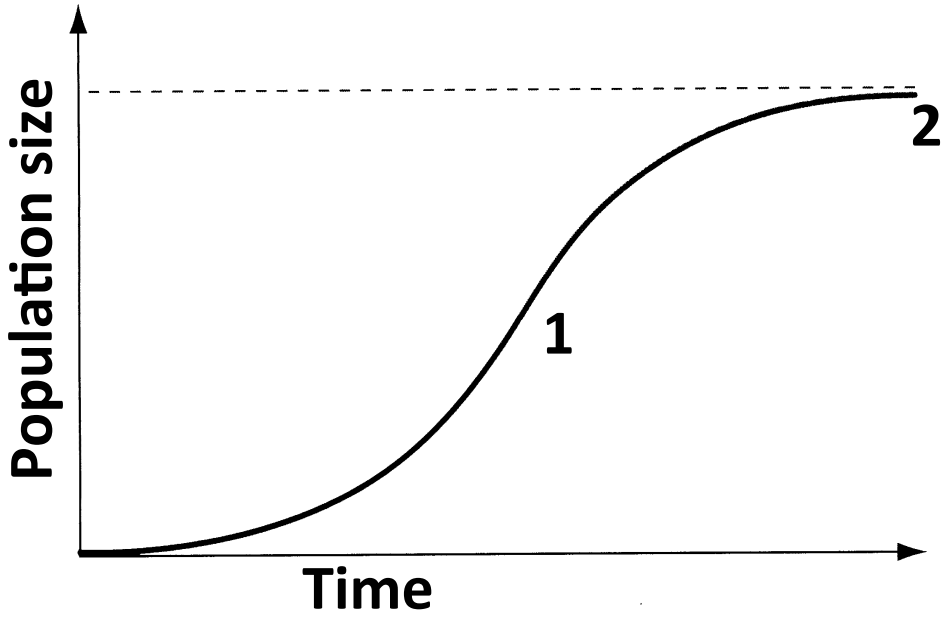
Human Population Growth
Analyzing Life History

Today's questions:

I. **What will the human population be over the course of your lifetime?**
II. **How do fitness trade-offs affect the evolution of life histories?**

(cell phones off, please)

Q1. Which of the following best describes this population?

