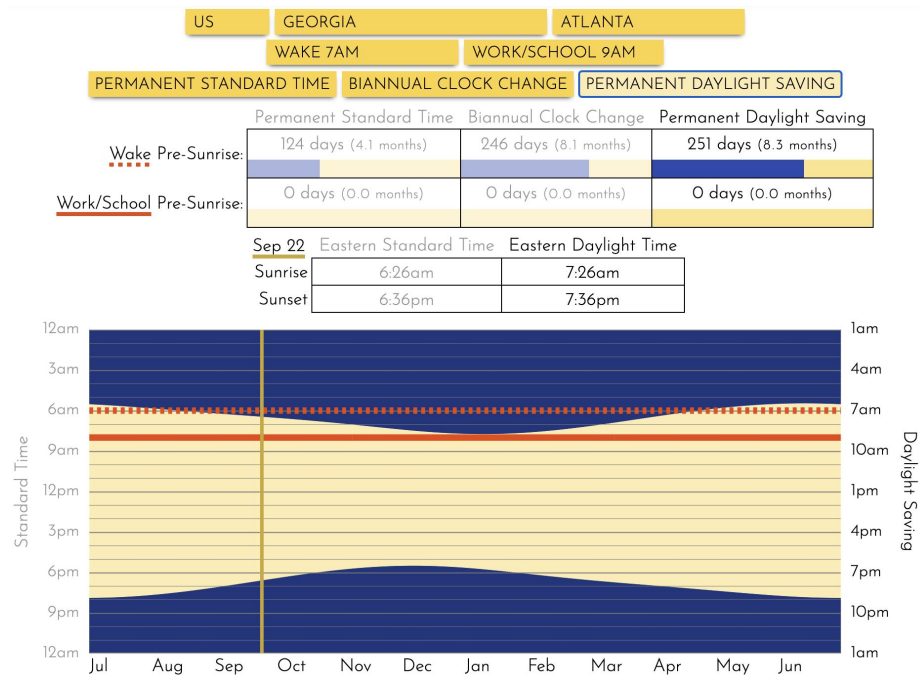
# Standard Time -> Daylight Savings Time Biannual Change



# Permanent Standard Time



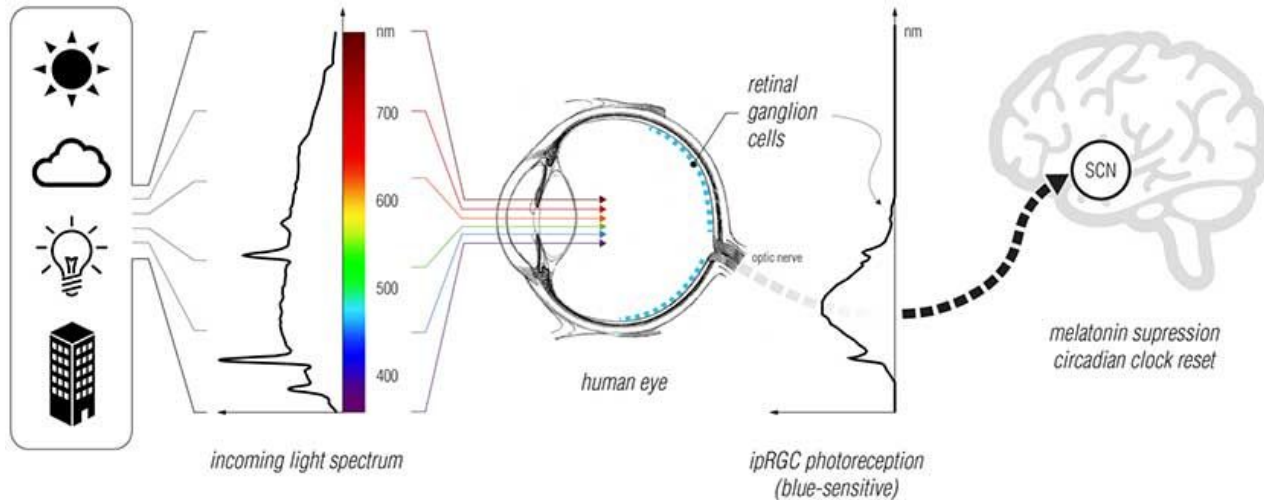
# Permanent Daylight Savings Time



Any observations?

