Experiment 1 –

Iterations/Updates = 100

Population = 100

<u>01</u> Cooperators <u>99</u> Defectors <u>00</u> PartialCooperators

Expt. No.	Cooperators	Defectors	PartialCooperators	Average Cooperation Value
1	0	100	0	0.0
2	0	100	0	0.0
3	0	100	0	0.0
4	0	100	0	0.0
5	0	100	0	0.0
6	0	100	0	0.0
7	0	100	0	0.0
8	0	100	0	0.0
9	0	100	0	0.0
10	0	100	0	0.0
		Average Cooperation Value		0.0

Seeing the overwhelming majority of Defectors, I had predicted for this experiment that the only Cooperator in the population would be replaced by defectors sooner or later. Even if the Cooperator reproduces, the number of reproductions by defectors would be in no match with that of the Cooperators. Hence, defectors would thrive in such a population. The data clearly supports this as the defectors gain complete control of the population in all of the experiments.

Experiment 2 –

Iterations/Updates = 100

Population = 100

99 Cooperators 01 Defectors 00 PartialCooperators

Expt. No.	Cooperators	Defectors	PartialCooperators	Average Cooperation Value
1	100	0	0	1.0
2	100	0	0	1.0
3	0	100	0	0.0
4	100	0	0	1.0
5	100	0	0	1.0
6	20	80	0	0.2
7	100	0	0	1.0
8	100	0	0	1.0
9	100	0	0	1.0
10	100	0	0	1.0
		Average Cooperation Value		0.82

I had predicted that usually the cooperators would wipe out the defectors. However, there would be some cases where defectors would actually take the majority control over the population, when defectors reproduce. During the update of cooperators, defectors (old and new) would gain **a lot of energy** and grow, while not providing energy to cooperators after they start growing rapidly, thereby taking control of the population. The same has been supported by the data above as well!

Experiment 3 –

Iterations/Updates = 100

Population = 100

01 Cooperators 01 Defectors 98 PartialCooperators

Expt. No.	Cooperators	Defectors	PartialCooperators	Average Cooperation Value
1	0	68	32	0.16
2	0	0	100	0.5
3	0	0	100	0.5
4	0	0	100	0.5
5	0	0	100	0.5
6	0	0	100	0.5
7	0	42	58	0.29
8	0	0	100	0.5
9	0	0	100	0.5
10	0	0	100	0.5
		Average Cooperation Value		0.445

Similar to Experiment 2, I had predicted that the partial cooperators would clear out all the defectors in most cases. However, there would be some cases where defectors would actually close up with the population of partial cooperators, when defectors reproduce. During the update of partial cooperators, defectors (old and new) would gain **some energy** and grow, while not providing energy to partial cooperators at all, after they start growing, thereby nearing, or even exceeding partial cooperators population. The data displays a similar phenomenon with patches of defectors and partial cooperators sharing similar populations.

Experiment 4 –

Iterations/Updates = 100

Population = 100

33 Cooperators 33 Defectors 34 PartialCooperators

Expt. No.	Cooperators	Defectors	PartialCooperators	Average Cooperation Value
1	0	100	0	0.0
2	0	100	0	0.0
3	0	98	2	0.01
4	0	100	0	0.0
5	0	98	2	0.01
6	0	99	1	0.005
7	0	94	6	0.03
8	0	92	8	0.04
9	0	96	4	0.02
10	0	99	1	0.005
		Average Cooperation Value		0.012

In the previous two experiments, it was clear that defectors start growing pretty fast once they become considerably populated in the Petri dish. In this experiment, all of the types of organisms start at almost the same population, and hence, the defectors are bound to take over the entire population very fast. However, there may arise cases where partial cooperators may close up with defectors owing to their property of behaving like both, cooperators and defectors. However, the same has not been displayed by the data in the above table, though there has been clear evidence of how the defectors grow upon the other types for gaining control of the population.

Experiment 5 –

Iterations/Updates = 100

Population = 100

50 Cooperators 25 Defectors 25 PartialCooperators

Expt. No.	Cooperators	Defectors	PartialCooperators	Average Cooperation Value
1	0	100	0	0.0
2	0	98	2	0.01
3	0	99	1	0.005
4	0	99	1	0.005
5	0	100	0	0.0
6	0	92	8	0.04
7	0	96	4	0.02
8	0	94	6	0.03
9	0	98	2	0.01
10	0	98	2	0.01
		Average Cooperation Value		0.013

As mentioned in the previous experiment, the defectors start growing pretty fast once they become considerably populated and, in this experiment, they start at almost 1/4th of the population. Hence, the defectors are bound to take over the entire population rapidly. However, there may arise cases where partial cooperators may close up with defectors in this experiment as well, due to their characteristic of behaving like both, cooperators and defectors. However, it has not been displayed by the data of this experiment as well, though the data did show that defectors gained control of the population.

Conclusion –

With the pattern and trends shown by the experiments above, we can say that cooperators are the most vulnerable type of organisms amongst the other two, followed by Partial Cooperators. Since Defectors don't share their energy with the others, when they start growing, most of the updates would increase their energy while not effecting the other organisms as they don't cooperate. The cooperators on the other hand, gain an energy and share it with eight others, which might include Defectors.

Hence, the Defectors can gain energy rapidly while also slowing down the rate of growth of the cooperators. In this way, Defectors gain control of the population IF THE Cooperators can't eliminate them by replacing their new borns with the Defectors. *Thus, for Cooperators to succeed, they need an extremely high cooperator is to defector ratio in the population. Else, they would go extinct.*

The same can be said for Partial Coordinators as well, with the only difference being that defectors won't be able to rapidly gain majority in the population. This is because Partial Coordinators behave like Defectors half the time and like Coordinators for the other half.