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PART FOUR. TRANSMISSION TASK LIST

This is the list of tasks for Part Four. Transmission

Check them off as you complete them.

TASKS

- 4-1 ☐ Investigating Mosquito Borne Disease Distribution
- 4-2 ☐ Modeling Vector Disease Transmission
- 4-3 ☐ Understanding Disease Hosts
- 4-4 ☐ Identifying Local Disease Hosts
- 4-5 ☐ Collecting Local Transmission Histories
- 4-6 ☐ Analyzing Community Surveys (Transmission)
- 4-7 ☐ Debriefing Transmission

In this part, the team will focus on understanding factors that affect how mosquito-borne diseases are transmitted. Research includes identifying potential host animals, local histories, and changes in the local environment that could affect how diseases may be transmitted through your research site now and in the future.




4-1 Investigating Mosquito-borne Disease Distribution

Welcome to Part Four: Transmission and Task 4-1. In Part Three you learned more about the mosquito as an animal. Now the team will begin learning more about how diseases are spread from mosquitoes to humans and other animals.

Objective

In this task, the team will be focusing on the following questions from the question map.

- What is the distribution of mosquito-borne diseases around the world?
- What factors influence the spread of mosquito-borne diseases?

The team will now examine a variety of maps to think about the relationship between mosquitoes, diseases spread by mosquitoes, temperature, and precipitation. The team will also read some frequently asked questions (FAQs) about the different mosquito-borne diseases, to learn more.

1. Go to the Task 4-1 folder and get the Mosquito-Borne Disease FAQ Sheets, maps, and analysis questions. There is only one version of this task, but two options for organizing are provided.
2. As a team, use the maps and FAQ sheets to complete the analysis questions.
3. As a team, share all important information that could be useful to the research.
4. As a team, discuss the following questions:

- How can maps be helpful when studying mosquitoes and mosquito-borne diseases?
- How does understanding the environmental conditions (temperature, precipitation, elevation) of your location help when thinking about the problem question: How can we ensure health for all from mosquito-borne diseases?

4-1

• How does understanding the distribution of different mosquitoes and diseases help when thinking about the problem question: How can we ensure health for all from mosquito-borne diseases?

• How do the environmental conditions (temperature and precipitation) change throughout the year in your location? Does it rain more or less in your community at different times of year? Does it snow in your community? Does the temperature change at different times of the year in your community?

• Have you been monitoring the environmental conditions of your location since Task 3-3? If so, what have you learned so far? If not, how could you monitor the changes in temperature and precipitation in your community throughout the year? Look at the instructions in Task 3-3 to get started.

Research Tip

What other mosquito-borne diseases are affecting people in your location or in other parts of the world? Do some research to find out and compare it to the analysis you did here.

Citizen Science Tip

Collecting and sharing data about your research site can be helpful to scientists when making and updating maps like these about diseases around the world. Think about how you could share your data with others.

Hooray! You completed Task 4-1. Check it off the task list. *Go to Task 4-2!*

4-2

Modeling Vector Disease Transmission

Objective

In this task, the team will model the spread and transmission of a disease among a group of mosquitoes (vector) and humans (host). The team will use the model to explore how a disease can move through a group of humans (hosts) using a mosquito (vector). We will also explore how different factors can affect disease transmission.

In this task, the team will be focusing on the following questions from the question map. How do mosquitoes spread disease? What factors influence this?

1. Go to the Task 4-2 folder and get the Modeling Vector Disease Transmission activity. Choose the Mosquito A or Mosquito B version of the task. Remember, both can be played inside or outside. You decide!

2. Run as many models as you can, following the task instructions. Collect and compile the data.
3. Compare and contrast the results of different model setups. What effect does the model have on the transmission rate?
4. As a team, discuss the following:
   - Were more or fewer people infected than you expected?
   - What are some ways this model does not accurately model mosquito-human interactions?
   - What factors can affect how quickly a disease spreads through a group of mosquitoes and humans?
   - What other factors do these models not incorporate? How could you incorporate them into the model?
5. Develop a new model of your own using this setup. Run the model and compare the results.
   - How can models like these be useful when thinking about questions on the map, such as what factors influence how mosquitoes spread diseases? How can we ensure health for all from mosquito-borne diseases?

4-3 Understanding Disease Hosts

In Task 4-2, the team learned more about factors that affect how diseases can be spread to a host. In the models in Task 4-2, the human was the host. The mosquito was the vector.

Objective

In this task, the team will run a series of transmission models with a variety of different mosquito-borne disease hosts. This will help you understand more factors that can affect the spread and transmission of mosquito-borne diseases through a community.

In this task, the team will be focusing on the following questions from the question map.

- How do mosquitoes spread disease?
- What factors influence this?

1. Go to the Task 4-3 folder and get the Vector and Host Game instructions. There is only one version of this task, but can be played inside or outside. You decide!

2. As a team, go over the following terms.
   - A disease vector is an organism that can transmit diseases between humans or from animals to humans.
   - A disease host is an organism that can harbor a disease and typically provide the disease nourishment and shelter. Diseases can survive in a host over a period of time. There are two types of hosts, primary and secondary.
   - In primary hosts, the diseases living in these hosts can be spread back to other mosquitoes and then to other humans or animals.
   - In secondary hosts, the disease is not transmitted to other mosquitoes or animals.
3. Use the instructions in the task folder to play the Vector and Host Game.
4. As a team, discuss the questions in the game instructions.
5. As a team, discuss:
   - How can models such as this game be helpful when doing research?
   - What are some ways this model does not accurately model mosquito-human interactions?
   - What factors can affect how quickly a disease spreads through a group of mosquitoes and humans?
   - What other factors do these models not incorporate? How could you incorporate them into the model?
6. Develop a new model of your own using this setup. Run the model and compare the results

• How can models such as these be useful when thinking about questions on the map, such as what factors influence how mosquitoes spread diseases? How can we ensure health for all from mosquito-borne diseases?

4-4 Identifying Local Disease Hosts

In Task 4-3 the team learned that mosquitoes can use different hosts. The addition of different disease hosts in a community can affect the problem.

Objective

In this task, the team will work to identify animal hosts and signs of animals hosts in and around the research site. Knowing what hosts might live in and around your research site can be useful when you think about how different diseases could move through your community. In this task, the team will be focusing on the following questions from the question map.

- How do mosquitoes spread disease?
- What factors influence this?

1. Go to the Task 4-4 folder and get the Identifying Local Disease Hosts instructions. There is only one version of this task.
2. As a team, look over the list of potential mosquito vector disease hosts.
3. Do you know if any of these disease hosts live in your area? If so, what and where.
4. View any of the Learning Lab resources for this task about studying disease hosts, if you are able.
5. Why might it be important to learn more about animals living in your community when thinking about mosquito-borne diseases?
6. Follow the instructions in the task folder to complete the Research Site Disease Host Survey for Active Wildlife and Evidence of Wildlife.
7. As a team, discuss the following:

• Based on the observations of your research site, how could this information be useful when thinking about how mosquitoes could spread diseases in your local community?

• Changes in wildlife can affect mosquitoes in your local area. How could you monitor wildlife changes in your research site in the future? How could this information be useful to address the problem question in the future?

• How could this information be useful when developing solutions to manage mosquitos in your local community?

• How could this information be useful when thinking about the problem question: How can we ensure health for all from mosquito-borne diseases?

4-5 Collecting Local Transmission Histories

In previous tasks, the team learned about some factors that affect the spread of mosquito-borne diseases. These factors include temperature, precipitation, disease hosts, and income.

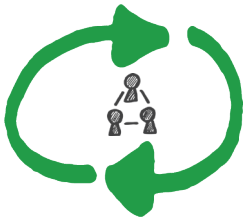
Objective

In this task, the team will explore some other factors that can affect the spread of mosquito-borne diseases in a community. The team will also work to understand how these factors have changed over time in the community. These factors include urbanization, natural disasters, deforestation, and changes in population. To understand how these factors have changed in your community, the team must talk to local people of various ages.

In this task, the team will be focusing on the following questions from the question map.

- What factors influence how mosquitoes develop and reproduce?
- What factors influence how mosquitoes spread disease?
- Who are local people, organizations, associations that can provide valuable information related to this problem?

1. Go to the Task 4-5 folder and get the Meet the Team reading. This reading includes the interview questions.
2. As a team, read the Meet the Team reading.
3. Outline three to five very important points from the reading. Share as a team.
4. Use the resources in the Learning Lab task folder to learn more about the effects of natural disasters and urbanization on mosquitoes.
5. Read the interview questions provided.
6. Decide which questions you will use during your interview.
7. Create any additional interview questions as a team.
8. Identify various people in your community that team members could interview.



4-5

Research Tip

Use the field safety tips in the safety documents on Learning Lab before going out into the community to survey or interview people. Be polite, never go alone, and always be aware of your surroundings.

9. Determine how you will document the responses of the people you are interviewing.
10. Conduct interviews with these people.
11. As a team, share and compile the results of these interviews.
12. As a team, discuss the following:
    - Based on your interviews, how has the urbanization of your community changed over time?
    - Has it become more crowded? Have many people moved there or moved away? Has human contact with animals increased or decreased?
    - Have any natural events, such as large storms, tornadoes, or hurricanes, happened in the area?
    - Have people become more or less healthy? How has their living situation changed for better or worse?
    - What are some limitations of these types of interviews?
    - How are interviews about the past different than data or evidence from the past?
    - How did the interviews shed light on the present? Write a few examples of current things that make more sense now than before you heard about the past.
    - How might these things, or other parts of what you heard, tie into the community's health?
    - How can the information from these interviews be useful when considering the problem question and other questions from the map?
    - What factors influence how mosquitoes develop and reproduce? What factors influence how mosquitoes spread disease?
    - Who are local people, organizations, associations that can provide valuable information related to this problem?
    - How can we ensure health for all from mosquito-borne diseases?

4-6

Analyzing Community Surveys (Transmission)

In Task 2-3, the team surveyed people in your local community about mosquitoes.

Objective

In this task, you will do the same analysis you did during Tasks 2-4 and 3-6. Now you will focus on the community survey results only for Part Four: Transmission. The team will analyze the other parts of the survey in future tasks, so keep the survey results in a safe place.

In this task, the team will be focusing on the following questions from the question map in Task 1-10.

- What do people in our local community think and know about mosquitoes and mosquito-borne diseases?
- How can we effectively share and communicate mosquito-borne disease evidence with the community?

1. Go to the Task 4-6 folder and get the survey analysis instructions and questions. Choose the Mosquito A or Mosquito B task from the task folder.
2. As a team, determine how to compile the community survey results for Part Four from all team members. You will want to analyze the compiled data from the entire team. Develop your own method for compiling the data for Part Four, or use one of the methods in the instructions.
3. Create some graphs about this compiled community survey data. Use the instructions and examples in the task folder.
4. Use the graphs and data to answer these questions:
5. What interesting patterns do you see in the data from Part Four questions?
6. Which questions did most people in the community agree on?
7. Which questions did people in the community have different responses to?

Research Tip

As you may have noticed, the survey is broken into the same parts as this research guide. Analyze only the results from that part of the survey while working on that Part of the guide to make the analysis more manageable.

4-6

8. Discuss how this survey evidence could be useful when thinking about the question: What do people in our local community think about mosquitoes and mosquito-borne diseases?
9. Discuss how this survey evidence could be useful when thinking about the question: How can we effectively share and communicate mosquito-borne disease evidence with the community?
10. Discuss how this survey evidence could be useful when thinking about the problem question: How can we ensure health for all from mosquito-borne diseases?
11. Select one or two survey questions, write a claim, and provide the supporting evidence for the claim based on the question and evidence collected

Examples:

- The local community does not have a good understanding of what time of the day mosquitoes bite.
- The local community has poor understanding that only female mosquitoes can transmit diseases to humans.

12. Explain how the data evidence from the community survey supports your claims.
13. As a team, share some claims you created and the evidence that supports that claim.

Hooray! You completed Task 4-6. Check it off the task list. *Go to Task 4-7!*

4-7 Debriefing Transmission

This is the last task of Part Four: Transmission.

Objective

In this task, we will debrief Part Four: Transmission. This is good to do before we move on to the next part. Each debrief will be very similar and is broken down into the same parts. The objective is to think about and discuss helpful information that was gathered during that part.

1. Remember the team norms.
   - Recognize the benefits of listening to a range of different perspectives and viewpoints.
   - Be open to new ideas and perspectives that challenge your own.
   - Be willing to cooperate with others to change things for the better.
2. Remember to use your meaningful conversation starters as needed throughout this discussion.
   - I agree with _____ because…
   - I disagree with _____ because…
   - I'd like to go back to what _____ said about …
   - I'd like to add_____
   - I noticed that …
   - Another example is …
3. Remember when you are making claims from evidence to use the following sentences.
   - I think this claim is best supported because …
   - I do not think this claim is best supported because …
   - I think this piece of evidence supports this claim because …
   - I do not think this piece of evidence supports this claim because …

4-7

4. Go to the Task 4-7 folder to get Debriefing Transmission instructions. There is only one version of the debrief.

5. Follow the instructions in the task folder to complete the five sections of the debrief.
   - Question Map Analysis
   - Community Partners
   - Perspectives
   - Identity
   - Problem Question

Hooray! You completed Task 4-7 and Part 4. Check it off the task list.

