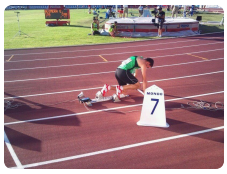
The Contraction Cycle Lab

Name _____

Date _____

Period _____

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Do Now A sprinter hears the starting gun. In about 0.15 seconds, her leg muscles are pushing off the blocks. 2 minutes, before you open the lab

A. What has to happen before her leg muscle can pull?

☐ A nerve sends a signal ☐ The muscle pulls by itself ☐ The bone moves first

B. When a muscle lets go and relaxes, does it need energy? ☐ Yes ☐ No ☐ Not sure

☐ I can put the events of a contraction in order, from the nerve signal to the pull.

☐ I can explain what calcium and ATP each do in the cross-bridge cycle.

☐ I can explain how a muscle relaxes, and why a body stiffens after death.

Part 1. Signal to pull (Tab 1)

SEP 2 Developing and Using Models · CCC Systems and System Models

Press Send signals and watch the whole run. Read the event log. Then click the part that released the calcium.

1. Copy the time for each event from your event log. Then number the events 1 to 7, first to last.

Event	Time (ms)	Order (1 to 7)
SR releases calcium		
ACh released into the gap		
Myosin grabs actin and pulls		
Impulse spreads over the sarcolemma		
Signal reaches the axon terminal		
Impulse runs down the T-tubules		
ACh binds to the muscle fiber		

2. How many ms after the first signal did the muscle reach full pull? _____ ms

3. The signals stopped at 100 ms. How many ms later was the muscle fully relaxed? Show your math.

_____

READ FIRST. In the lab, find the green Learn It box and read it. Then answer 4 to 6.

4. What does each part do? Tick one in each row.

Acetylcholine (ACh)	☐ crosses the gap	☐ carries the impulse inside	☐ stores calcium
T-tubules	☐ crosses the gap	☐ carries the impulse inside	☐ stores calcium
SR	☐ crosses the gap	☐ carries the impulse inside	☐ stores calcium

5. Model check (SEP 2). The lavender net stands for the _____ and the blue dots stand for _____. Name one way this model is not like a real muscle.

6. A muscle fiber is wide. Why does it need T-tubules to carry the impulse deep inside?

Part 2. The cross-bridge cycle (Tab 2)

SEP 5 Using Mathematics · CCC Structure and Function

Press Start over before each run. Press Next step again and again. Read Your counts after each run.

7. Do three runs. Copy Your counts for each run.

Run	What you did	Power strokes	ATP used	Actin moved (nm)
A	Calcium released. Stop after 3 power strokes.			
B	Calcium: None. Press Next step 2 times.			
C	Calcium released. Keep going until the head is stuck.			

8. Use run C (SEP 5). How many nm did actin move for each ATP used? Show your math. _____ At that rate, how many ATP would one head use to pull actin 100 nm? _____

READ FIRST. In the lab, find the green Learn It box and read it. Then answer 9 to 11.

9. Number the four steps of the cycle. Start with the head holding a fresh ATP.

Step	Order (1 to 4)
Power stroke: actin moves	
ATP splits and the head cocks	
A new ATP binds and the head lets go	
The head grabs actin	

10. Tick the two jobs ATP does in the cycle.

☐ makes the head let go of actin ☐ opens the binding sites ☐ cocks the head when it splits

☐ carries the nerve signal

11. In run B, the head could not grab actin. Explain why. Use the words troponin and tropomyosin.

Part 3. Break one step (Tab 3)

SEP 6 Constructing Explanations · CCC Cause and Effect

Run the healthy muscle first. Then run all five cases. Read Your runs.

12. Copy Your runs.

Case	Highest pull	Relaxed at the end?
Healthy muscle		
Botulinum toxin		
Myasthenia gravis		
Nerve agent		
Dantrolene		
After death		

13. Which two cases never relaxed? _____

READ FIRST. In the lab, find the green Learn It box and read it. Then answer 14 to 16.

14. Which step breaks first in each case? Tick one in each row.

Botulinum toxin	☐ ACh released	☐ ACh binds	☐ SR releases calcium	☐ ACh broken down
Myasthenia gravis	☐ ACh released	☐ ACh binds	☐ SR releases calcium	☐ ACh broken down
Nerve agent	☐ ACh released	☐ ACh binds	☐ SR releases calcium	☐ ACh broken down
Dantrolene	☐ ACh released	☐ ACh binds	☐ SR releases calcium	☐ ACh broken down

15. Jordan says, "A muscle needs energy to pull, but relaxing is free." Do you agree? Use evidence from two tabs.

16. Explain it (SEP 6). A few hours after an animal dies, its muscles lock stiff. This is rigor mortis. Why does this happen?

Claim	
Evidence from the lab	
Reasoning	