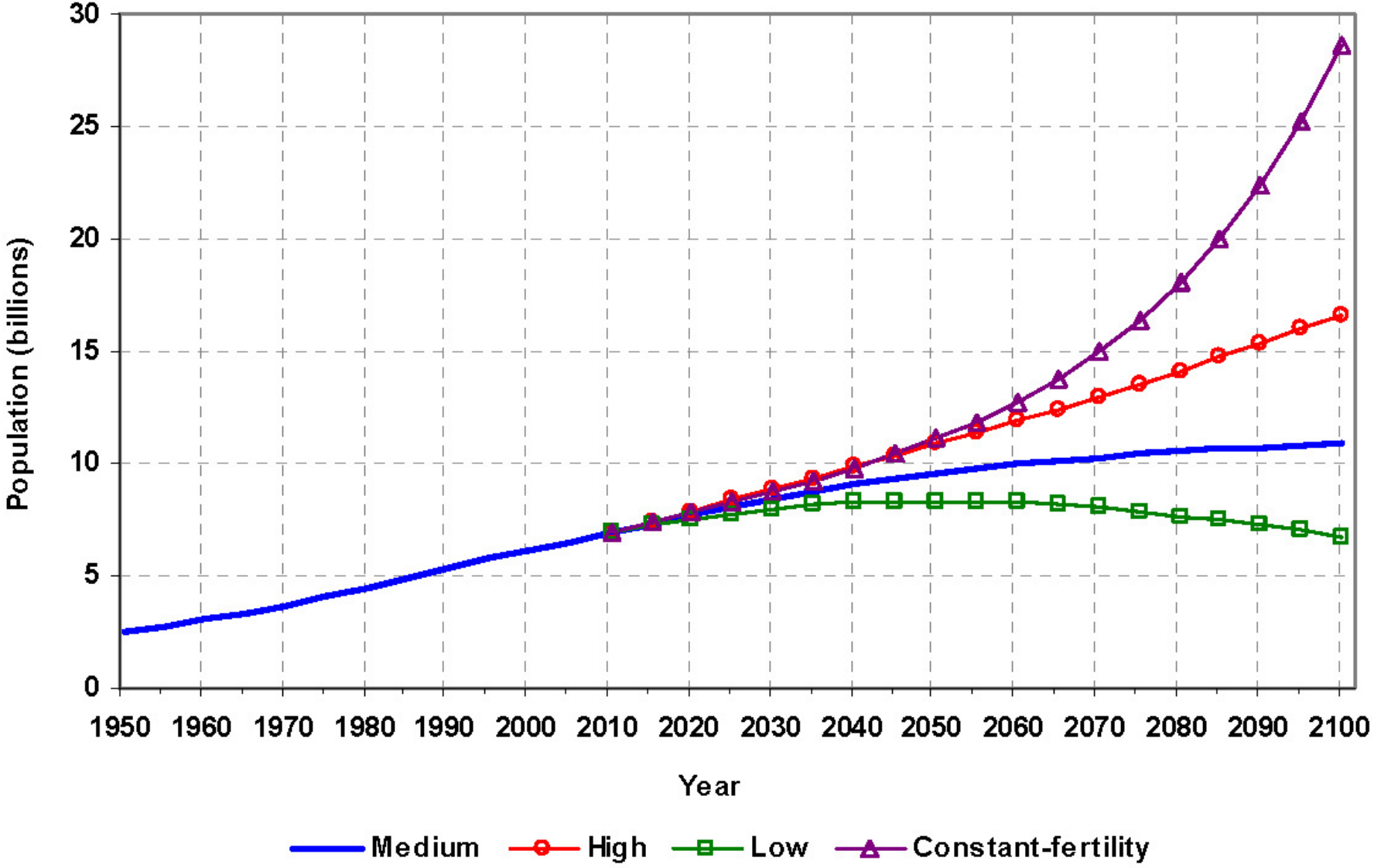


	Point 1	Point 2	Dashed line	Type of growth
1.	*r* = positive	*r* = negative	overshoot	Exponential (fast, then slow)
2.	*r* = positive	*r* = 0	r_{max}	Exponential (fast, then slow)
3.	*r* = positive	*r* = positive	carrying cap.	Density-dependent
4.	*r* starts decline	*r* = 0	carrying cap.	Density-dependent

I. What will the human population be when you're in your early 60s, and beyond?

Current population ~7.2 billion

2012 update:	fertility (avg. #kids/female)	2100 pop'n (billions)
Current, continued	~2.53, no change	
"High" projection	to ~2.49 by 2100	
"Medium" proj'n	to ~1.99 by 2100	
"Low" projection	to ~1.49 by 2100	


Population (billions)
30
25
20
15
10
5
0
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
Year
Medium
High
Low
Constant-fertility