Congratulations! You have completed Part Four of your research. Give yourself a pat on the back.

You now know more about how mosquito-borne diseases are spread and transmitted. You also know more about factors that can affect how these diseases spread.

Keep this research easily available. Think about how it could help with your final project.

The next part of your research will focus on understanding more about the habitats of mosquitoes throughout your community.

Continue to Part 5: Habitats.

Notes:

Notes:

Task 4-1

Investigating Mosquito Borne Disease Distribution

Analysis Questions

Task Options

- A – Jigsaw this task. Four diseases will be covered in this task: Malaria, Dengue Fever, Zika, and West Nile.
    - Break the team into four groups.
    - Have each group read the FAQ sheet and analyze the maps for one disease.
        - Have each group share out important information they identified in the FAQ sheet.
        - Have each group share out to the team their map analysis of their disease according to the questions in this document.
        - Post the information so all groups can see the analysis.
- B – Have each team member or small group look at all four diseases and FAQ sheets. Compare and contrast all four diseases.
    - Have individuals or groups share out important information they identified in the FAQ sheet.
    - Have each group share out to the team their map analysis of their disease according to the questions in this document.

Political Distribution

- Look at the Political map of the World. (Map 1)
- As a team, find the country where you live. Where inside this country do you live?
- What are the names of some other countries near or around you?

Malaria Disease Distribution

- Read the Malaria Frequently Asked Questions Sheet to learn more about this disease.
  - Identify 3-5 Very Important Parts from the FAQ sheet.
- Look at the Malaria Disease Distribution Map (2).
- Find your country on this map.
- Determine the color of your location. This color tells you if your location is at risk or not .
- Use the key to determine the risk status of your country. Red means high risk of getting malaria. Blue means lower risk. Light grey means no risk. Dark grey means risk is unstable, so not likely.
- Make a list of 10 countries that have higher risk of malaria (reds, yellows) according to this research in the year 2010. Use the political map to find names.
- Make a list of 10 countries that have lower risk of malaria (blues) according to this research in the year 2010. Use the political map to find names.
- Make a list of 10 countries that have no current risk of malaria transmission (grey) according to this research in the year 2010.

Malaria – *Anopheles* Mosquito

- Malaria is spread by the *Anopheles* mosquito.
- Look back at pictures and information about the *Anopheles* mosquito from task 3-2.
- Look at the Distribution map of the *Anopheles* mosquito (3)
- Compare the *Anopheles* map to the Malaria Risk Map (2+3)
  - Determine some countries where *Anopheles* mosquitoes live, but Malaria is currently not a risk. What could be causing this?
- Compare and contrast the Malaria map with the temperature and precipitation maps. (2+ 4 + 5)
- Describe the relationships between temperature, precipitation, *Anopheles* mosquitoes, and malaria (2+3+4+5).
- Compare and contrast the Malaria map with the Income map. (2+ 6)
- Describe the relationships between temperature, precipitation, *Anopheles* mosquitoes, malaria, and income (2+3+4+5+6).

Dengue Fever Disease Distribution

- Read the Dengue Fever Frequently Asked Questions Sheet to learn more about this disease.
- Identify 3-5 Very Important Parts from the FAQ sheet.
- Look at the Dengue Fever Suitability Map (7).
- Find your country on this map.
- Determine the color of your location. This color tells you if your location is good for Dengue Fever or not.
- Use the key to determine the how suitable your country is for Dengue fever. Red means more suitable and more likely to have Dengue. Blue means lower suitability and less likely to have Dengue. Grey means unsuitable, so Dengue should not be found in these places.
- Make a list of 10 countries that have higher suitability of dengue (reds, yellows) according to this research in the year 2012. Use the political map to find names.
- Make a list of 10 countries that have lower suitability of dengue (blues) according to this research in the year 2012. Use the political map to find names.
- Make a list of 10 countries that have no current suitability of dengue transmission (grey) according to this research in the year 2012.

Dengue Fever – *Aedes* Mosquito

- Dengue Fever is spread by the *Aedes* mosquito.
- Look back at pictures and information about the *Aedes* mosquito from task 3-2.
- Look at the Distribution map of the *Aedes* mosquito (map 8).
- Compare the *Aedes* map to the Dengue Fever Suitability Map.
- Compare and contrast the Dengue map with the temperature and precipitation maps (4+5+7).
- Describe the relationships between temperature, precipitation, *aedes* mosquitoes, and dengue (4+5+7+8).
- Compare and contrast the Dengue map with the Income map. (6+7)
- Describe the relationships between temperature, precipitation, *Aedes* mosquitoes, dengue, and income (4+5+6+7+8).

Zika Disease Distribution

- Read the Zika Frequently Asked Questions Sheet to learn more about this disease.
- Identify 3-5 Very Important Parts from the FAQ sheet.
- Look at the Zika Risk Map (9).
- Find your country on this map.
- Determine the color of your location. This color tells you if your location has a risk of Zika or not .
- Use the key to determine how suitable your country is for Zika.
    - Orange means your location is at risk due to only environmental factors, such as temperature and precipitation.
    - Purple means your location is at risk because of Socioeconomic status and accessibility. Socioeconomic status is based on income, education, and occupation. Accessibility has to do with how easily people can move into and out of these places.
    - Blue means that all factors (environmental, socioeconomic status, and accessibility) are in place at these locations.
    - Grey indicates that Zika cases are currently unlikely at these locations.
- Make a list of 10 countries that have risk for Zika for environmental reasons (orange) according to this research in the year 2016. Use the political map to find names.
- Make a list of 10 countries that have risk for Zika for Socioeconomic and Accessibility reasons (purple) according to this research in the year 2016. Use the political map to find names.
- Make a list of 10 countries that have risk for Zika for all factors (blue) according to this research in the year 2016.. Use the political map to find names.
- Make a list of 10 countries that have no current risk of Zika (grey).

Zika– *Aedes* Mosquito

- Zika is spread by the *Aedes* mosquito.
- Look back at pictures and information about the *Aedes* mosquito from task 3-2.
- Look at the Distribution map of the *Aedes* mosquito (8).
- Compare the *Aedes* map to the Zika Risk Map (8+9).
- Compare and contrast the Zika map with the temperature and precipitation maps (4+5+9).
- Describe the relationships between temperature, precipitation, *aedes* mosquitoes, and Zika (4+5+8+9).
- Compare and contrast the Zika map with the Income map. (6+9)
- Describe the relationships between temperature, precipitation, *Aedes* mosquitoes, Zika, and income (4+5+6+8+9).

West Nile Virus Disease Distribution

- Read the West Nile Virus Frequently Asked Questions (FAQ) Sheet to learn more about this disease.
- Identify 3-5 Very Important Parts from the FAQ sheet.
- Look at the West Nile Virus Distribution Map (10).
- Find your country on this map.
- Determine if your country is Red, Blue, or Grey. This color tells you if West Nile is present in your country or not .
- Use the key to determine the status of your country.
- Make a list of 10 countries that have human cases of west nile virus (red) according to this research in the year 2015. Use the political map to find names.
- Make a list of 10 countries that have nonhuman cases of west nile virus (blue) according to this research in the year 2015. Use the political map to find names.
- Make a list of 10 countries that have no data or positive cases of west nile virus (grey) according to this research in the year 2015.

West Nile Virus – *Culex* Mosquito

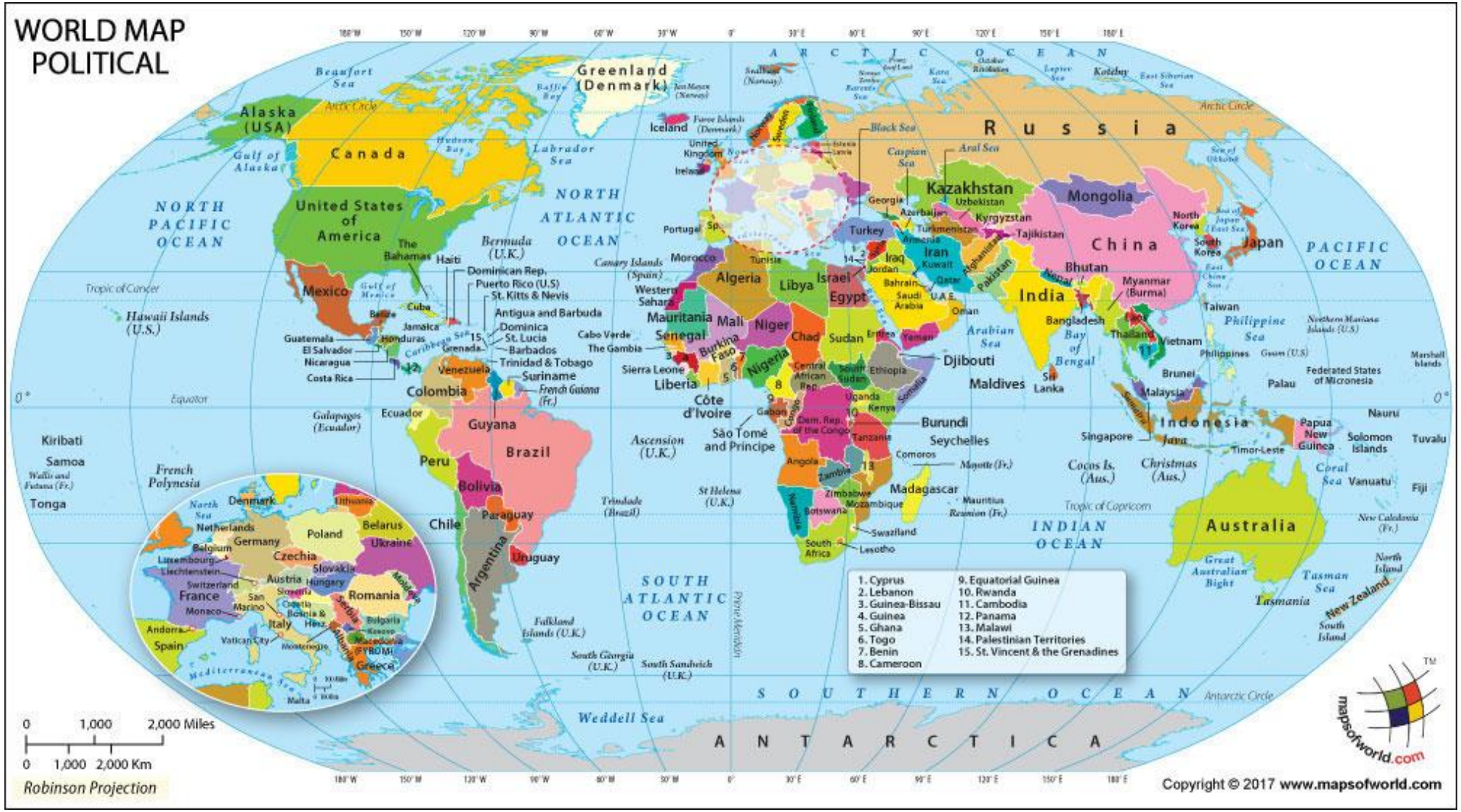
- West Nile virus is spread by the *Culex* mosquito.
- Look back at pictures and information about the *Culex* mosquito from task 3-2
- Look at the Distribution map of the *Culex* mosquito (11)
- Compare the *Culex* map to the West Nile Map (10 +11)
  - On the West Nile map (1) there are some dashed lined circles. What do you think those areas indicate?
  - Determine some countries where *Culex* mosquitoes live, but West Nile is currently not found. What could be causing this?
  - Determine some countries where West Nile is currently found, but *Culex* mosquitoes do not live there. What could be causing this?
- Compare and contrast the West Nile map with the temperature and precipitation maps (4+5+10).
- Describe the relationships between temperature, precipitation, *Culex* mosquitoes, and West Nile (4+5+10+11).
- Compare and contrast the West Nile map with the Income map. (6+10)
- Describe the relationships between temperature, precipitation, *Culex* mosquitoes, West Nile, and income (4+5+6+10+11).

