DISCUSSION GUIDE FOR
“Biosecurity”
a video interview with Dr. Megan Palmer,
Center for International Security and Cooperation

Organizing Questions
• What is biosecurity?
• What are biological threats?
• How can we prevent and prepare for biological threats?
• How can citizens engage with biosecurity?

Summary
In this video, Dr. Megan Palmer discusses the pandemic brought about by the 2019 novel coronavirus and how it has changed our lives. Dr. Palmer also introduces various types of biological threats and how we can prevent, prepare for, and minimize the risk of such threats. Katherine Healzer, a high school intern with Dr. Palmer’s group, shares some ideas on how to engage with biosecurity as community members.

Objectives
During and after viewing this video, students will:
• gain a general understanding of biosecurity;
• learn about different types of biological threats; and
• examine how to prevent and prepare for biological threats.

Materials
Handout 1, Video Notes, pp. 4–5, 30 copies
Handout 2, Biological Weapons Convention, p. 8, 30 copies
Handout 3, Engaging in Biosecurity, p. 9, 30 copies
Answer Key 1, Video Notes (Answer Key), pp. 6–7
Teacher Information, Video Transcript, pp. 10–16
Video, “Biosecurity,” online at https://youtu.be/mr-c5O1RdbM
## Equipment
- Computer with Internet access
- Computers with Internet access (for student research on Day Two if doing research in class and not as homework)
- Computer projector and screen
- Computer speakers

## Teacher Preparation
Instructions and materials are based on a class size of 30 students. Adjust accordingly for different class sizes.
1. Preview Video, “Biosecurity.”
2. Become familiar with the content of handouts, answer key, and teacher information.
3. Make the appropriate number of copies of the handouts.
4. Set up and test computer, projector, speakers, and video before beginning the lesson.

## Time
Two full class periods

## Procedures
### Day One
1. Explain to students that they will be viewing a short video that introduces biosecurity. Dr. Megan Palmer, Executive Director of Bio Policy and Leadership Initiatives at Stanford University, Adjunct Professor in the department of Bioengineering, and Affiliate of the Center for International Security and Cooperation, is the main speaker.
2. Distribute one copy of Handout 1, Video Notes, and Handout 2, Biological Weapons Convention, to each student. Give students several minutes to read through the questions and defined terms on Handout 1 and Handout 2.
3. View the Video, “Biosecurity.” If necessary, pause the video at various points to allow students to respond to the prompts on Handout 1.
4. Once the video has ended, give students several minutes to write their answers to the questions.
5. Organize students into six groups. Distribute one copy of Handout 3, Engaging in Biosecurity, to each student.
6. For homework (or in class), have students begin thinking about their responses and let them know that they will be sharing them in their groups. And let them know that they will share some of the responses with the class for discussion.

### Day Two
1. Students may draw from personal experience, refer to all handouts, conduct research on the Internet, as well as use reference points made in the video to create their presentations.
2. Have each group present their findings to the class and as a class, elaborate and discuss any key points that stand out to the class.
3. Debrief with class using the following wrap-up discussion questions:
   • What is biosecurity?
   • What are biological threats?
   • How can we prevent and prepare for biological threats?
VIDEO NOTES

You are about to watch a 23-minute video interview with Dr. Megan Palmer, Executive Director of Bio Policy and Leadership Initiatives at Stanford University, Adjunct Professor in the department of Bioengineering, and Affiliate of the Center for International Security and Cooperation. In this lecture Dr. Palmer will discuss how biological threats shape our world—different types of threats and what we can do to prevent and to prepare for them. Katherine Healzer, a high school intern with Dr. Palmer’s group, will also share some ideas on how to engage with biosecurity as community members.

Use the space below to answer each question; you may want to take notes on another sheet of paper as you watch the video.