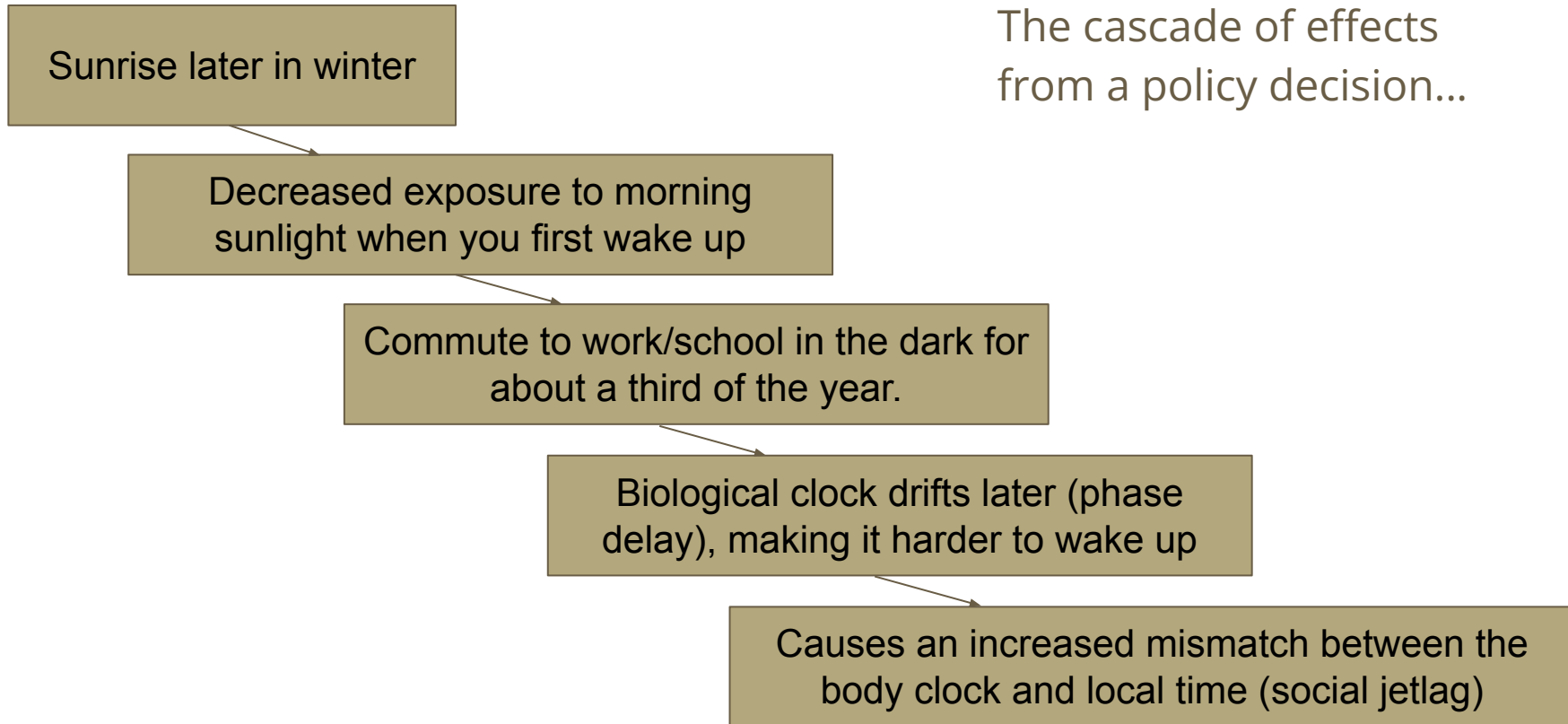
# Review: morning light as a natural cue for wakefulness

- Morning light *advances* the clock by triggering photoreceptors in your eye that suppress melatonin



# Consequences of permanent DST

The cascade of effects  
from a policy decision...