1. What is the definition of replacement rate?

2. Why isn't the replacement rate 2.0?

3. Why is the replacement rate higher in developing nations versus industrialized nations?

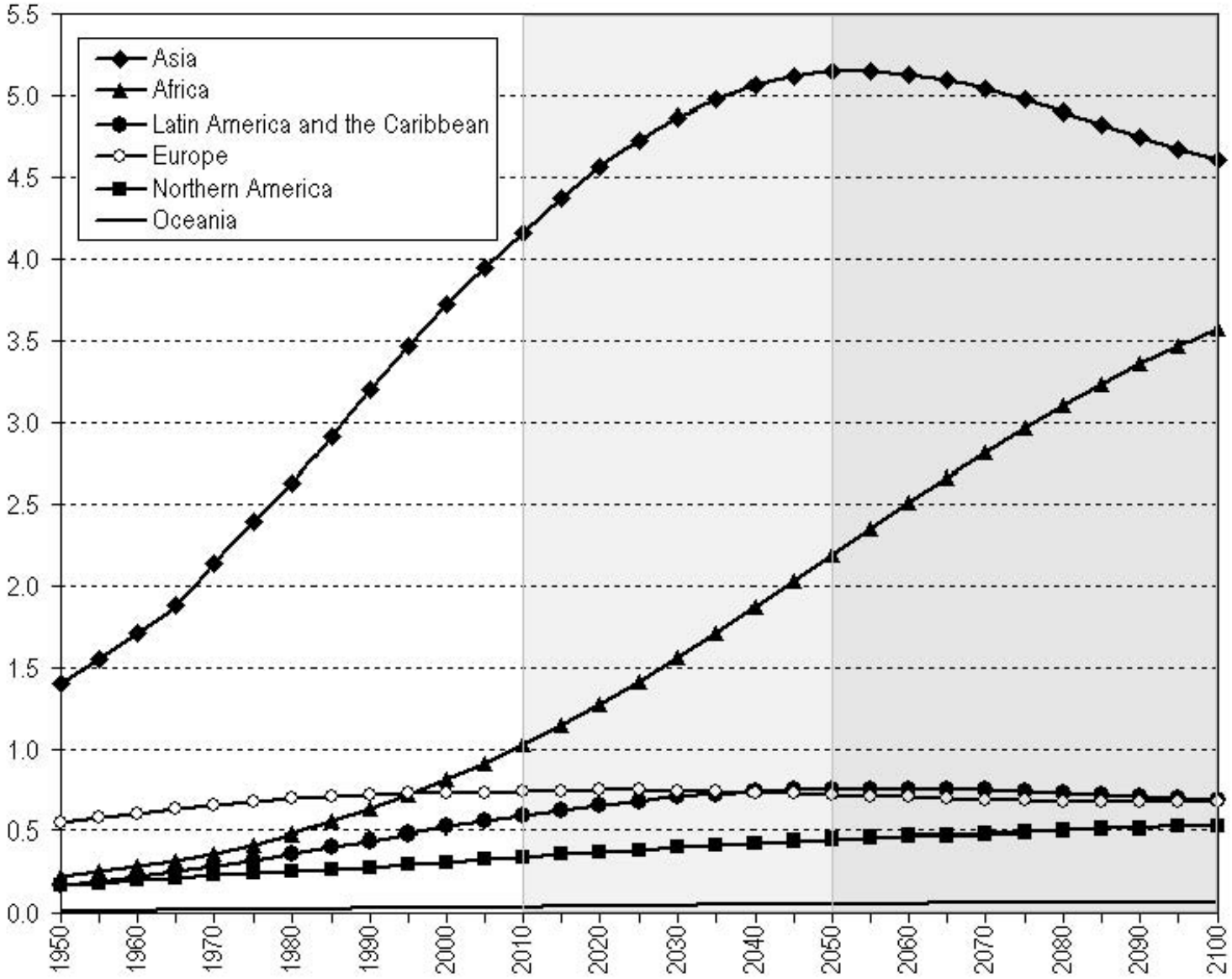
Q2. If average global fertility in humans is 2.1 from now until 2050, by 2050 the overall growth rate will be 0.47% per year. Why will the population still be increasing?

1. **There are an extremely large number of young females in the current population.**
2. **Survivorship will be constant or decrease slightly as the planet gets more crowded (and people in developed countries get more obese!).**
3. **There are strong male biases in the sex ratios of several large-population countries.**
4. **High divorce rates mean that many women are re-marrying and starting a second family.**

Trends in growth rate and fertility:

	Growth rate/year	Avg. fertility
1965-70:	2.04%	4.9
1990-95:	1.46%	3
2000-05:	1.2%	2.6
2014:	1.12%	2.3

We're currently adding ~77 million people/year … where?


Asia
Africa
Latin America and the Caribbean
Europe
Northern America
Oceania
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

What conditions contribute to fertility rates, and why?

- **Income**
- **Lifespan/child mortality**
- **Women's rights (education; access to birth control)**
- **Religious beliefs**

The role of emigration/immigration

Will all of the people born in developing countries stay in developing countries?

2004 Pew Hispanic Center survey in Mexico: If you could, would you emigrate to the United States?

40% yes x 109 million = million

In terms of biological impact of humans, the two key factors are:

1. **Number of people (population size)**

2. **Resources used per person**

Currently, what is the relationship between these two factors?