1. What is biosecurity?

2. How did the 2019 novel coronavirus, or SARS-CoV-2, transform how people live?

3. How is biology seen as both a threat and a tool to our lives?

4. Give two examples of previous pandemics that have threatened the world.

5. Are biological threats limited to only humans?

6. What is the dual-use dilemma? Give one example of this.

7. According to Katherine, what are two things that students and community members can do to take social responsibility and engage in biosecurity?
Reference: Defined Terms (in order of mention)

**biosecurity**—defined differently by a variety of different stakeholder groups; at a high level, it is about how we protect against biological threats

**pandemic**—an epidemic of an infectious disease that has spread across a large region, for instance multiple continents or worldwide, affecting a substantial number of people

**biological threat**—an infectious disease with the potential to spread and cause an outbreak

**dual-use dilemma**—advances that offer a promise for help, but also a potential for harm, e.g., ability to reconstruct a pathogen so that it can be researched to develop defenses against potential pathogens of the future

**Biological Weapons Convention**—prohibits the development, production, acquisition, transfer, stockpiling and use of biological and toxin weapons
1. What is biosecurity?
   - Biosecurity is defined differently by a variety of different stakeholder groups. At a high level, we are talking about how we protect against biological threats.

2. How did the 2019 novel coronavirus, or SARS-CoV-2, transform how people live?
   - Countries locked down and borders closed, shortages of common goods and fractured supply chains, people separated from their friends, families, and communities, businesses closing, rampant unemployment, the loss of people’s livelihoods and of course millions of deaths with more to come
   - In the United States, there have been big changes: largest social spending programs in American history and a federal election conducted largely by mail
   - Transformations in the way people think about and go to work

3. How is biology seen as both a threat and a tool to our lives?
   - Biology is the fabric of the living world, and it’s what we are made of; we are more vulnerable to biological threats than other types of threats. But we can also use biology (e.g., vaccines) as a tool to protect us.
   - Biology can also be used for harm in the form of biological weapons.
   - Accidental leaks—research conducted to develop defenses against both SARS and anthrax both have a history of laboratory accidents. With SARS, those accidents resulted in several additional epidemics after the initial pandemic subsided.

4. Give two examples of previous pandemics that have threatened the world.
   - Bubonic plague or Black Death
   - Smallpox
   - 1918 Spanish Influenza

5. Are biological threats limited to only humans?
   - Many infectious diseases find reservoirs in animal populations, such as bats, which are a reservoir for several highly pathogenic viruses, including Ebola, SARS, MERS, and Nipah viruses.
   - Other animals and plants—including those that we rely upon for food—can also be threatened by biological threats. Examples include the black-footed ferret, which is a critically endangered species and highly susceptible to Sylvatic Plague, and the American chestnut which was nearly wiped out due to fungal blight.

6. What is the dual-use dilemma? Give one example of this.
   - Advances that offer a promise for help, but also a potential for harm
   - Ability to reconstruct a pathogen so that it can be researched to develop defenses against potential pathogens of the future
   - Controversy around reconstruction of the 1918 influenza—researchers used tools of reading, writing, editing evolving DNA to synthesize and assemble an extinct virus and wanted to publish their methods; debate if sharing research of this nature makes us more secure or more vulnerable
7. According to Katherine, what are two things that students and community members can do to take social responsibility and engage in biosecurity?

- Global health security: do your part by getting vaccinated and sharing accurate information from reliable sources with others to help protect your communities
- Form a community team or school club to learn about biosecurity and how you can help prepare for, respond to, and recover from public health threats
- Study biology and biotechnology
- Stay informed on new developments in the life sciences and biotechnology, and consider how they relate to issues in your local community
- Participate as a team Member in iGEM, an international competition dedicated to the advancement of synthetic biology through fostering the values of community, collaboration, and security
**Biological Weapons Convention**

The Biological Weapons Convention (BWC) prohibits the development, production, acquisition, transfer, stockpiling and use of biological and toxin weapons. It was the first multilateral disarmament treaty banning an entire category of weapons of mass destruction (WMD).