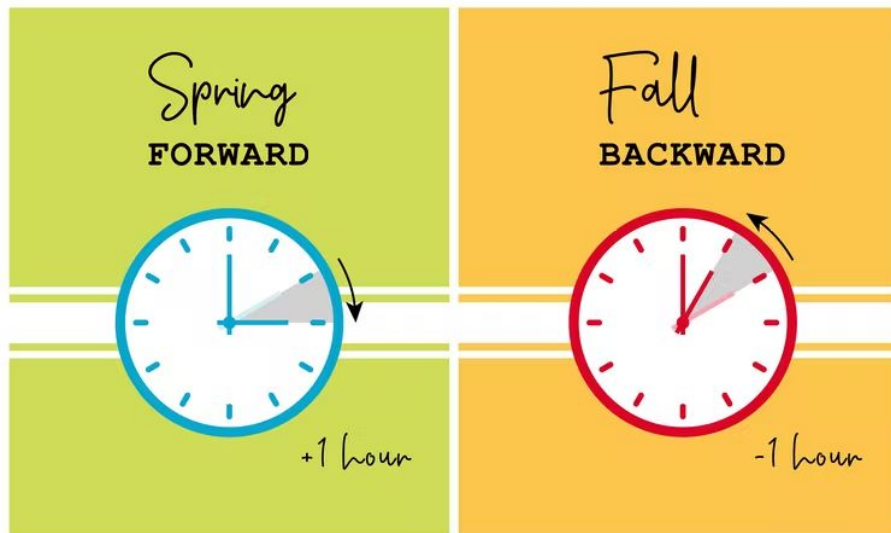




**Has anyone been personally  
affected by daylight savings time?**

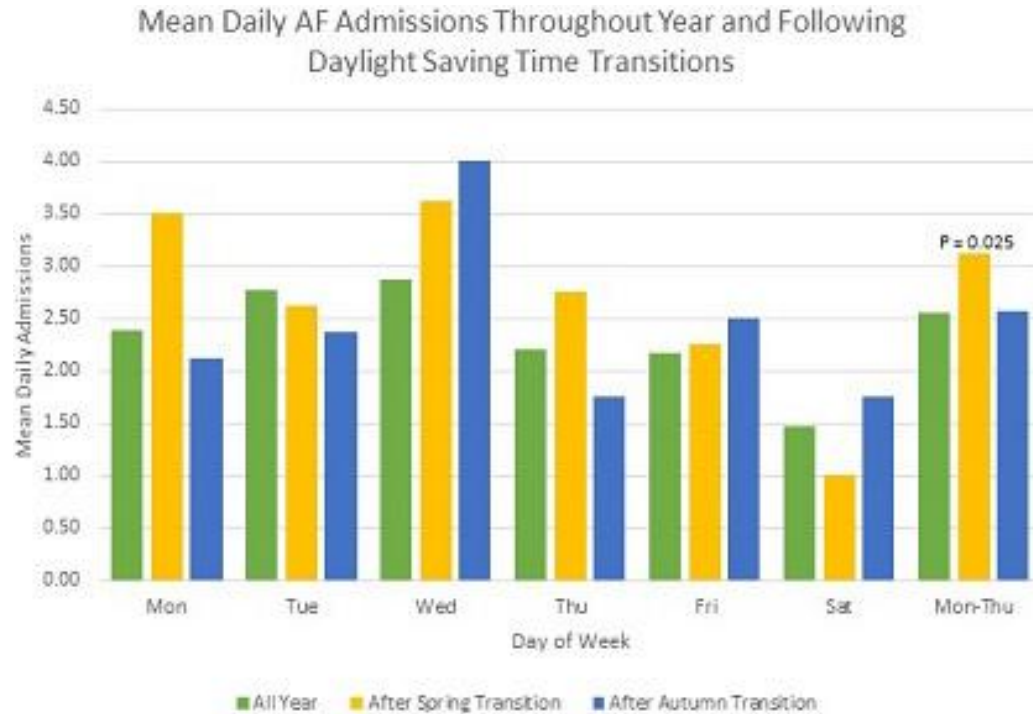
# DST and health outcomes

- Daylight savings time can increase many different health and safety risks.
  - Sleep
  - Diabetes risk
  - Cardiovascular health
  - Digestion
  - Psychiatric health
  - Traffic accidents



# Increased Atrial Fibrillation following start of DST

- Data on admission for atrial fibrillation (AF) collected from 2009 to 2016.
- Significant increase in incidence AF following start of DST.

