

Laboratory Exercise: Red Queen Card Game

Set up

Pick a partner: the game is played in teams of two, with one person playing the host and one playing the parasite. Consider switching roles halfway through the game.

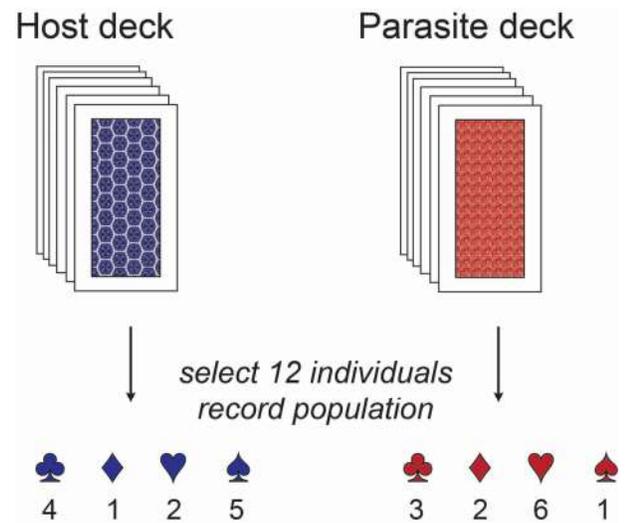
Your pair will need two card decks, one red-backed and one blue-backed. The host plays blue and the parasite red. Each deck contains 4 suits: spades, clubs, hearts, and diamonds. These represent our host and parasite genotypes.

Pick up a numbered card as well – this is the number for your group.

Data sheets: open the Google sheet “redqueengame” and navigate to the tab that matches your group’s number. You’ll enter your data in the Counts columns for Host (B-E) and Parasite (G-J).

Establish host and parasite starting populations:

- Shuffle each deck: blue for host and red for parasite
- Randomly select 12 cards from each deck
- The remaining cards are your reserve deck
- Record the number of individuals of each “genotype” (suit) in the generation 0 row of your data sheet.
- **Check:** do your numbers sum to 12? They should. Look at column F for host and K for parasite.



How to play

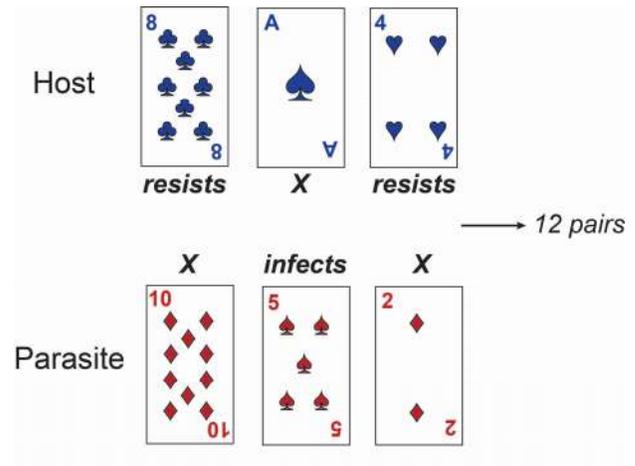
The game has 4 steps. Hosts come into contact with parasites. Then, parasites attempt to infect hosts. Success is determined by the combination of host and parasite suits. Hosts that resist parasites reproduce; infected hosts die. Parasites that infect hosts reproduce; thwarted parasites die. Host and parasite populations are then set to their

carrying capacity of 12 individuals. Finally, host and parasite players record the number of individuals of each genotype in the data sheet. Repeat steps 1-4 until you've played for 15 rounds, or generations.

Repeat steps 1- 4

Step 1: host-parasite contact

- Host: deal out cards in a row, face up
- Parasite: deal out one card across from each host card, face up



Step 2: infection and selection

- Each host card is paired with the parasite card dealt across from it
- **Mismatch:** if the host and parasite suits do not match, the host resists the parasite. The parasite dies – discard the card in the parasite reserve deck.
- **Match:** if the host and parasite suits match, the parasite has successfully infected its host. The host dies – discard the card in the host reserve deck.

Step 3: reproduction

- **Host:** each host that resisted infection makes one offspring. Add 1 card of a matching suit from the host reserve deck.
- **Parasite:** each parasite that infected its host makes two offspring. Add 2 cards of a matching suit from the parasite reserve deck.
- **Too few matching cards?** Randomly select cards from your reserve deck until each individual has reproduced. These offspring will not match their parent's suit: you might think of this as mutation.

Step 4: population size regulation

- Host and parasite population size are held constant at 12 individuals

3. What do you think would happen to host genotype frequencies over time if parasites were absent? Sketch your prediction. Design a modification of the game to test your prediction.

4. Compare the oscillations of your host and parasite genotype frequencies. For a given suit, are the oscillations of host and parasite perfectly in sync with one another? If not, is host or parasite lagging, and by how many generations? Based upon your experience in the game, why do you think this might be?

Extensions of the game

1. Many theoretical investigations of the Red Queen Hypothesis have focused on the virulence of the parasite that is required to maintain polymorphism in the host population. What is the virulence of the parasite in the current game?

Design a modification of the game that would test the role of virulence in the maintenance of polymorphism.

2. In class, we learned that sexual reproduction produces offspring with rare genotypes. In light of your data from the game, why might this be advantageous?

How do the hosts in the game reproduce? How might we incorporate competition between different reproductive modes?