The BWC is a key element in the international community’s efforts to address WMD proliferation and it has established a strong norm against biological weapons. The Convention has reached almost universal membership with 183 States-Parties and four Signatory States. The BWC itself comprises only of 15 articles. The key provisions, as outlined by the United Nations, are listed below:

<table>
<thead>
<tr>
<th>Article</th>
<th>Provision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Article I</td>
<td>Undertaking never under any circumstances to develop, produce, stockpile, acquire or retain biological weapons.</td>
</tr>
<tr>
<td>Article II</td>
<td>Undertaking to destroy biological weapons or divert them to peaceful purposes.</td>
</tr>
<tr>
<td>Article III</td>
<td>Undertaking not to transfer, or in any way assist, encourage or induce anyone to manufacture or otherwise acquire biological weapons.</td>
</tr>
<tr>
<td>Article IV</td>
<td>Requirement to take any national measures necessary to prohibit and prevent the development, production, stockpiling, acquisition or retention of biological weapons within a State’s territory, under its jurisdiction, or under its control.</td>
</tr>
<tr>
<td>Article V</td>
<td>Undertaking to consult bilaterally and multilaterally and cooperate in solving any problems which may arise in relation to the objective, or in the application, of the BWC.</td>
</tr>
<tr>
<td>Article VI</td>
<td>Right to request the United Nations Security Council to investigate alleged breaches of the BWC, and undertaking to cooperate in carrying out any investigation initiated by the Security Council.</td>
</tr>
<tr>
<td>Article VII</td>
<td>Undertaking to assist any State Party exposed to danger as a result of a violation of the BWC.</td>
</tr>
<tr>
<td>Article X</td>
<td>Undertaking to facilitate, and have the right to participate in, the fullest possible exchange of equipment, materials and information for peaceful purposes.</td>
</tr>
</tbody>
</table>

Source: [https://www.un.org/disarmament/biological-weapons/](https://www.un.org/disarmament/biological-weapons/)
ENGLISH IN BIOSECURITY

Biosecurity isn’t just the responsibility of scientists, lawmakers, and world leaders. It also depends greatly on social responsibility. As both Dr. Palmer and Katherine mentioned, with global health security we can do our part by seriously consider getting vaccinated and sharing accurate information from reliable sources with others to help protect our communities. Prior to the development of vaccines, practicing social distancing, wearing a mask, and washing our hands regularly were all things that people could do to help prevent the spread of COVID-19.

Think about how COVID-19 has transformed your life. Discuss amongst your group the following five points and choose some examples from your group to share with the class. If time allows, as a group choose one of the sample activities that are listed below the five points and complete as homework.

1. Ways that you have been engaged in biosecurity during the pandemic
2. Challenges that you faced during the pandemic
3. Some solutions you came up with to alleviate those challenges
4. If you think your community was prepared for the pandemic
5. What things can be done to better prepare for the next one

Group Homework

1. Develop a poster or webpage that highlights important ways to keep safe from COVID-19.
2. Develop an op-ed piece that highlights information from this lesson that focuses on ways to keep educational spaces safe.
3. Design two graphic stories that focus on hosting a large event: (1) hosting a large event without taking the risk of COVID-19 into consideration; (2) designing an alternative to the same event keeping the risk of COVID-19 in mind.
4. Write a short article about the benefits and risks of one COVID-19 vaccine.
5. Write a response to Dr. Palmer’s comment, “Biology is the fabric of the living world, and it’s what we are made of—so we are both vulnerable to biological threats in more ways that can be more complex than other types of threats. But we also are able to use biology as a tool to protect us.”
6. Develop a one-page description of the dual-use dilemma that is accessible to high school students.
On-screen text:
Biosecurity
a discussion with Megan Palmer & Katherine Healzer

On-screen text:
Megan Palmer
Executive Director of Bio Policy & Leadership Initiatives,
Adjunct Professor, Department of Bioengineering, Stanford University

On-screen text:
What is ethnic cleansing and genocide?

Megan Palmer: Hi, my name is Megan Palmer. I am the Executive Director of Bio Policy and Leadership Initiatives at Stanford University. I’m also an adjunct professor in the department of Bioengineering and an affiliate of the Center for International Security and Cooperation. Today I’m going to talk to you about biosecurity; I’m also joined by a high school intern with our group Katherine Healzer. Hi Katherine.

Katherine Healzer: Hi. Thank you Dr. Palmer. Thank you! It’s an honor to join you.

Megan Palmer: Thanks for being with us Katherine!