Change is opportunity

II. How do fitness trade-offs affect the evolution of life histories?

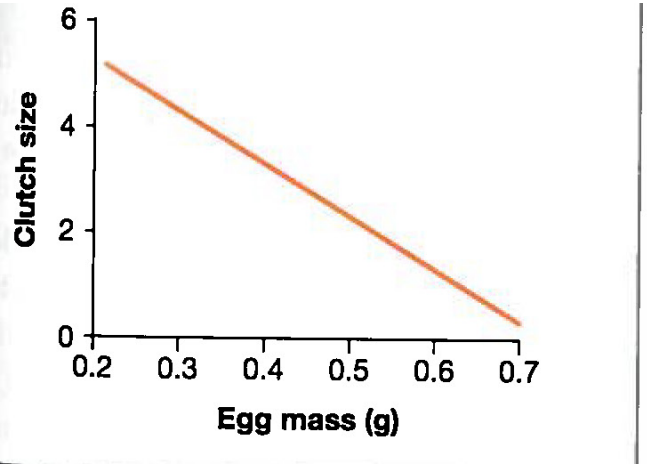
Experiment on side-blotched lizards:

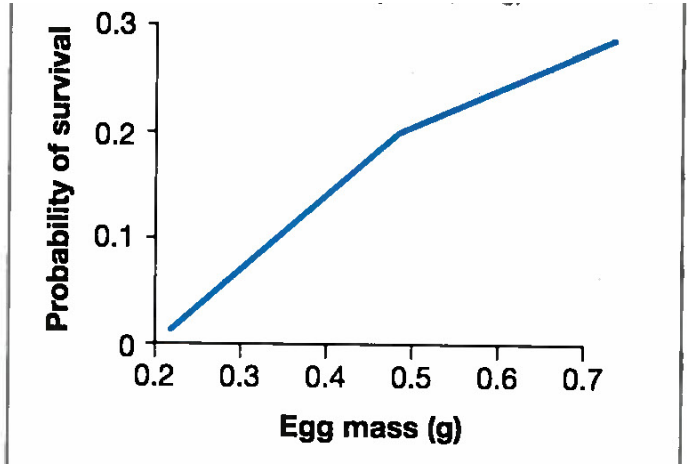
1. Remove yolk from eggs

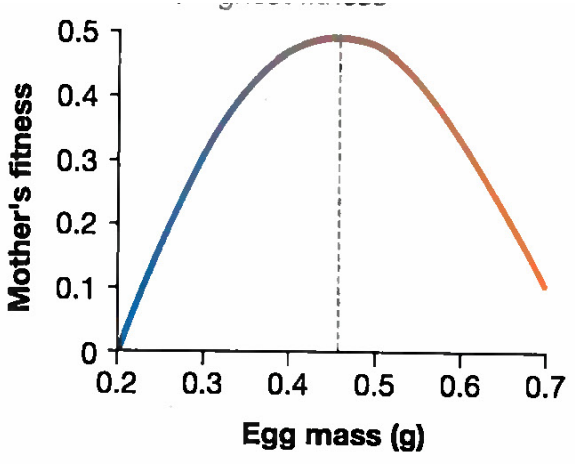
2. Remove all but 2-3 eggs

3. Sham operation

In terms of maternal investment in offspring, what does each treatment group represent?







1. What is the relationship between clutch size and egg size?

2. What is the relationship between egg size and offspring survival?

3. Did mothers that laid large eggs or small eggs have optimal fitness?

Q3. These results are evidence for which of the following patterns?

1. **Disruptive selection**
2. **Fitness trade-offs**
3. **Directional selection**
4. **Stabilizing selection**

Q4. On the south side of Chicago, lifespan in humans is extremely low due to poor nutrition, high violence, and inadequate medical care. Because education levels are low and unemployment is high, men are seldom able to invest in offspring. According to life history theory, which of the following is a logical consequence?

1. **Mothers do not care for their children.**
2. **Male-male competition is intense.**
3. **There are many unwed, teenaged mothers.**
4. **Average birthweight is extremely high.**