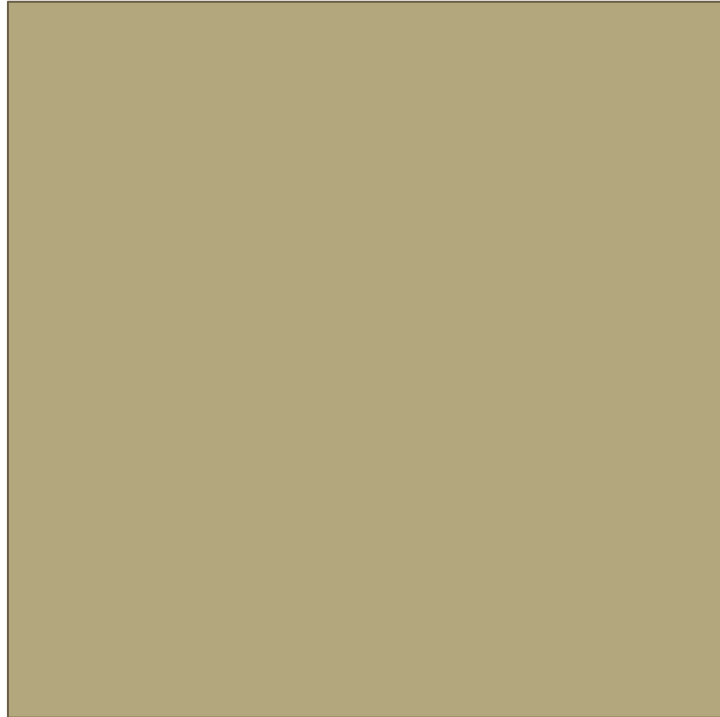


- **24%** higher risk of heart attacks
- **6%** spike in fatal car accidents
- **8%** increase in stroke risk
- **11%** spike in depressive episodes

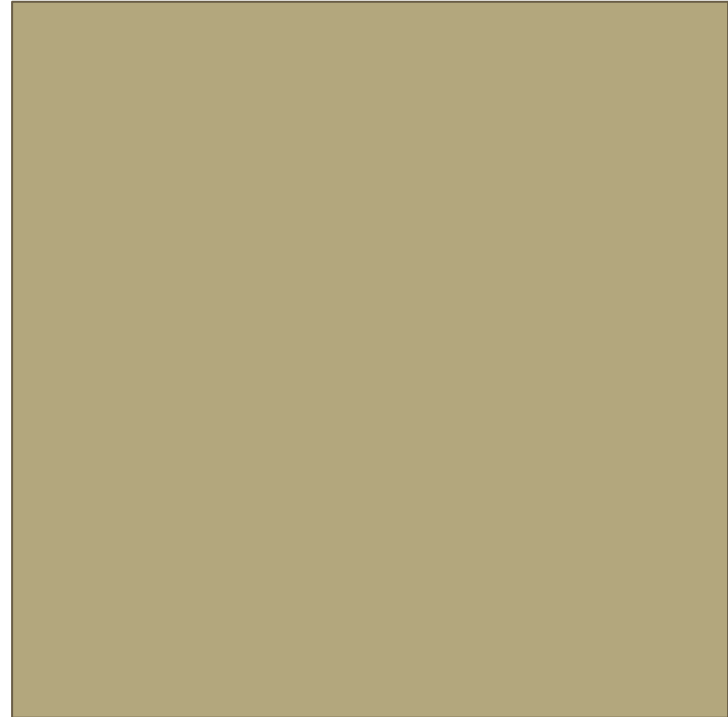
# The week after shifting into DST

# Group Activity: DST or ST?

**In favor of  
Permanent DST**



**In favor of  
Permanent ST**



# Natural Rhythms Vs Society

- Previously, we learned that the body interacts with the environment allowing for entrainment of the biological clock.
- Environmental Influences:
  - Shift work
  - School start times
  - Daylight Savings Time
  - Traveling
  - Social Jetlag
- These environmental cues interact with the natural expression of our circadian rhythmicity.