Slide 2
This module is being produced in late August 2021 while the world still grapples with a pandemic brought about by the 2019 novel coronavirus, or SARS-CoV-2. In California, where we are, and across the United States, and in many places around the world, communities are again reinstating public health measures in an effort to blunt, in this case, the “third wave” of this pandemic and a new variant that has emerged, the SARS-CoV-2 Delta Variant.

In this last year and a half we have lived through a world in turmoil, countries locked down and borders closed, shortages of common goods and fractured supply chains, people separated from their friends, families, and communities, business closing, and rampant unemployment and the loss of people’s livelihoods and of course millions of deaths with more to come all brought about by a biological threat.

We have had to adapt significantly to the realities of living in a pandemic. In the U.S. for instance, we have seen big changes, the largest social spending programs in American history, a federal election conducted largely by mail. Complete transformations in the way people think about and go to work and pursued a monumental global scientific and public health effort to get us through this situation. This effort produced a wealth of potential innovations that we hope
will help us improve in our response to future pandemics, but at the moment we are still dealing with the current situation.

What effects of the past year and a half will endure—good and bad—remains to be seen.

One thing is certain: our collective reckoning with the topic of today’s module—biosecurity—will not be forgotten.

Slide 3

Biosecurity is defined differently by a variety of different stakeholder groups. At a high level, we are talking about how we protect against biological threats. In this module we will discuss how biological threats shape our world. Different types of threats, what we can do to prevent and to prepare for them and what you can do to engage with biosecurity in your own life and career.

Slide 4

First, we are in the midst of a pandemic that is reminding us all of the power of biology to threaten our safety, our security and our entire way of life. But also as we take vaccines that help to protect us, we’re also reminded of the importance of biological knowledge and technologies to protect us against those biological threats. To understand this pandemic and what we need to be prepared for, in the future it’s important to keep this balance in context. Biology is the fabric of the living world, and it’s what we are made of. So we are both vulnerable to biological threats in more ways that can be more complex than other types of threats. But we also are able to use biology as a tool to protect us.

Slide 5

As another point of context, it’s good to keep in mind that this is not the first pandemic we have faced. There is a long history of humans dealing with biological threats. It is also not likely the last pandemic we will face. Here are several examples of previous pandemics. You may have heard of some including the bubonic plague—or Black Death—and smallpox. Both bubonic plague and smallpox were even more significant threats than SARS-CoV-2 in terms of the deadliness of those diseases. There are legitimate concerns that even these very deadly diseases might not be the worst we could face in the future.

When we try to keep these threats and context it’s also important to look beyond biology.

We can look to the types of harm that have been caused by pandemics and biological threats and compare them with other sources of human suffering. For instance, in World War I some 16 million people were killed in the war; in the same period there were roughly 50 million people who died of the 1918 Spanish Influenza pandemic. This illustrates the huge and growing role of biological threats in our global security landscape.

Slide 6

Here we can look at a history of just a few past pandemics and compare to. The Black Death brought about in 1347 by Yersinia Pestis, and H1N1 Influenza increased in, much more modern history. What has changed is that there has been not only changes in the threats but also changes
in human mobility and other factors that are making pandemics more difficult to combat and contain. Even despite the improved number and efficacy of tools available, like vaccines and therapies. So this threat is evolving along with our societies.

Slide 7
But, biological threats don’t only involve and don’t only threaten humans. Many of these types of infectious diseases find reservoirs in animal populations one example here are bats, which are a reservoir for several highly pathogenic viruses, including Ebola, SARS, MERS, and Nipah viruses.

Other animals and plants—including those that we rely upon for food—can also be threatened by biology threats. Two examples are the black footed ferret, which is a critically endangered species and highly susceptible to Sylvatic Plague, and the American chestnut which was nearly wiped out due to fungal blight.

One Health is an increasingly popular framework and approach to biosecurity that acknowledges the connection between the security of humans and the health and welfare of other plants and animals.

Slide 8
Now, we’ve only been talking about the types of biological threats that might emerge naturally. There are other sources of threats, including those arise from people that might be interested in using the power of biology for intentional harm. There is a long history of humans using biology as a tool or a weapon during conflict, including biological weapons development programs in the United States and elsewhere. On the left hand side is an image of American soldiers preparing for the potential use of chemical and biological weapons. Other countries, such as the Soviet Union, have pursued biological weapons programs as well, even after there were international agreements in place not to develop those weapons.