Task 4-1

Investigating Mosquito Borne Disease Distribution

Maps

Map 1


WORLD MAP
POLITICAL
Greenland (Denmark)
Alaska (USA)
Canada
United States of America
Mexico
Russia
Kazakhstan
Mongolia
China
India
Japan
Algeria
Libya
Egypt
Iran
Iraq
Saudi Arabia
Indonesia
Australia
Brazil
Peru
Bolivia
Chile
Argentina
Colombia
Venezuela
Ecuador
Guyana
Suriname
Nigeria
Ethiopia
Sudan
Mali
Niger
Chad
Madagascar
Djibouti
Maldives
Sri Lanka
Bhutan
Myanmar (Burma)
Bangladesh
Thailand
Vietnam
Philippines
Malaysia
Singapore
Brunei
Taiwan
North Korea
South Korea
Papua New Guinea
Solomon Islands
Vanuatu
Fiji
Tuvalu
Nauru
Kiribati
Samoa
Tonga
French Polynesia
New Zealand
Tasmania
Cuba
Haiti
Dominican Rep.
Puerto Rico (U.S)
Jamaica
Honduras
Guatemala
El Salvador
Nicaragua
Costa Rica
Panama
Belize
Antigua and Barbuda
Dominica
St. Lucia
Barbados
Trinidad & Tobago
St. Kitts & Nevis
Grenada
Bermuda (U.K.)
Iceland
Ireland
United Kingdom
Portugal
Spain
Morocco
Western Sahara
Mauritania
Senegal
Burkina Faso
Sierra Leone
Liberia
Côte d'Ivoire
Ghana
Togo
Benin
Cameroon
Equatorial Guinea
Gabon
Rwanda
Burundi
Uganda
Kenya
Tanzania
Angola
Zambia
Zimbabwe
Mozambique
Namibia
Botswana
South Africa
Lesotho
Swaziland
Comoros
Seychelles
Mauritius
Réunion (Fr.)
São Tomé and Principe
Cabo Verde
The Gambia
Guinea
Guinea-Bissau
Central African Rep.
South Sudan
Eritrea
Yemen
Oman
U.A.E.
Qatar
Bahrain
Kuwait
Iraq
Jordan
Turkey
Georgia
Azerbaijan
Armenia
Turkmenistan
Uzbekistan
Kyrgyzstan
Tajikistan
Afghanistan
Pakistan
Nepal
Cambodia
Laos
Philippines
Brunei
Palau
Federated States of Micronesia
Marshall Islands
Northern Mariana Islands (U.S.)
Guam (U.S.)
Taiwan
Cocos Is. (Aus.)
Christmas (Aus.)
Tasmania
Great Australian Bight
Coral Sea
Tasman Sea
North Island
South Island
New Caledonia (Fr.)
Arctic Ocean
Pacific Ocean
Atlantic Ocean
Indian Ocean
Southern Ocean
Antarctica
Weddell Sea
Falkland Islands (U.K.)
South Georgia (U.K.)
South Sandwich (U.K.)
Ascension (U.K.)
St Helena (U.K.)
Tristan da Cunha (U.K.)
Hawaii Islands (U.S.)
Galapagos (Ecuador)
Baffin Bay
Labrador Sea
Hudson Bay
Gulf of Alaska
Beaufort Sea
Bering Sea
Sea of Okhotsk
Caspian Sea
Aral Sea
Black Sea
Red Sea
Persian Gulf
Gulf of Mexico
Caribbean Sea
Mediterranean Sea
Arabian Sea
Bay of Bengal
Philippine Sea
Coral Sea
Tropic of Cancer
Tropic of Capricorn
Equator
Arctic Circle
Antarctic Circle
Prime Meridian
1. Cyprus
2. Lebanon
3. Guinea-Bissau
4. Guinea
5. Ghana
6. Togo
7. Benin
8. Cameroon
9. Equatorial Guinea
10. Rwanda
11. Cambodia
12. Panama
13. Malawi
14. Palestinian Territories
15. St. Vincent & the Grenadines
Denmark
Lithuania
Netherlands
Poland
Belarus
Germany
Ukraine
Belgium
Czechia
Luxembourg
Slovakia
Liechtenstein
Austria
Hungary
Switzerland
France
Romania
San Marino
Monaco
Italy
Andorra
Spain
Vatican City
Greece
Malta
0 1,000 2,000 Miles
0 1,000 2,000 Km
Robinson Projection
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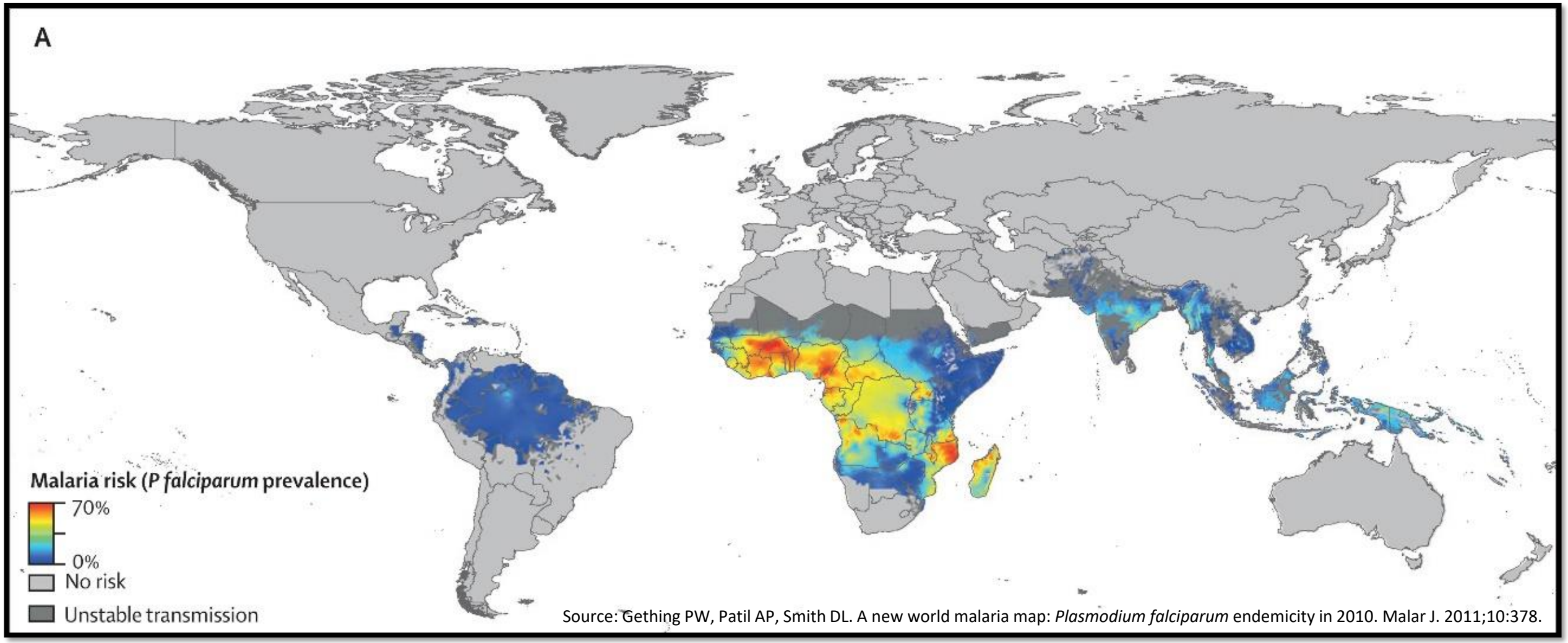
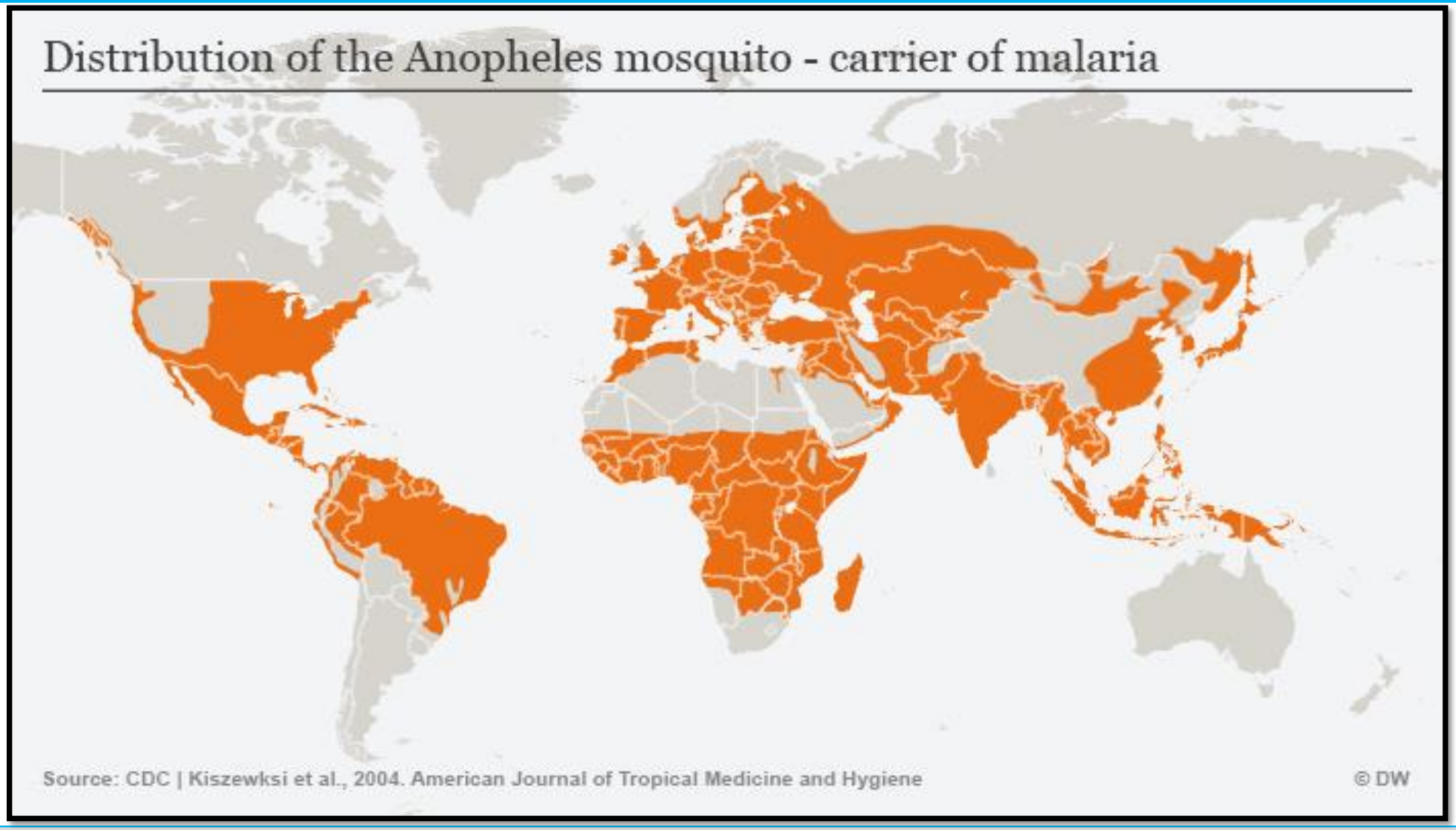
Map 2 Malaria Risk Map - Spread by Anopholes Mosquito



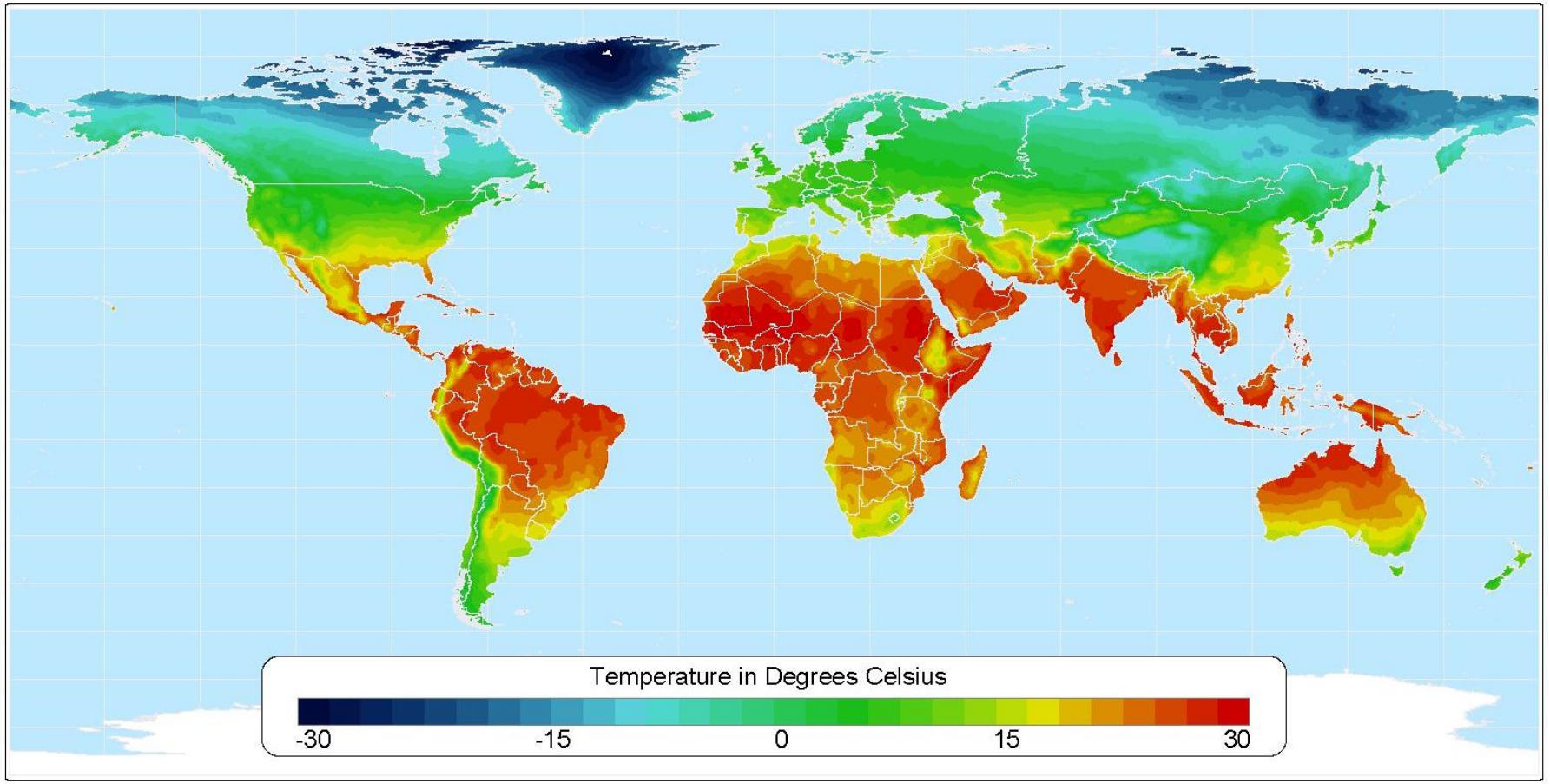
Source: Gething PW, Patil AP, Smith DL. A new world malaria map: *Plasmodium falciparum* endemicity in 2010. Malar J. 2011;10:378.