# Chronotypes

- The behavioral expression of our circadian rhythmicity.
  - Influenced by age, environment, genetics, and sex.
- Chronotypes are categorized into the following:
  - Morningness - "Lark"
  - Intermediate - "Finch"
  - Eveningness - "Owl"



# Activity: AutoMEQ Chronotype Quiz

Link to the AutoMEQ Quiz is on course website:

bit.ly/mahping

<https://chronotype-self-test.info/index.php?sid=61524&newtest=Y>



**What is your chronotype and, in your opinion, does it match with your social behavior?**



When poll is active, respond at **pollev.com/laurenminer448**

Text **LAURENMINER448** to **37607** once to join

# What chronotype are you?

Morningness

Eveningness

Intermediate



Powered by  **Poll Everywhere**

Start the presentation to see live content. For screen share software, share the entire screen. Get help at [pollev.com/app](https://pollev.com/app)

# Do you think your chronotype matches your social behavior?



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Start the presentation to see live content. For screen share software, share the entire screen. Get help at [pollev.com/app](https://pollev.com/app)

# Chronotypes and Disease Risk

## Morningness

- Associated with lower BMI
- Little to no expression change in clock genes
- Better sleep quality
- Better at following social and work time norms

## Eveningness

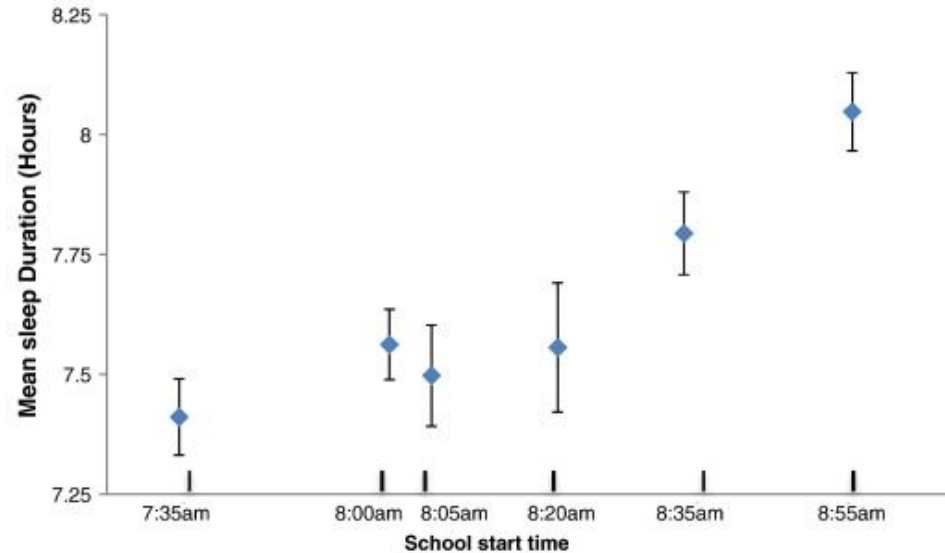
- Associated with higher BMI
- Associated with Type 2 Diabetes prevalence and lack of glycemic control
- Poor sleep quality and increased sleep disturbance
- Changes in clock gene expression
- High association with anxiety and depression

# School Start Times

- Basis of school times started in the 19th century when schools were care for the children of daytime laborers.
  - However, it is unclear why, historically, high schools have opened before schools serving younger students.
- School start times as they currently are **do not follow the natural biology**--- young children wake up much earlier than adolescents, who need more sleep.
  - Scientists are pushing for school start times to be later due to the phase delay middle and high school students experience.



