

Code for Model 1A: First Responders' willingness to enter an area with radioactive contamination

```
breed [doctors doctor]                ;; designates the first responder agents

doctors-own [                           ;; assigns which variables the first responder agents possess
  my-neighbors                          ;; remnant variable- no effect on code
  nearest-neighbor
  flockmates
  mineRadiationTolerance
]

patches-own [                            ;; assigns which variable patches possess
  falloutZone?                          ;; this variable report TRUE or FALSE if a patch is within the designated falloutZone
  radiation                             ;; a radiation variable is included in the background environment within the contaminated area
  pointsourceRad                        ;; an additional pointsource of radiation is overlapped within the contaminated area
]

to setup
  clear-all
  setup-patches
  setup-doctors
  reset-ticks
end

;; this command series determines the visual characteristics of the first responder agents and restricts generation
of only one agent per patch area and also determines the "mineradiationtolerance" numerical value
representative of the assigned personal perception radiation risk

to setup-doctors
  set-default-shape doctors "person doctor"
  ask n-of initial-number-FirstResponders
    (patches with [pxcor > -40 and pycor < -18] )
    [ sprout-doctors 1 ]

ask doctors [
  set color green
  set mineRadiationTolerance random-poisson 2.5
  if mineRadiationTolerance < 1
    [set mineRadiationTolerance 1]
  if mineRadiationTolerance > 5
    [set mineRadiationTolerance 5]
]
end
```



```
if ((mineRadiationTolerance >= 2.5 and mineRadiationTolerance < 4))
  [fd fast]
if mineRadiationTolerance >= 4
  [fd fastest]
]
end
```

;;this tells the agents to communicate the mean mineRadiationTolerance variable to each other

```
to-report average_mineRadiationTolerance
  let myRT mean [mineRadiationTolerance] of flockmates
  report mean myRT
end
```

;;this tells the first responder agents to consider the mean mineRadiationTolerance of their neighbors and move faster towards the area with radioactive contamination if that value is >= 2.5

```
to move-doctors1
  let speed_gungho 0.02
  ask doctors [
    show-radiation-dread
    if falloutZone? = True [set speed_gungho .3 * speed_gungho]
    let F count flockmates
    if F > 0
      [ let myRT mean [mineRadiationTolerance] of flockmates
        if myRT >= 2.5
          [fd speed_gungho]
        ]
      ]
  ]
end
```

;;this directs the agents to move in a northern direction towards the area with radioactive contamination

```
to set-master-heading
  ask turtles [
    set heading 2
  ]
end
```

;;this directs the agents to reset their direction to a random point

```
to reset-heading
  ask turtles [
    set heading random 10
    fd 0.02
  ]
end
```

;;this directs the agents to look and see if they have any neighbors and move towards them

to flock1

ask doctors [

;;this command line doesn't affect the agent behavior the model is designed to simulate

let myx mineRadiationTolerance

find-flockmates

if any? flockmates

[find-nearest-neighbor

ifelse mineRadiationTolerance >= myx

[align cohere]

[separate]

]

]

end

;;this directs first responder agents to consider their neighbors or "flockmates" within whatever distance the Communication variable is set to

to find-flockmates

set flockmates other turtles in-radius Communication

end

;;this directs the agents to locate their nearest neighbor

to find-nearest-neighbor

set nearest-neighbor min-one-of flockmates [distance myself]

end

;;this directs the agents to move away from their nearest neighbor

to separate

turn-away ([heading] of nearest-neighbor) 2.0

end

;; this directs the agents to move towards their neighbors

to align

turn-towards average-flockmate-heading 2.0

end

;; this directs the agents to keep moving relative to their neighbors

to cohere

turn-towards average-heading-towards-flockmates 2.0

end

;;this directs the agents to communicate the mean directional heading of their neighbors and is referenced from the flocking model in the NetLogo library of models

to-report average-flockmate-heading

```
let x-component sum [dx] of flockmates
let y-component sum [dy] of flockmates
ifelse x-component = 0 and y-component = 0
  [ report heading ]
  [ report atan x-component y-component ]
end
```

;;this directs the agents to communicate the mean directional heading of themselves towards their neighbors

to-report average-heading-towards-flockmates

```
let x-component mean [sin (towards myself + 180)] of flockmates
let y-component mean [cos (towards myself + 180)] of flockmates
ifelse x-component = 0 and y-component = 0
  [ report heading ]
  [ report atan x-component y-component ]
end
```

;;these following commands direct "flocking" movement of the agents like birds or "boyds" the agents move continually with respect to each other

to turn-towards [new-heading max-turn]

```
turn-at-most (subtract-headings new-heading heading) max-turn
end
```

to turn-away [new-heading max-turn]

```
turn-at-most (subtract-headings heading new-heading) max-turn
end
```

to turn-at-most [turn max-turn]

```
ifelse abs turn > max-turn
  [ ifelse turn > 0
    [ rt max-turn ]
    [ lt max-turn ] ]
  [ rt turn ]
end
```

;;these following commands direct the first responders to respond to the presence of radiation within the contaminated area with directed movement to pause redirect their heading and move forward until they find an area with less radiation

to show-radiation-dread

```
ask doctors [  
  if ((radiation >= 9 or pointsourceRad >= 9) and mineRadiationTolerance >= 2.5)  
    [wiggle]  
  if ((radiation >= 9 or pointsourceRad >= 9) and mineRadiationTolerance < 2.5)  
    [wiggle1]  
  ]  
end
```

;; directs "wiggle" movement of agents to turn right 40 degrees in a random direction and move back 2 patches

```
to wiggle  
  back .1  
  rt random 40 - 80  
  forward .2  
end
```

```
to wiggle1  
  back .1  
  rt random 40 - 80  
  forward .1  
end
```

;;these commands direct setup of the background environment within the model

```
to setup-radiation  
  if falloutZone? [  
    set radiation random-poisson 9  
    set pcolor scale-color red radiation 50 0  
  ]  
end
```

```
to setup-pointsource  
  set pointsourceRad 17 - distancexy 0 30  
  set pcolor scale-color orange pointsourceRad 30 0  
  if (pointsourceRad <= 0) [set pcolor 69]  
  if (pointsourceRad < 0) [ set pointsourceRad 0]  
end
```

```
to setup-falloutZone?  
  set falloutZone?  
  random pycor > 10  
end
```