Map 3



Map 4

Average Annual Temperature



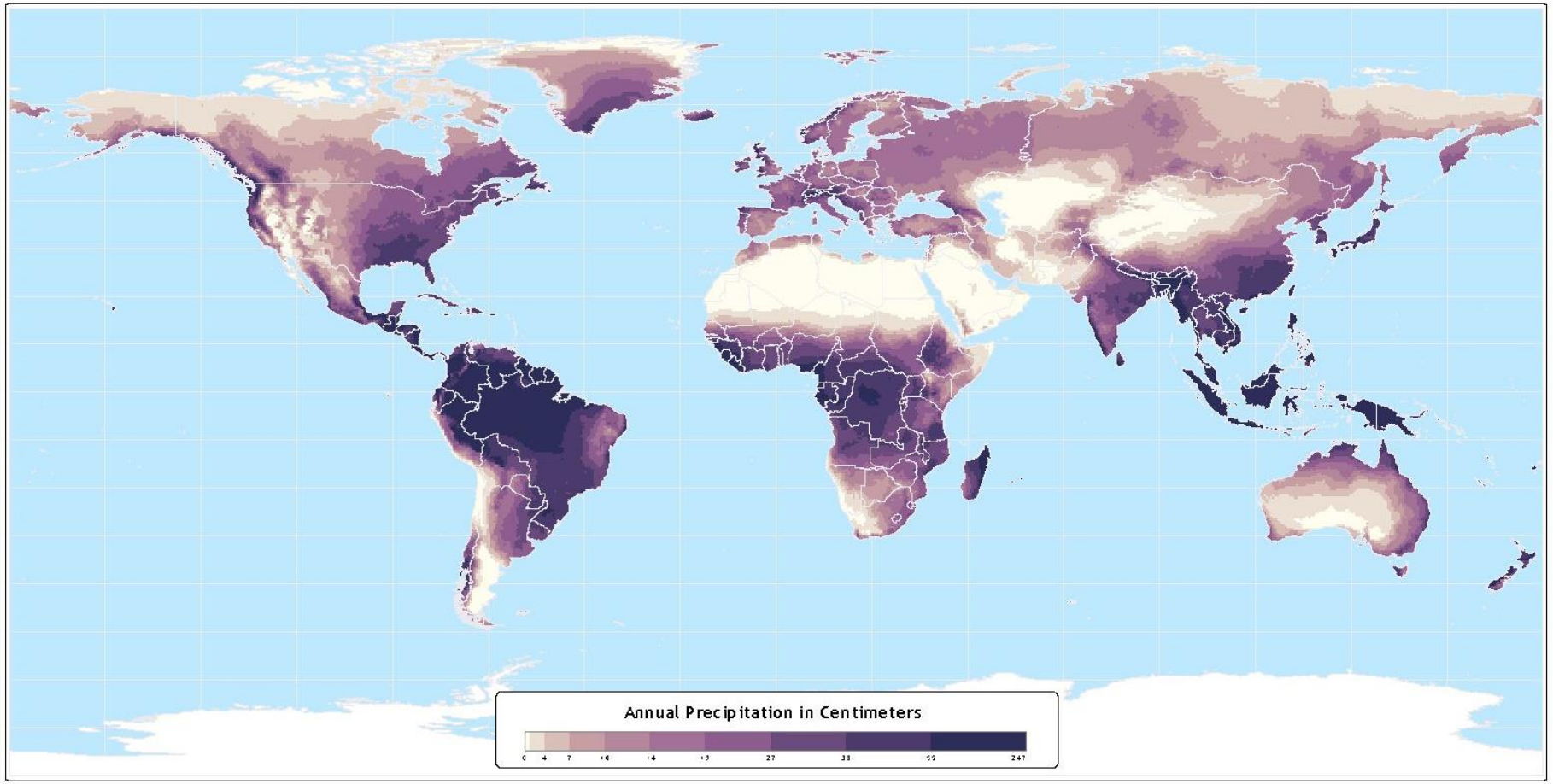
Data taken from: CRU 0.5 Degree Dataset (New, et al.)

Atlas of the Biosphere

Center for Sustainability and the Global Environment
University of Wisconsin - Madison

Map 5

Annual Total Precipitation



Data taken from: CRU 0.5 Degree Dataset (New et al)

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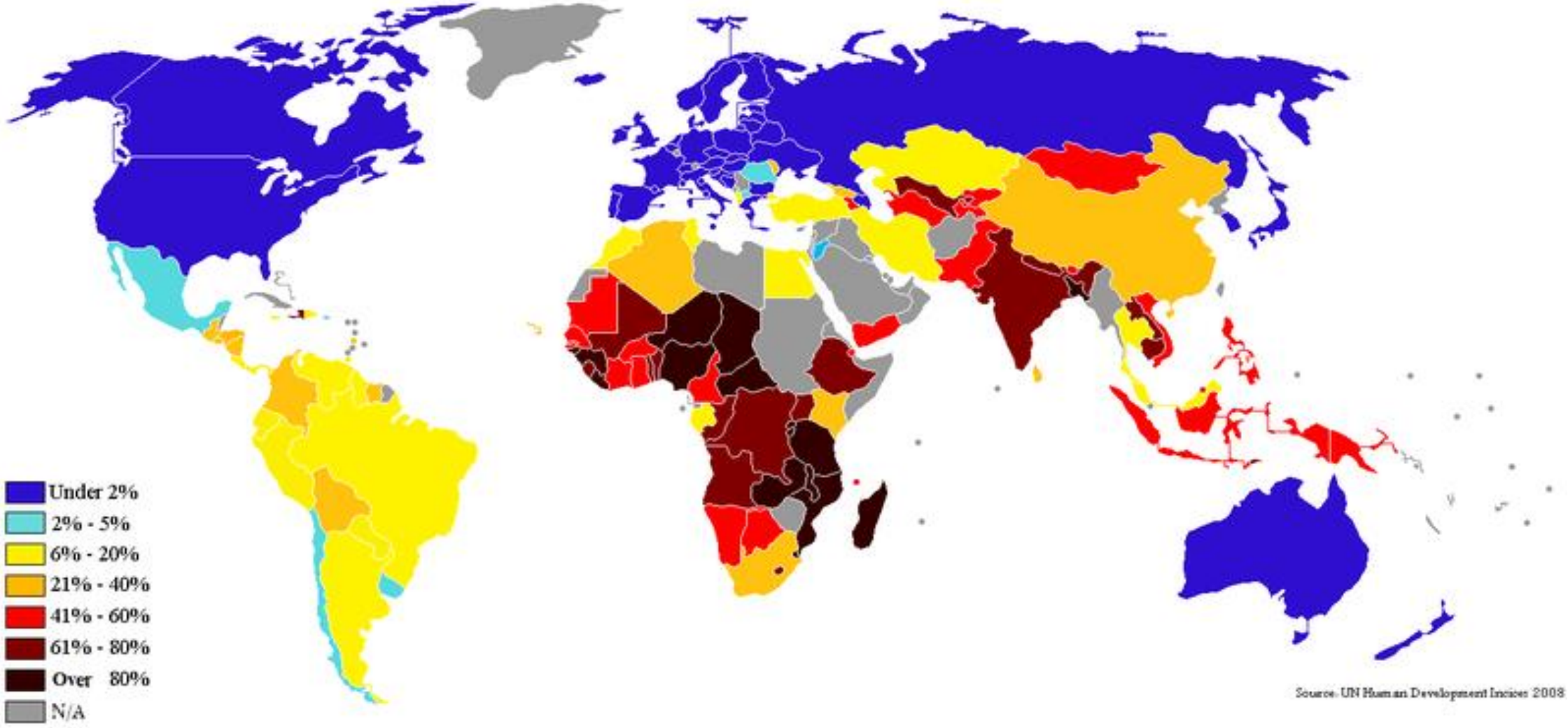
Center for Sustainability and the Global Environment
University of Wisconsin - Madison

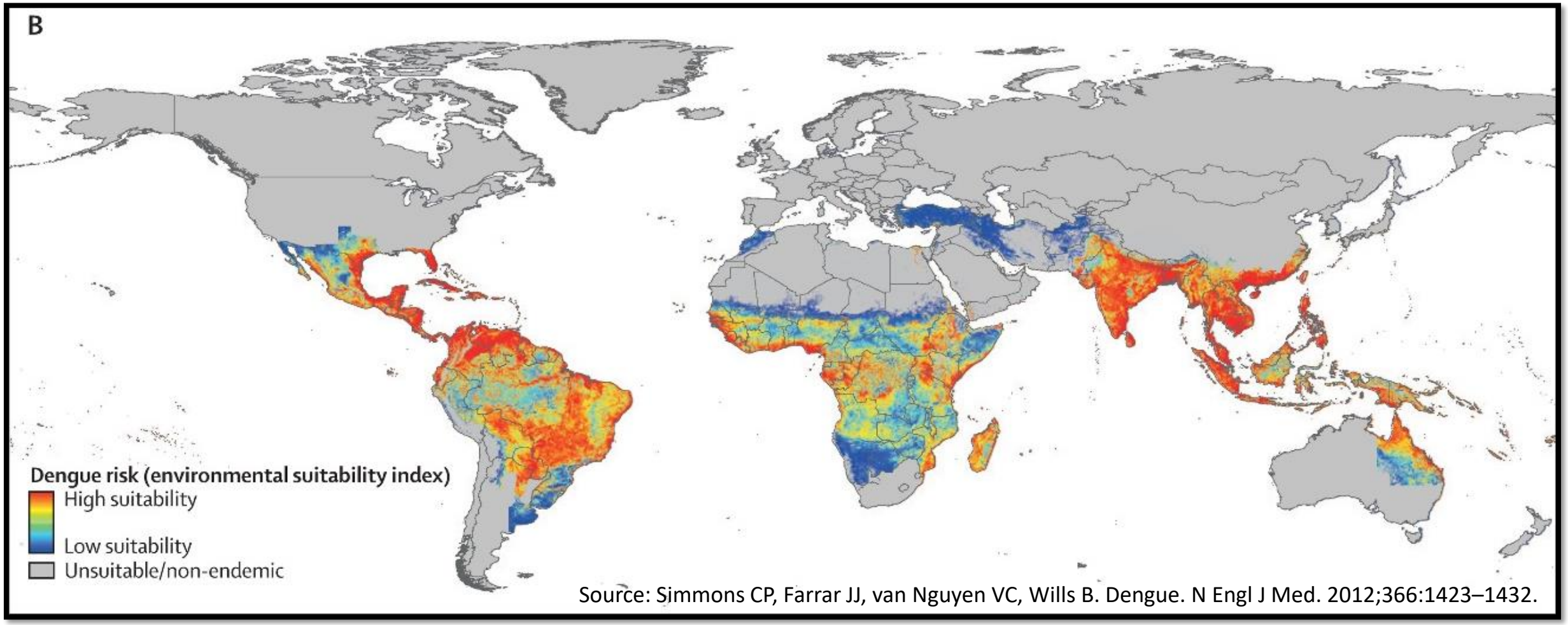
Map 6 - Income

Percentage of Country Population on Under US$2/Day (UN 2009)



