

## Marine Biology Case Study Worksheet for Part 2, pp 36-42

1. On page 36, the author lists the public member functions in the `Fish` class.
- What other function in the `fish.h` file is available for a client to use?

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- Why are all of the accessing functions written as `const` functions?

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- There are two helper functions in the private section. Why are these in the private section and not in the public section?

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2. In the `fish.cpp` file the implementation for the operator `<<` code is shown. If the first statement was changed to `out << fish.ShowMe()`, what would the output look like?

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3. In the last paragraph the author talks about the “zero-argument constructor.” What is another name for this kind of constructor? \_\_\_\_\_

4. On page 37 in the second paragraph, the author discusses the `Fish::Move` function.

- What range of numbers is established by the statement `RandGen randomVals` (a bit of a tricky question)?

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- If you wanted to add new directions for `Fish::EmptyNeighbors` to consider (eg, NorthWest) you would need to add an additional call to `Fish::AddIfEmpty` for each new direction. What other changes would you need to make to this and possibly other classes?

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- c. In this code, there is a check to see if at least one position in the neighborhood exists. If this is removed, what processing error would result (this is trickier than it may at first appear). You might consider making this modification, creating a small fish file to test it, and possibly also enabling the debugging routine in `utils.cpp` to help you out.
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5. At the end of the fourth paragraph, the author asks rhetorically “Why is it (moving a fish) so difficult?” The answer lies in understanding exactly what is changing.

a. In what class and structure is a fish actually stored throughout the entire run of the simulation? \_\_\_\_\_

b. When a fish is going to be moved, is the fish object that called `Move` the actual fish or a copy of the fish? Justify your answer.

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6. In the second paragraph on page 38, three actions in `Fish::Move` are listed. For each of the actions, write the statement in `Fish::Move` which accomplishes each action.

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

7. Name all of the classes that are involved in the `Fish::Move` function.

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8. In the second to last paragraph on page 39, the author talks about a number of options to deal with the positions of fish. If a fish did not maintain its position and the fish relied on the environment to provide its position, the author says that the grid would have to be searched. Assume the  $n \times n$  matrix (grid) has  $k$  fish located in the environment.

a. How many fish on average would need to be checked if the  $n \times n$  matrix were searched on the basis of the fish ID to find a fish's location? \_\_\_\_\_

b. If  $k$  fish were stored in a vector instead of a matrix, how many fish on average would need to be checked? \_\_\_\_\_

c. Which of these approaches would be faster? Justify your answer.

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9. In the code for `Environment::Update` shown at the bottom of the chart on page 40, the if statement `if (! (oldLoc == newLoc))` occurs. In what situations either in this simulation or in a revised simulation can this situation be false (ie, `oldLoc == newLoc`)?

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10. In that same area is the statement

```
myWorld[oldLoc.Row()][oldLoc.Col()] = emptyFish;
```

occurs. Could this have been written as

```
myWorld[oldLoc.Row()][oldLoc.Col()] = Fish();
```

similar to an statement in `Fish::AddFish` shown on page 32? If not, why not; if so, why might this not be desirable?

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11. At the top of page 41, the code for the `Neighborhood` constructor is shown with the author's comment about the hardcoded size of 4. On another sheet, rewrite the `Neighborhood` constructor so that the size needed is passed as a parameter (argument) in the constructor.

12. In `Neighborhood::Select` there is no check to make sure that the precondition is true. On another sheet, rewrite the body of this function to include such a check and consider possible options if the check is false. Justify the choice you make to handle this error condition.

13. In the `Position` class, consider adding a function called `Position::NorthEast()`. On another sheet, write the function header and its body which would implement this new function.