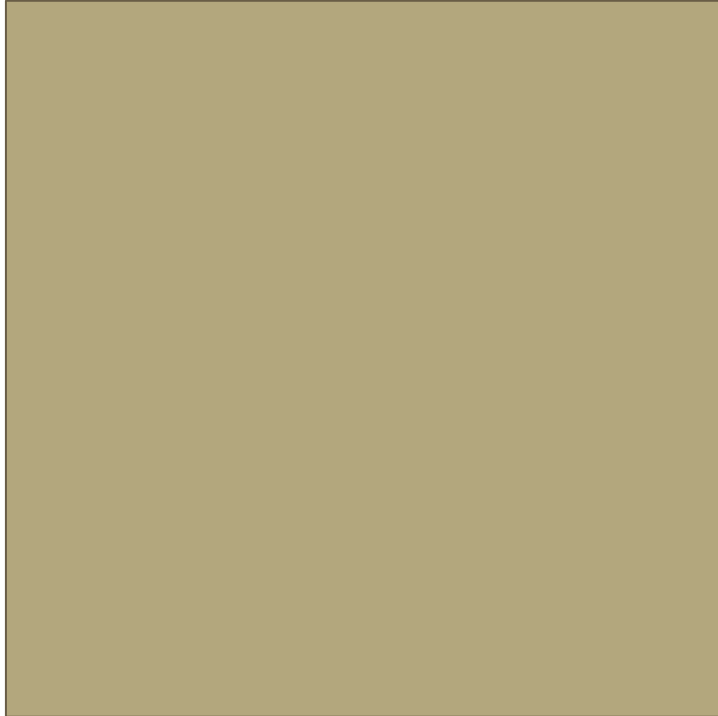
# School start time and sleep duration



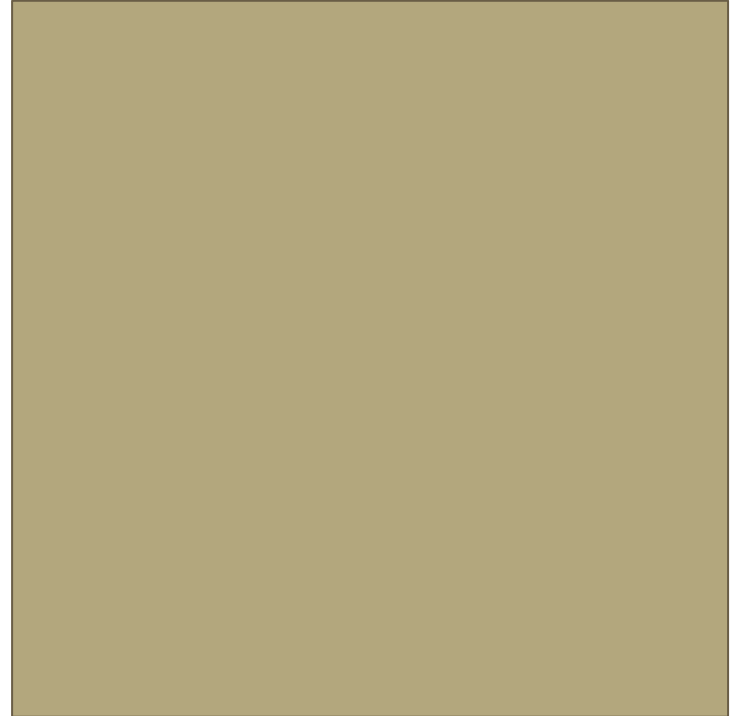
- Sleep duration increases with later school start times.
- Increased sleep duration also related to decreased risk of mental health and substance abuse concerns.
- DST can exacerbate the effects of school start times.

# Pros and Cons to Early School Start Times

## Pros

A large, empty rectangular box with a light beige background and a thin black border, intended for listing the pros of early school start times.

## Cons

A large, empty rectangular box with a light beige background and a thin black border, intended for listing the cons of early school start times.

# Think. Pair. Share.

Let's imagine the US and state government does not make any policy change to promote circadian health. Using any prior knowledge and what has been taught about circadian biology throughout this course, discuss with your partner(s) ways we can mitigate the effects of environmental factors on our overall health and progressively demote diseases caused by environmental circadian disruption?





**TODAY**

ON THE SHOW

SHOP

HEALTH

PARENTS

FOOD

 **TODAY** *all day*



PARENTS

# Let the kids sleep: California becomes first state to mandate later school starts

Experts say the initiative should go national, because teens can't learn when they're sleep-deprived.