Map 7

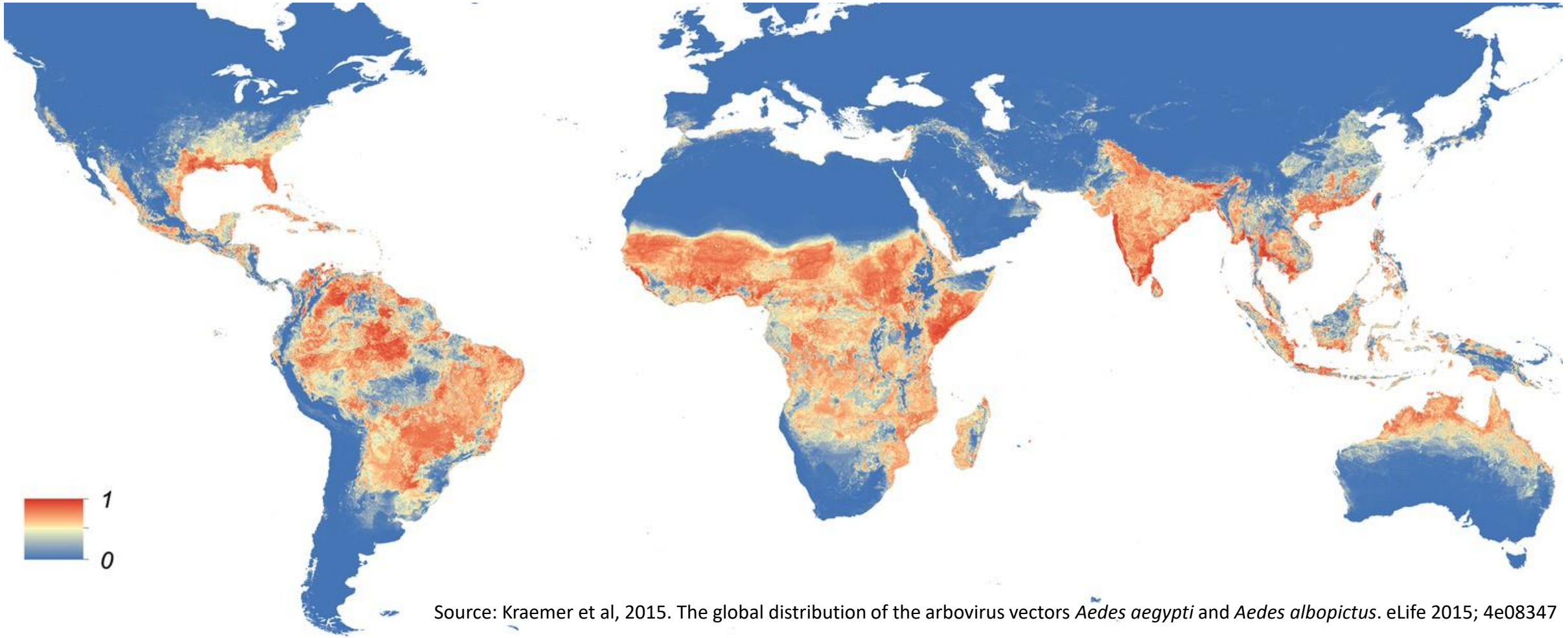
Dengue Fever Environmental Suitability Map – Spread by *Aedes* Mosquito



Source: Simmons CP, Farrar JJ, van Nguyen VC, Wills B. Dengue. N Engl J Med. 2012;366:1423–1432.

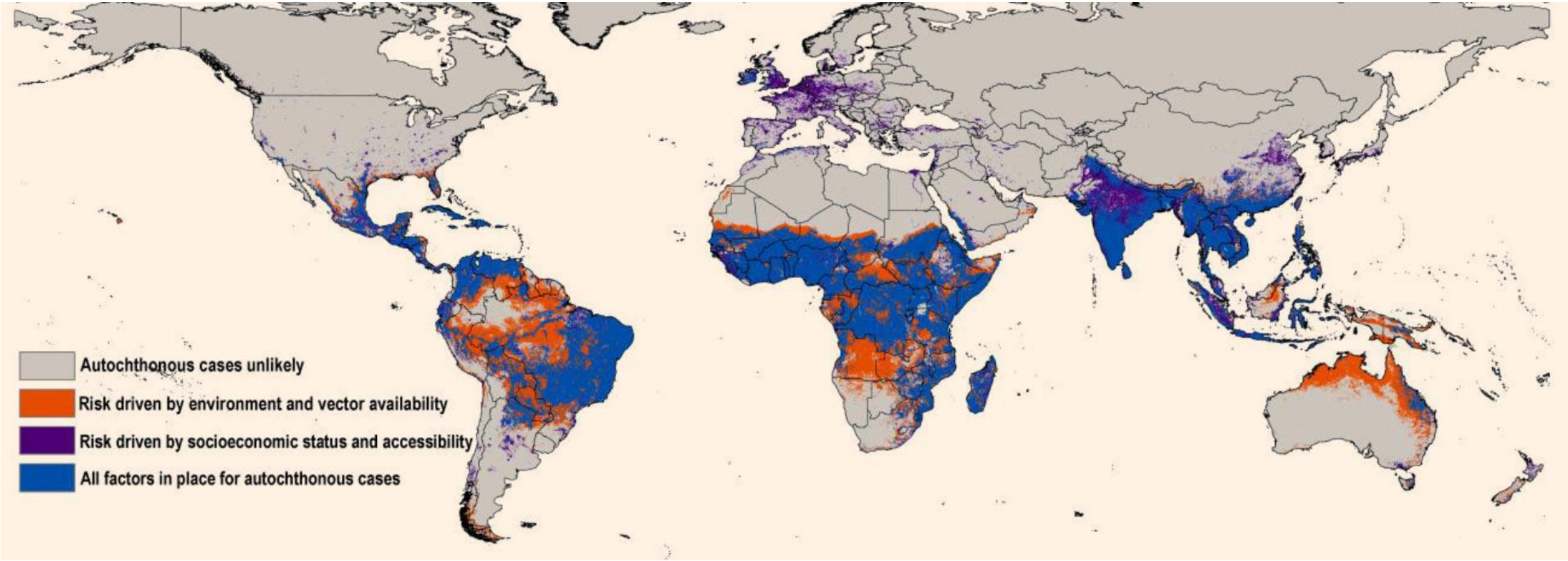
Map 8

Distribution of *Aedes* Mosquitoes



Source: Kraemer et al, 2015. The global distribution of the arbovirus vectors *Aedes aegypti* and *Aedes albopictus*. eLife 2015; 4e08347

Map 9 Zika Risk Map – Spread by *Aedes* Mosquito

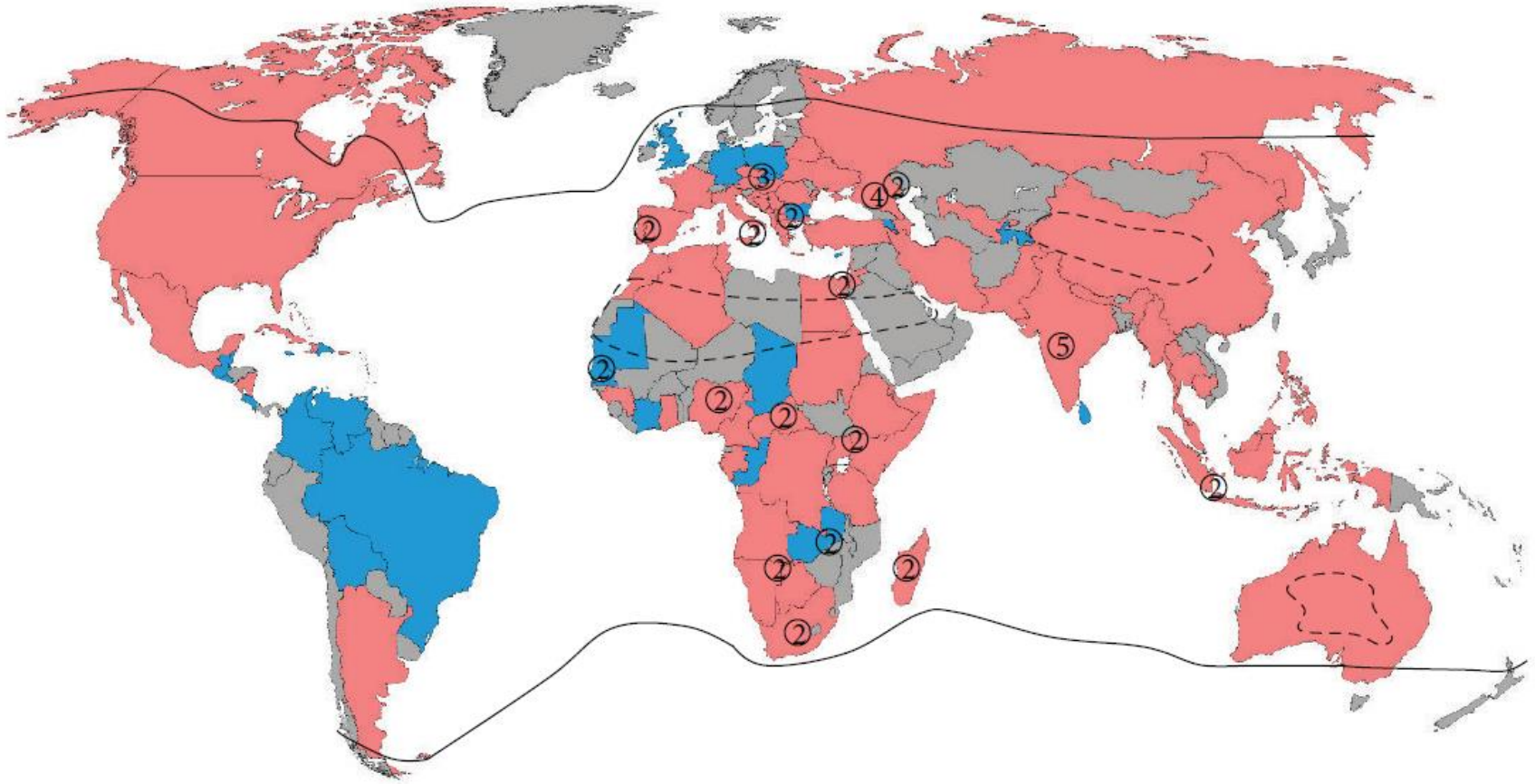


Source: Samy, Thomas, Wahed, Cohoon, Peterson. 2016. Mapping the global geographic potential of Zika virus spread. *Mem Inst Oswaldo Cruz*

Map 10

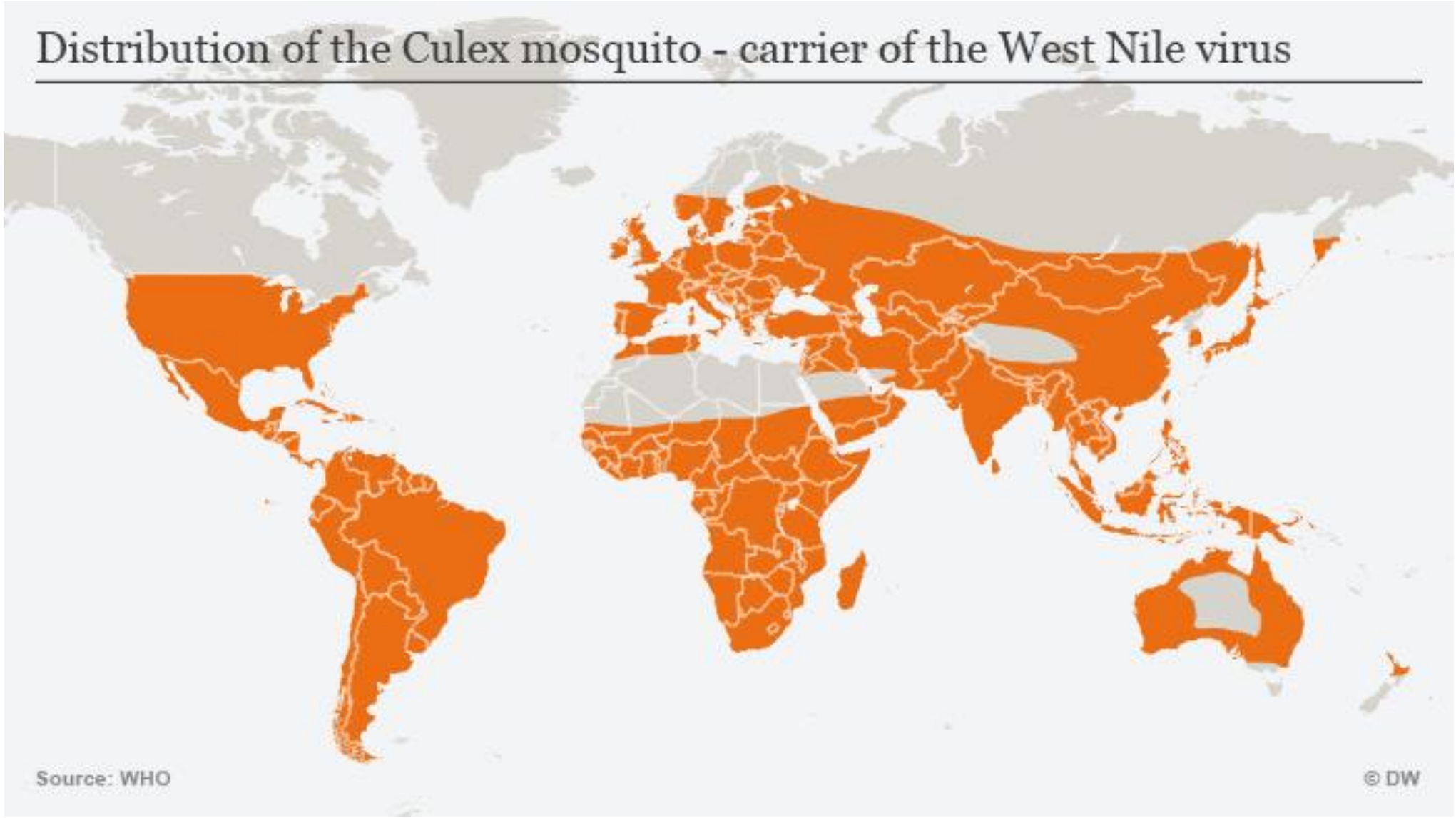
West Nile Distribution – Spread by *Culex* Mosquitoes

Red – Human Cases reported
Blue – Nonhuman (birds, horses) and Mosquito Cases reported
Gray – No data or no positive cases reported



Source: Chancey, Grinev, Volkova, Rios, 2015. The Global Ecology and Epidemiology of West Nile Virus. BioMed Research International

Map 11



Task 4-1 – Investigating Mosquito-borne Disease Distribution

Dengue—Frequently Asked Questions

Q: What is dengue?

A: Dengue (pronounced *DEN-gee*) is a disease transmitted to humans by the bite of an infected mosquito. In the Western Hemisphere, the *Aedes* mosquito is the most important transmitter or vector of dengue viruses. It is estimated that there are more than 100 million cases of dengue worldwide each year.

Q: How is dengue transmitted?

A: Dengue is transmitted to people by the bite of an *Aedes* mosquito that is infected with dengue virus. The mosquito becomes infected with dengue virus when it bites a person who has dengue virus in their blood. The person may have symptoms of dengue fever, or they may have no symptoms. After about one week, the mosquito can then transmit the virus while biting a healthy person. Dengue cannot be spread directly from person to person.

Q: What are the symptoms of dengue?

A: The main symptoms of dengue fever are high fever, severe headache, severe pain behind the eyes, joint pain, muscle and bone pain, rash, and mild bleeding (for example, the nose or gums bleed, easy bruising). Generally, younger children and those with their first dengue infection have a milder illness than older children and adults.

Q: What is the treatment for dengue?

A: There is no specific medication to treat a dengue infection. People who think they have dengue should use pain relievers with acetaminophen and medicines containing aspirin. They should also rest, drink plenty of fluids, and consult a physician. If they feel worse (for example, start vomiting and develop severe abdominal pain) in the first 24 hours after the fever declines, they should go immediately to the hospital for evaluation.

Q: Where can outbreaks of dengue occur?

A: Outbreaks of dengue occur primarily in areas where *Aedes* mosquitoes live. This includes most tropical urban areas of the world. Dengue viruses may be introduced into other areas by travelers who become infected while visiting areas of the tropics where dengue commonly exists.

Q: What can be done to reduce the risk of acquiring dengue?

A: There is no vaccine for preventing dengue. The best preventive measure for residents living in areas infested with *Aedes* is to eliminate the places where the mosquito lays her eggs, primarily containers that hold water.

Items that collect rainwater or store water (for example, plastic containers, 55-gallon drums, buckets, or used automobile tires) should be covered or properly discarded. Pet and animal watering containers and vases with fresh flowers should be emptied and cleaned (to remove eggs) at least once a week. This will eliminate the mosquito eggs and larvae and reduce the number of mosquitoes present in these areas.

Using air conditioning or window and door screens reduces the risk of mosquitoes coming indoors. Proper application of mosquito repellents containing 20 percent to 30 percent DEET as the active ingredient on exposed skin and clothing decreases the risk of being bitten by mosquitoes. The risk of dengue infection for international travelers appears to be small. There is increased risk if an epidemic is in progress or if visitors are staying in housing without air conditioning or screened windows and doors.

Go back to Research Guide now

Task 4-1 – Investigating Mosquito-borne Disease Distribution

Malaria—Frequently Asked Questions

Q: What is malaria?

A: Malaria is a serious and sometimes fatal disease caused by a parasite that commonly infects *Anopheles* mosquitoes that feed on humans. People who get malaria are typically very sick, with high fevers, shaking chills, and flu-like illness.

Globally, the World Health Organization estimates that in 2015, 212 million clinical cases of malaria occurred, and 429,000 people died of malaria, most of them children in Africa. Because malaria causes so much illness and death, the disease is a great drain on many national economies. Since many countries with malaria are already among the poorer nations, the disease maintains a vicious cycle of disease and poverty.

Q: How is malaria transmitted?

A: Usually, people get malaria by being bitten by an infectedfemale *Anopheles* mosquito. Only *Anopheles* mosquitoes can transmit malaria,and they must have been infected through a previous blood meal taken from aninfected person. When a mosquito bites an infected person, a small amount ofblood is taken in, which contains microscopic malaria parasites. About one weeklater, when the mosquito takes its next blood meal, these parasites mix with themosquito's saliva and are injected into the person being bitten.Because the malaria parasite is found in the red blood cells of an infected person,malaria can also be transmitted through blood transfusion, organ transplant, orby sharing needles or syringes contaminated with blood. Malaria may also betransmitted from a mother to her unborn infant before or during delivery (knownas "congenital malaria").

Q: Who is at risk for malaria?

A: Anyone can get malaria. Most cases occur in people who live in countries with malaria transmission. People from countries with no malaria transmission can become infected when they travel to countries with malaria or through a blood transfusion (although this is very rare). Also, an infected mother can transmit malaria to her infant before or during delivery.

Q: What are the signs and symptoms of malaria?

A: Symptoms of malaria include fever and flu-like illness, including shaking chills, headache, muscle aches, and tiredness. Nausea, vomiting, and diarrhea may also occur. Malaria may cause anemia and jaundice (yellowing of the skin and eyes) because of the loss of red blood cells. If not promptly treated, the infection can become severe and may cause kidney failure, seizures, mental confusion, coma, and death. For most people, symptoms begin 10 days to four weeks after infection, although a person may feel ill as early as seven days or as late as one year later.

Q: What is the treatment for malaria?

A: Malaria can be cured with prescription drugs. The type of drugs and length of treatment depend on the type of malaria, where the person was infected, their age, whether they are pregnant, and how sick they are at the start of treatment.

Q: Where can malaria occur?

A: Malaria typically is found in warmer regions of the world—in tropical and subtropical countries. Higher temperatures allow the *Anopheles* mosquito to thrive. Malaria parasites, which grow and develop inside the mosquito, need warmth to complete their growth before they are mature enough to be transmitted to humans.Malaria occurs in more than 100 countries and territories. About half of theworld's population is at risk. Large areas of Africa and South Asia and parts of Central and South America, the Caribbean, Southeast Asia, the Middle East, and Oceania are considered areas where malaria transmission occurs.Yet malaria does not occur in all warm climates. For example, malaria has been eliminated in some countries with warm climates, while a few other countries have no malaria because *Anopheles* mosquitoes are not found there.

Q: What can be done to reduce the risk of acquiring malaria?

A: You and your family can most effectively prevent malaria by taking all three of these important measures.

- Take antimalarial medication to kill the parasites and prevent becoming ill.
- Keep mosquitoes from biting you, especially at night.
- Sleep under insecticide-treated bed nets, use insect repellent, and wear long-sleeve clothing if you're out of doors at night.

Go back to Research Guide now

Task 4-1 – Investigating Mosquito-borne Disease Distribution

West Nile Virus—Frequently Asked Questions

Q: What is West Nile virus?

A: West Nile virus is a disease most commonly spread by infected *Culex* mosquitoes. West Nile virus can cause fever, encephalitis (inflammation of the brain), or meningitis (inflammation of the lining of the brain and spinal cord).

Q: How is West Nile virus spread?

A: Most people get infected with West Nile virus from the bite of an infected *Culex* mosquito. Mosquitoes become infected when they feed on infected birds. Infected mosquitoes can then spread the virus to humans and other animals. In a very small number of cases, West Nile virus has been spread through blood transfusions, organ transplants, and from mother to baby during pregnancy, delivery, or breastfeeding.

Q: What are the symptoms of West Nile virus disease?

A: Most people (70 to 80 percent) who become infected with West Nile virus do not develop any symptoms.
About one in five people who are infected will develop a fever with other symptoms, such as headache, body aches, joint pains, vomiting, diarrhea, or rash. Most people with this type of West Nile virus disease recover completely, but fatigue and weakness can last for weeks or months.
Less than 1 percent of people who are infected will develop a serious neurologic illness, such as encephalitis or meningitis (inflammation of the brain or surrounding tissues). The symptoms of neurologic illness can include headache, high fever, neck stiffness, disorientation, coma, tremors, seizures, or paralysis.

Q: What is the treatment for West Nile virus?

A: There are no medications to treat or vaccines to prevent West Nile virus infection. Over-the-counter pain relievers can be used to reduce fever and relieve some symptoms.
People with milder symptoms typically recover on their own, although some symptoms may last for several weeks.

In more severe cases, patients often need to be hospitalized to receive supportive treatment, such as intravenous fluids, pain medication, and nursing care.

Q: Who is at risk for infection with West Nile virus?

A: Anyone living in an area where West Nile virus is present in mosquitoes can get infected. The risk of infection is highest for people who work outside or participate in outdoor activities, because of greater exposure to mosquitoes.

Q: How soon do people get sick after getting bitten by an infected mosquito?

A: The incubation period is usually two to six days, but ranges from two to fourteen days. This period can be longer in people with certain medical conditions that affect the immune system.

Q: Where can outbreaks of West Nile occur?

A: West Nile virus transmission has been documented in Europe and the Middle East, Africa, India, parts of Asia, and Australia. It was first detected in North America in 1999, and has since spread across the continental United States and Canada.

Q: How can people reduce the chance of getting infected?

A: The most effective way to avoid West Nile virus disease is to prevent mosquito bites.

- Use insect repellents when you go outdoors. Repellents containing DEET, picaridin, IR3535, and some oil of lemon eucalyptus and para-menthane-diol products provide longer-lasting protection.
- Wear long sleeves and pants from dusk through dawn, when many mosquitoes are most active.
- Install or repair screens on windows and doors. If you have it, use your air conditioning.
- Help reduce the number of mosquitoes around your home. Empty standing water from containers such as flower pots, gutters, buckets, pool covers, pet water dishes, discarded tires, and birdbaths.

Go back to Research Guide now

Task 4-1 – Investigating Mosquito-borne Disease Distribution

Zika—Frequently Asked Questions

Q: What is Zika?

A: Zika virus disease is caused by the Zika virus, which is spread to people primarily through the bite of an infected *Aedes* mosquito. The illness is usually mild, with symptoms lasting up to a week, and many people do not have symptoms or will have only mild symptoms. However, Zika virus infection during pregnancy can cause a serious birth defect called microcephaly, and other severe brain defects.

Q: How is Zika spread?

A: Zika is spread to people primarily through the bite of aninfected *Aedes* mosquito. A pregnant woman can pass Zika to her fetus duringpregnancy or around the time of birth. Also, a person with Zika can pass it to hisor her sex partners. People who have traveled to or live in places with a risk ofZika are encouraged to protect themselves by preventing mosquito bites andsexual transmission of Zika.

Q: What are the symptoms of Zika virus disease?

A: The most common symptoms of Zika virus disease are fever, rash, headache, joint pain, red eyes, and muscle pain. Many people infected with Zika won't have symptoms or will have mild symptoms, which can last for several days to a week.

Q: What health problems can result from getting Zika?

A: While people infected with Zika will have no symptoms or mild symptoms, Zika infection during pregnancy can cause a serious birth defect
called microcephaly (an abnormally small head) and other severe fetal brain defects. Once someone has been infected with Zika, it's very likely they'll be protected from future infections. There is no evidence that past Zika infection poses an increased risk of birth defects in future pregnancies.

Q: What is the treatment for Zika?

A: If you have symptoms of Zika (fever, rash, headache, joint pain, red eyes, or muscle pain) and you live in or recently traveled to an area with a risk of Zika, you should see your doctor or health care provider and tell him or her about your

symptoms and recent travel. There is no specific medicine for Zika, but you can treat the symptoms.

If you are diagnosed with Zika, protect those around you by taking steps to prevent mosquito bites and to prevent sexual transmission of Zika. Because Zika can generally be found in blood during approximately the first week of infection, and can be passed to another person through mosquito bites, help prevent others from getting sick by strictly following steps to prevent mosquito bites during the first week of illness.

Q: If I am traveling to an area with a risk of Zika, should I be concerned about Zika?

A: Travelers who go to places with a risk of Zika can become infected. Many people will have mild or no symptoms. However, Zika can cause microcephaly and other severe birth defects. For this reason, pregnant women should not travel to any area with a risk of Zika, and women trying to get pregnant should talk to their doctor before traveling to an area with a risk of Zika. Those traveling to areas with a risk of Zika should take preventive steps during and after they travel.

Q: What can people do to prevent Zika?

A: The best way to prevent Zika is to protect yourself and your family from mosquito bites.

- Use Environmental Protection Agency (EPA)-registered insect repellents.
- Wear long-sleeve shirts and long pants.
- Sleep under a mosquito bed net if air conditioned or screened rooms are not available, or if you are sleeping outdoors.