**TIME**

**SUBSCRIBE**

HEALTH • SLEEP

## Why Sleeping In On School Days May Be Good for Teen Health

[back to school](#)

## California late start law: Experts, parents weigh pros and cons of late school start time



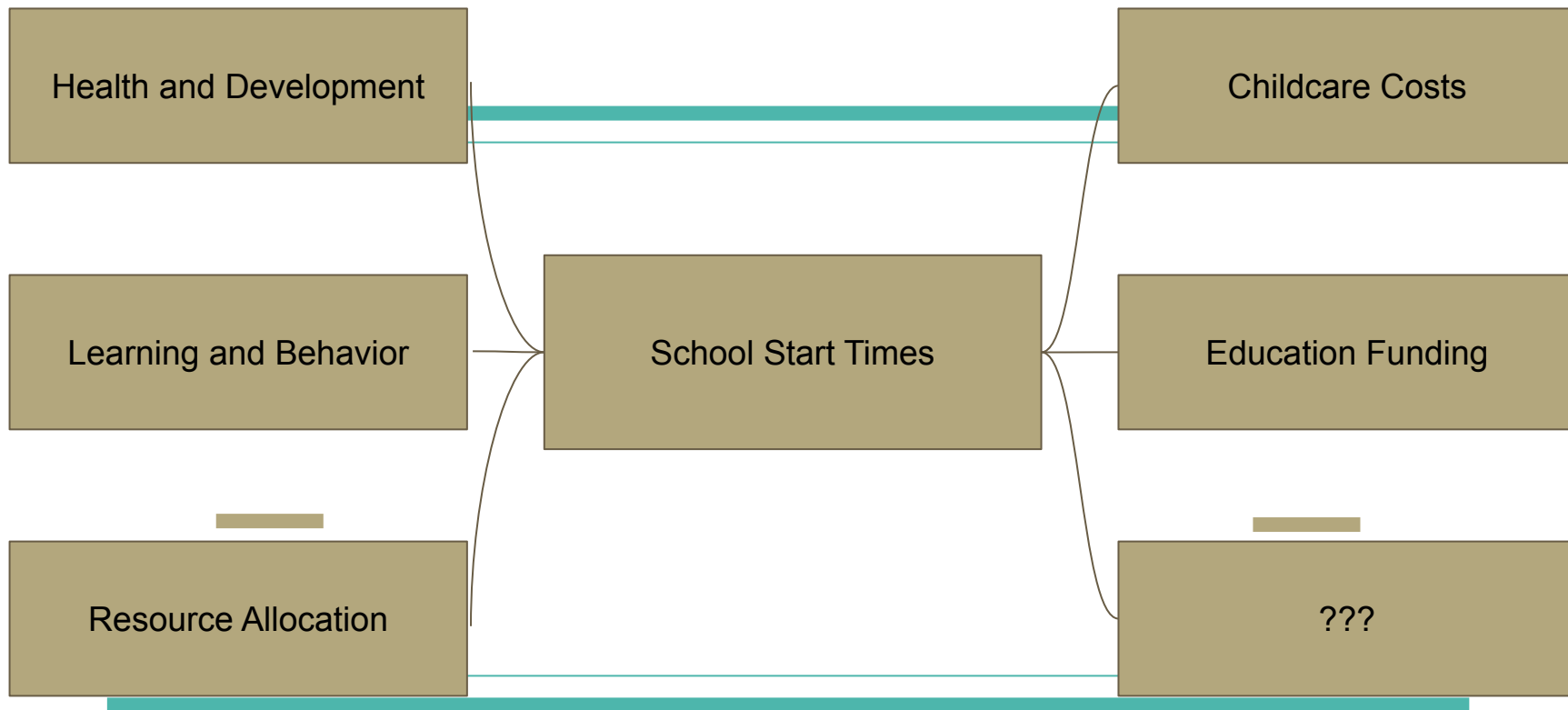
By [Rob McMillan](#) via 

Tuesday, August 16, 2022



<https://abc7.com/california-late-start-law-high-school-time-middle-sleep/12130485/>

## Factors Affecting Policy Changes Around School Start Times



# What other factors must be considered in a science-centered approach to policy?



# Course Summary

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- What are circadian rhythms, and why do they matter?
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# Thank you for taking our class!



Please take the post course quiz on our website: [bit.ly/mahping](https://bit.ly/mahping)