Zika can be spread by a person infected with Zika to his or her sex partners. Condoms can reduce the chance of getting Zika from sex. Condoms include male and female condoms. Pregnant couples with a partner who traveled to or lives in an area with a risk of Zika should use condoms every time they have sex or not have sex during the pregnancy.

Go back to Research Guide now

Zika Awareness and Prevention (ZAP) Game

The Zika Awareness and Prevention (ZAP) Game was developed to strengthen students and communities in their ability to stop Zika virus disease. Zika virus is a mosquito-borne virus, spread primarily by the bite of an infected *Aedes* species mosquito. Through simulation, this game educates students about Zika virus, common mosquito breeding sites, Zika virus disease symptoms, and pregnancy risks associated with Zika. Practices that help to prevent mosquito bites are also covered such as using an EPA registered insect repellent with DEET, the importance of wearing long sleeved shirts and long pants when outdoors, and treating clothing with permethrin. Multiple choice and matching games are provided to gauge how much you learned about Zika.

Use the following link to access the game, and have fun!
http://zika.vmasc.odu.edu/zap/

Computer WebGL Compatibility: Chrome 64 bit Version 57 and newer, Microsoft Edge version 16 or newer, Safari version 11 or newer, and Firefox version 52 or newer. Firefox users check your privacy settings.

For more information about the ZAP Game or for any other concerns please email us at Zapzika@odu.edu or contact:

Bridget Giles PhD
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Old Dominion University
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Suffolk, VA 23435
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Phone: 757-638-4436

Team New Articles for Task 4-1

Zika ZAP Game News Article
https://www.odu.edu/news/2017/6/zika_game#.WzE7aadKiUk

Task 4-2 Modeling Vector Disease Transmission Activity—Mosquito A

Follow the directions to set up the model to explore vector disease transmission through a group of people.

Use the Model numbers chart at the end of this document to determine how many people will model humans and how many will model mosquitoes, based on the total number of team members.

Model 1

- All humans start uninfected.
- The number of infected mosquitoes is determined by the table. Do not let the humans or other mosquitoes know which mosquito is infected before the round begins.
- Run the model according to the instructions below.

Model 2

- Start with 10 percent of the humans already infected (so 90 percent uninfected).
- Based on the chart, start with the designated number of infected mosquitoes. Do not let the humans or other mosquitoes know who is infected.

Model 3

Follow the same setup as Model 2, but increase number of infected mosquitoes at the start.

Model 4

Follow the same setup as Models 1 or 2, but increase the number of times each mosquito can "bite" in each round. For example, each mosquito bites four or five people in a round. What effect does this have on the results?

Instructions for Running the Model

1. Humans and mosquitoes will slowly roam around the room or in an outside area. There is no talking during this activity.
2. Mosquitoes will tag a human. When they do, they will simulate biting the human by shaking their hand.
3. If the mosquito is infected, the mosquito should squeeze the human's hand twice when shaking their hand, to let them know they are now infected. No talking, and do not share this information with anyone else.
4. The human is now infected and will squeeze the hand of other mosquitoes to infect them.
5. Once a human is infected, the human should also squeeze the hand of a mosquito twice. If the mosquito was uninfected, but then bites an infected human, they are now infected.
6. The mosquito will then move on to another human.
7. Each mosquito will "bite" a total of three people during each model round. Note that a human can be bitten by more than one mosquito during a round.
8. After all mosquitoes have bitten three people, have the mosquitoes and humans stand in separate areas.
9. All infected humans and mosquitoes then raise their hands.
10. Count how many mosquitoes and humans are infected at the end of each round.
11. Use the data collection sheet to compile the data.
12. Repeat the model using different model setups.
13. Compare and contrast results of different model setups. What effect does the model have on the transmission rate?

Model Numbers Chart

Total # of team members	Humans	Total # of mosquitoes	Infected mosquitoes
10	8	2	1
11	8	3	1
12	9	3	1
13	10	3	1
14	11	3	1
15	11	4	1
16	12	4	1
17	13	4	2
18	14	4	2
19	14	5	2
20	15	5	2
21	16	5	2
22	17	5	2
23	17	6	2
24	18	6	2
25	19	6	2
26	20	6	2
27	20	7	2
28	21	7	2
29	22	7	2
30	23	7	2
31	23	8	3
32	24	8	3
33	25	8	3
34	26	8	3
35	26	9	3
36	27	9	3
37	28	9	3
38	29	9	3
39	29	10	3
40	30	10	3
41	31	10	3
42	32	10	3
43	32	11	4
44	33	11	4
45	36	11	4
46	35	11	4
47	35	12	4
48	36	12	4
49	37	12	4
50	38	12	4

Data Table

Model setup	# of humans	# of infected humans to start	# of infected humans at end of round	# of mosquitoes	# of infected mosquitoes to start	# of infected mosquitoes at end of round	Notes

Go back to Research Guide now

Task 4-2 Modeling Vector Disease Transmission Activity—Mosquito B

Follow the directions to set up the model to explore vector disease transmission through a group of people.

Materials

- Use the Model numbers chart at the end of this document to determine how many people will model humans and how many will model mosquitoes, based on the total number of team members. This will also tell you how many human and mosquito cups you will need.
- Have one small cup for each human and one for reach mosquito. Label each with a number.
- Have one eye dropper, pipette or syringe for each mosquito
- Infected and uninfected solutions (see below)
- Vinegar

Uninfected Solution: Mix 1 liter of water with 1 cup of flour. Mix well.

Infected Solution: Mix 1 liter of water with ½ cup flour and ½ cup baking soda. Mix well.

The team will use these materials to run various models. Use the setups described for each model. Then use the instructions to run each model.

Clean and rinse all cups and pipettes between each round.

Model 1

1. Fill all of the humans' cups with uninfected solution.
2. Give each human a numbered cup.
3. Based on the chart, fill the designated number of mosquito cups with infected solution. Fill the others with uninfected solution. Document which numbered cups contain the infected solution. Do not tell mosquitoes whether or not they are infected.
4. Run the model according to the instructions below.

Model 2

5. Fill 10 percent of the humans' cups with infected solution to start. Document which numbered cups contain the infected solution.
6. Fill the other 90 percent of the humans' cups with uninfected solution.
7. Give each human a numbered cup. Do not let the infected people know they are infected.
8. Based on the chart, fill the designated number of mosquito cups with infected solution. Fill the others with uninfected solution. Document which numbered cups contain the infected solution. Do not tell mosquitoes whether or not they are infected.

Model 3

Follow the same setup as Model 2, but increase number of infected mosquitoes at the start.

Model 4

Follow the same setup as Models 1 or 2, but increase the number of times each mosquito can "bite" in each round. For example, each mosquito bites four or five people in a round. What effect does this have on the results?

Instructions for Running the Model

1. Humans and mosquitoes will slowly roam around the room or in an outside area. There is no talking during this activity.
2. Mosquitoes will tag a human. When they do, they will simulate biting the human by squirting all of their liquid into the human's cup using the eye dropper, pipette, or syringe.
3. The mosquito will then simulate feeding by mixing the contents in the human's cup and filling their cup with half the solution from the human's cup, using the eye dropper, pipette, or syringe.
4. The mosquito will then move on to another human.
5. Each mosquito will "bite" a total of three people during each model round. Note that a human can be bitten by more than one mosquito during a round.
6. After all mosquitoes have bitten three people, have the mosquitoes stand at the front of the team.
7. Each mosquito and human cup will now be tested for infection. To test each cup, pour a small amount of vinegar in each cup and swirl the solution.
   - If the cup bubbles, the person is infected.
   - If the cup does not bubble, the person is not infected.
8. Use the data collection sheet to compile the data.
9. Clean out all cups and pipettes.
10. Repeat the model using fresh solutions and different model setups.
11. Compare and contrast the results of different model setups. What effect does the model have on the transmission rate?

Model Numbers Chart

Total # of team members	Humans	Total # of mosquitoes	Infected mosquitoes
10	8	2	1
11	8	3	1
12	9	3	1
13	10	3	1
14	11	3	1
15	11	4	1
16	12	4	1
17	13	4	2
18	14	4	2
19	14	5	2
20	15	5	2
21	16	5	2
22	17	5	2
23	17	6	2
24	18	6	2
25	19	6	2
26	20	6	2
27	20	7	2
28	21	7	2
29	22	7	2
30	23	7	2
31	23	8	3
32	24	8	3
33	25	8	3
34	26	8	3
35	26	9	3
36	27	9	3
37	28	9	3
38	29	9	3
39	29	10	3
40	30	10	3
41	31	10	3
42	32	10	3
43	32	11	4
44	33	11	4
45	36	11	4
46	35	11	4
47	35	12	4
48	36	12	4
49	37	12	4
50	38	12	4

Data Table

Model setup	# of humans	# of infected humans to start	# of infected humans at end of round	# of mosquitoes	# of infected mosquitoes to start	# of infected mosquitoes at end of round	Notes

Go back to Research Guide now

Task 4-3

Mosquito! Task 4-3 Understanding Disease Hosts - HHMI West Nile Game Resources
https://www.hhmi.org/biointeractive/west-nile-virus-vectors-and-hosts-game

Task 4-4 Identifying Local Disease Hosts

The following is a list of disease hosts that use the mosquito as a vector.

Disease	Disease Vector	Disease Host(s)
Zika	Mosquito	Primates, including humans
Dengue	Mosquito	Monkeys and humans
West Nile	Mosquito	Birds, horses, humans
Malaria	Mosquito	Humans
Venezuelan equine encephalitis	Mosquito	Rodents (such as mice, rats, squirrels)
Japanese encephalitis	Mosquito	Birds, pigs, horses
Ndumu virus	Mosquito	Cattle
Murray Valley encephalitis	Mosquito	Ardeidae water birds (such as herons and egrets)
Rift Valley fever	Mosquito	Goats, sheep, cattle
Ross River virus	Mosquito	Kangaroos, wallabies
Chikungunya	Mosquito	Humans

Source: Kuno, G.. "Vertebrate Reservoirs of Arboviruses: Myth, Synonym of Amplifier, or Reality?" *Viruses* 2017**,** *9*(7), 185.

To learn more about how researchers are studying mosquito disease hosts, view the resources in the Learning Lab for this task.

Do you know if any of these disease hosts live in your area?

Research Site Disease Host Survey

During this step, the team will look for animal hosts and/or signs of animal hosts within and around the research site. Knowing what hosts potentially live in and around your research site can be useful when thinking about how different diseases could move through your community.

Before going outside to make observations:

- Look at the list of disease hosts again. Make sure everyone is familiar with all of the animals on the list.
- Look over the data collection sheet. Make sure everyone understands what information you will be collecting.
    - Some wildlife you will see with your eyes.

  - Some wildlife you will hear or smell, but not see.
  - Some wildlife will leave when you arrive.
- Look at your research site map from Task 2-1. Note that when you find wildlife or signs of wildlife, you will need to mark this on your research site map.
- Practice proper wildlife observation behaviors. When observing wildlife, it is best to be quiet and calm. The less you make your presence known, the more likely you are to see wildlife. If you are loud, most wildlife will move away before you have a chance to view it.
- Pick a spot within your research site where you can sit down and observe quietly for a period of time. Mark this spot on your map. Sometimes animals will be scared away when you arrive, but will then return when you sit quietly in the same location for some time.
- Make observations for the determined time. Document all observations in the table and include locations on your research map from Task 2-1.
- Take pictures, if you have the technology.
- After the stationary observation time is complete, you will start a moving observation.
- The moving observation will also be focused also on looking for evidence of wildlife. These are things left behind by animals to tell you that they were there in the past. Things like animal tracks, scat (poop), feathers, fur, nests, chewed food, bones, scratches, and ruts in the ground are all evidence that an animal was here before.
- Slowly walk around your research site and look for any evidence of wildlife. Document this on your data sheet.
- Take pictures, if you have the technology.
- Describe the weather conditions during your observation period.
- Conduct your observations for the length of time determined by the team.

Research Site Survey—Disease Hosts

Name:

Date:

Survey start time:

Survey end time:

Weather:

- Clear
- Scattered clouds
- Complete cloud cover
- Rain
- Wind: calm, breezy, gusty

Air temperature:

Active Wildlife Observation Table

Wildlife seen or heard	Number of times seen or heard	Was the animal in or out of your research site?	Notes (include information about location in site)

Evidence of Wildlife Observation Table

Evidence of wildlife	Description (What does it look like? Where exactly was it found? Other observations)	Number of pieces of evidence found in research site	Number seen or found outside of research site
Tracks			
Feathers			
Fur			
Nests			
Chewed food			
Scat			
Other (bones, scratches, ruts, etc.)			

Go back to Research Guide now

Task Resources 4-4

One in Four U.S. Deer Is Infected With Malaria

Description:

Two new species of malaria have been discovered in Washington, D.C. by scientists at the Smithsonian's National Zoo. Previously, no type of endemic malaria was known to occur in American mammals.

http://www.smithsonianmag.com/smithsonian-institution/one-in-four-deer-infected-malaria-180958046/

When It Comes to West Nile Virus, Atlanta's Cardinals May Be Our Feathered Saviors

Description:

Since West Nile Virus was first detected in the United States in 1999, dead birds have become red flags for scientists tracking the virus. Though West Nile is spread by mosquitoes, many bird species act as carriers for the virus, hosting it until it can be transmitted to other animals by way of the next bug bite.

http://www.smithsonianmag.com/smart-news/when-it-comes-to-west-nile-virus-atlantas-cardinals-may-be-our-feathered-saviors-180960076/

Videos for Task 4-4

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60 Seconds of Science: Researchers Discover Widespread Malaria Parasite in White-Tailed Deer

Description:

Oh deer—our scientists found that up to 25%of white-tailed deer on the east coast of the U.S. have a deer malaria parasite. Don't panic, it's not a risk for humans, but we're still unsure of what it means for other hoofed species. The parasite has been hiding in plain sight and is the first malaria parasite found in a deer species. #WeSaveSpecies Read more: http://s.si.edu/1PFh4Gn

https://www.youtube.com/watch?v=sct-bW4JQ90&feature=youtube_gdata_player

Studying Birds and West Nile Virus on the National Mall

Description:

Smithsonian scientists are studying the effects of West Nile Virus on migratory birds and what that means for humans. Dr. Peter Marra of the Smithsonian Migratory Bird Center at the National Zoo discusses the work he's doing on the National Mall and what the robin population has to do with your chances of being infected with the virus.

https://www.youtube.com/watch?v=FQjlt8DQA3c&feature=youtube_gdata_player

B-roll for Media: SCBI Researchers Discover Widespread Malaria Parasite in White-Tailed Deer

Description:

Smithsonian Conservation Biology Institute Researchers Discover Widespread Malaria Parasite in White-Tailed Deer Additional Research Will Determine Health Risk to Deer and Related Species In a serendipitous turn of events, the Smithsonian Conservation Biology Institute (SCBI) and partners have discovered a malaria parasite, Plasmodium odocoilei, in up to 25 percent of white-tailed deer along the East Coast of the United States.

https://www.youtube.com/watch?v=E6wN4OD6gZI&feature=youtube_gdata_player

Task 4-5 Collecting Local Transmission Histories – Interview Questions

Use these questions to interview different people in your local community to learn more about its history.

1. Was our community always as crowded as it is now?
2. In your opinion, how has the community's health changed as a result?
3. Have many people moved here or moved away during your life? Were there ever any large events of immigration or emigration?
4. Has the community become more urban over time? How do you think the community's health has changed as a result?
5. Has the community built more homes or buildings over your life?
6. What roles do animals play in the community and how has this changed over time?
7. Have people been in contact with wildlife in your community during your life?
8. Has this contact changed over time?
9. Has the way land is used in the community changed during your life?
10. Has wild land in the community been cleared for agriculture during your life?
11. Have any unusual natural events, like large storms or strange seasons, occurred during the time that you have been here, and did they cause any changes in the community's health or the amount of mosquitos you noticed?
12. When you were younger, do you remember being bitten by mosquitoes more or less often than now?
13. Could you please describe any changes in your lifestyle or in the community that could be responsible for this?
14. Have guests always visited the community and where do they usually come from?
15. Has access to clean drinking water, electricity, and roads always been the same?
16. Create your own questions:_____

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Mosquito! Task 4-5 Collecting Local Transmission Histories

Learning about the changes to a place from the local people

Kelly Bennett - Biologist - Smithsonian Tropical Research Institute (Panama)

Mosquito-borne diseases like dengue, Zika, and yellow fever are emerging and reemerging all over the globe. The emergence of these diseases can be connected to urbanization and changes in land use over time. Urbanization is an increase in the number of people and a change in the way land is used in an area over time. As the number of people in a location changes, things like land use and contact with wildlife can change. These changes can affect the spread of mosquito-borne diseases in a community.

The problem of mosquito-borne disease has also been affected by increased human movement and trade around the world. Over time, this movement allows mosquitoes to travel and establish new populations. In addition, urbanization can increase contact people have with the surrounding forests. Over time, this contact is where diseases can switch from using animals as hosts to using humans as host. Increasing urbanization of communities means we must work together when thinking about this problem. Mosquitoes can be highly adaptive. New mosquito-borne diseases are emerging and spreading rapidly. A recent example is Zika virus. This disease has been around for along time. However, it has only recently become a worldwide problem. This is likely dueto the adaptive nature of *Aedes* mosquitoes, which are able to take advantage of their association with humans.

To fully understand urbanization and changes in a community over time, we have to start to uncover its history. For some things, this can be hard to do. Big histories, like those of nations, are often written down and are easy to find. Smaller histories, on the other hand, like those of towns, families, or events, are usually recorded in our memories and passed down through stories. This gives personal stories of the past, passed from one generation to the next, big value. They help us understand our current situation in ways that other methods cannot.

In this task, you will interview elderly members of your community to learn about the past. From this history, your will work to better understand the urbanization and changes of your community over time.

When you do your interviews, try to interview some people your parent's age, and some who are even older. The point is to see how things have changed over time.

In your interviews, try to listen much more than you talk, but still remain an active listener. Keep an ear out for themes like urbanization, globalization, contact with wildlife, natural events, health, and development. Understanding how these things have become the way they are will help you keep your community healthy.

Below are some questions to use in your interviews. Feel free to come up with more, especially ones that are specific to your area, but see these as a framework to follow.

How you set up an interview is your choice. If you aren't sure what to do, simply explain the project you are working on and politely ask your interviewee if they would be willing to tell you about the past of this place. It is best to meet someone in a space where they feel comfortable, and to start with some simple questions to let them warm up. Then, when they seem open to sharing stories, you can ask them the following **interview questions**.

- Was our community always as crowded as it is now?
- In your opinion, how has the community's health changed as a result?
- Have many people moved here or moved away during your life? Were there ever any large events of immigration or emigration?
- Has the community become more urban over time? How do you think the community's health has changed as a result?
- Has the community built more homes or buildings over your life?
- What roles do animals play in the community and how has this changed over time?
- Have people been in contact with wildlife in your community during your life?
- Has this contact changed over time?
- Has the way land is used in the community changed during your life?
- Has wild land in the community been cleared for agriculture during your life?
- Have any unusual natural events, like large storms or strange seasons, occurred during the time that you have been here, and did they cause any changes in the community's health or the amount of mosquitos you noticed?
- When you were younger, do you remember being bitten by mosquitoes more or less often than now?
- Could you please describe any changes in your lifestyle or in the community that could be responsible for this?
- Have guests always visited the community and where do they usually come from?
- Has access to clean drinking water, electricity, and roads always been the same?

Articles for Task 4-5

Harvey's Next Danger: Massive Mosquito Clouds
Description:
After the catastrophic devastation of hurricane Harvey, the people of Texas are now facing a slew of problems from contaminated floodwaters to toxic mold to giant alligators sneaking into homes to floating rafts of fire ants. But as Joe Hanson at *Texas Monthly* reports, Harvey victims have yet another galling problem to add the mix: giant clouds of mosquitoes.
http://www.smithsonianmag.com/smart-news/harveys-next-disaster-giant-clouds-mosquitoes-180964786/

The World's Megacities Are Making Dengue Deadlier
Description:
While the world's attention is focused on the Zika virus spreading through the Americas, large urban areas in Southeast Asia are fighting off outbreaks of dengue fever.
http://www.smithsonianmag.com/science-nature/worlds-megacities-are-making-dengue-deadlier-180958009/

Protecting Land in Brazil Reduces Malaria and Other Diseases
Description:
In the Brazilian Amazon, getting back to nature may really be the healthiest option. Data covering hundreds of municipalities show that people who live near areas under strict conservation protection experience lower incidences of common diseases and infections such as malaria.
http://www.smithsonianmag.com/science-nature/protecting-land-brazil-reduces-malaria-and-other-diseases-180955604/

Task 4-6 Analyzing Community Surveys (Transmission)—Mosquito A

Compiling Survey Data Options

First we must compile the answers from the community surveys to all of the questions from Part Four: Transmission. The team will look at the other parts in later tasks.

Here are some options for compiling the answers to the survey questions. But, as always, if you have different method you prefer, do that!

Option 1

Hand out a survey to each person.

Go through each question and team members can raise their hands to vote for the answer they prefer. Some team members can count up the votes and others can write down the totals for the team.

Option 2

Have questions on a board, paper, or computer where tallies can be compiled. Tally the responses and share the results.

Option 3

Digital survey: If you did the survey digitally, you should be able to see the results for each question.

Option 4

Create your own way of compiling survey data.

Graphing Survey Data

How could you graph parts of these survey results?

Which questions could you graph?

If you have the resources, pick some questions to graph that you think would be useful.

How would these graphs be useful when supporting claims with evidence?

Community Survey—Mosquito A

Use this survey to compile data.

Part 4: Transmission

Can mosquito-borne diseases be transmitted simply by being near people who are sick?		
Yes, mosquito-borne diseases can be transmitted by simply being near people who are sick	No, mosquito-borne diseases are not transmitted simply by being near people who are sick	Not sure

Can some mosquito-borne diseases be transmitted to other animals (birds, horses, dogs)?		
Yes, some mosquito-borne diseases can be transmitted to other animals	No, mosquito-borne diseases cannot be transmitted to animals	Not sure

Go back to Research Guide now

Task 4-6 Analyzing Community Surveys (Transmission)—Mosquito B

Compiling Survey Data Options

First we must compile the answers from the community surveys to all of the questions from Part Four: Transmission. The team will look at the other parts in later tasks.

Here are some options for compiling the answers to the survey questions. But, as always, if you have different method you prefer, do that!

Option 1

Hand out a survey to each person.

Go through each question and team members can raise their hands to vote for the answer they prefer. Some team members can count up the votes and others can write down the totals for the team.

Option 2

Have questions on a board, paper, or computer where tallies can be compiled. Tally the responses and share the results.

Option 3

Digital survey: If you did the survey digitally, you should be able to see the results for each question.

Option 4

Create your own way of compiling survey data.

Graphing Survey Data

How could you graph parts of these survey results?

Which questions could you graph?

If you have the resources, pick some questions to graph that you think would be useful.

How would these graphs be useful when supporting claims with evidence?

Community Survey—Mosquito B

Use this survey to compile data.

Part 4: Transmission

Can mosquito-borne diseases be transmitted simply by being near people who are sick?		
Yes, mosquito-borne diseases can be transmitted by simply being near people who are sick	No, mosquito-borne diseases are not transmitted simply by being near people who are sick	Not sure

Can some mosquito-borne diseases be transmitted to other animals (birds, horses, dogs)?		
Yes, some mosquito-borne diseases can be transmitted to other animals	No, mosquito-borne diseases cannot be transmitted to animals	Not sure

Go back to Research Guide now

Task 4-7 Debriefing Transmission

Question Map Analysis

1. Look at your team question map from Task 1-10. Are there any questions on your map that were addressed in Part Four: Transmission?
2. What evidence did you collect during Part Four that could be useful to answer any questions on your question map?
3. How could this evidence or information be useful to develop a solution to the problem question: How can we ensure health for all from mosquitoes?

Take time to rearrange, update, or modify any questions on your question map at this time.

Community Partners

1. As a team, look over the list of community partners you created in Task 2-5.
2. As a team, decide if there are any community partners you could contact to get more information about the research questions you identified on your question map from Task 1-10.
    - Make a plan as a team to communicate with these partners.
    - Create a list of questions you would like to ask these partners.
    - Email, phone, or write to each partner with your questions.
    - If your team decides it's appropriate, invite the community partner to meet with the team. Use your list of questions to have a conversation with them.

Perspectives—Four Corners Strategy

1. Label four corners of the room with the following signs: Social, Economic, Environmental, Ethical. If you do not have corners, just mark four different areas in the room.
2. Four different statements will be read to the team, one at a time.

Statements

- Understanding the history of our community is helpful when thinking about local problems.
- In addition to helping humans who are sick with mosquito-borne diseases, we should be helping animals, such as birds, horses, and pets, who get sick from mosquito-borne diseases.

- Changes in the local community, such as increases in the number of people or buildings, can have an effect on mosquitoes and mosquito-borne diseases.
- When spending money on local development, builders and governments should think about the possible effect it could have on mosquitoes and mosquito-borne diseases.

3. After each statement is read, take a minute and let each team member think about which category they think this statement best belongs in: Social, Economic, Environmental, or Ethical.
4. You can write down your answers and reasons for your choice, if you would like.
5. All team members should move to the corner that corresponds to their choice.
6. Move to a whole team discussion.
    - Remember, team members must back up opinions with information and other team members must listen carefully to one another.
    - Can individual team members explain to the team the reasons for their position at that corner?
    - How many team members changed their positions after hearing people talk during the whole team discussion?
    - What led you to change your mind?

Identity

- Look at your personal and team identity maps from Tasks 1-1 and 1-4. What aspects of your or your team's identity might influence your opinions on the perspectives?
- How might your decisions be influenced by these parts of your identity?
- Have any parts of your identity map changed?

Problem Question

- Is there anything you learned in this part that would be useful when thinking about the problem question: How can we ensure health for all from mosquitoes?

Go back to Research Guide now