Slide 9
Not just countries but individuals and organizations have also been inspired to use the power of biology for harm. On the left are the so-called Amerithrax letters which were mailed in the wake of 911, killing five people and infecting 17 more. While this killed relatively few people, they scared many and they fundamentally reshaped how we think about biological threats and their potential to cause widespread harm and concern. Another case was a group called Aum Shinrikyo, that wanted and pursued biological weapons for terror, but in their case they were not successful. Regardless, the idea that biology might be used for harm against other people has been a feature of our pasts, and may be a feature of our future.

Slide 10
Another area that we need to consider is the possibility for accidents. We are constantly—across many areas of science, engineering and public health—trying to understand the evolving threat landscape and develop solutions that counter those biological threats.
But this work to mitigate threats can be dangerous in itself, especially when research involves studying dangerous pathogens where potential accidents could be harmful.

For example, research conducted to develop defenses against both SARS and anthrax both have a history of laboratory accidents. In the case of SARS, those accidents resulted in several additional epidemics after the initial pandemic subsided.

**Slide 11**

One of the areas of my work studies is how advances in science and technology can be coupled to the development of new biological threats, but also help us with new tools and strategies to mitigate against them. Some of the tools that are making it easier to also develop biological security strategies include tools for editing, reading, and writing DNA and other nucleic acids, the underlying code of biology.

Some technological innovations, some of which are linked to our SARS-CoV-2 response, have generated renewed interest and optimism for more rapid diagnostics and vaccine development in the future.

There are also concerns that those same technologies might enable the development of even more severe biological threats that might be used by a broader set of people.

We often refer to this as the dual use dilemma: advances that offer a promise for help, but also a potential for harm.

**Slide 12**

One example of the dual-use dilemma is the ability to reconstruct a pathogen so that it can be researched to develop defenses against potential pathogens of the future.

One study that caused some controversy was the reconstruction of the 1918 influenza.

Researchers used these tools of reading, writing, editing evolving DNA—in this case being able to synthesize and assemble an extinct virus—then they wanted to publish their methods.

This caused a controversy surrounding whether or not we should be sharing information of this type and whether or not research of this nature makes us more secure or more vulnerable.

In this case, the decision, after much debate, was to publish.

**Slide 13**

We can see how each of the threat types we’ve discussed were considered in the response to SARS-CoV-2. There were early attempts to explore the pathways of zoonosis, to conspiracies surrounding its potential role in a bioweapons program, to concern about its potential escape from a research laboratory; to the dual use nature of technologies and techniques developed to respond to the crisis, SARS-CoV-2 provoked intense debate over the nature of its threat.

What is important to recognize is that these different threats are related and there is often uncertainty around where threats emerge that may not be resolved, but we still have to prepare and respond for a spectrum of future possibilities.
Slide 14

So what are some of our protections against biological threats? Some protections exist at the level of policies. The Biological Weapons Convention is arguably the most important.

Countries came together and decided that it would be in everyone’s best interest not to pursue these dangerous weapons. This treaty is probably the most important policy ensuring we can benefit from the peaceful purposes for biology.

Take this image of the 1969 United Nations Conference on Disarmament and contrast it with this image from the 2019 Meeting of States Parties, where nearly every country in the world has agreed to the Convention. This should be indicative of the importance of international norms around biological weapons non-proliferation. It not only protects against threats but also protects the possibility to pursue biology for peaceful purposes. However, we always have to safeguard against the development of biological weapons, because they have been pursued in the past despite a country’s agreement to the Convention.

Slide 15

While we do not have an offensive biological weapons program in the U.S., the U.S. and other countries still conduct defensive research to protect against threats. Some of the facilities for this research, Fort Detrick and a new National Bio and Agro-Defense facility, are shown here.

The research conducted at these latter are aimed at protecting against weapons that might be used, not against humans, but against the agriculture that humans rely upon to feed ourselves.

The SARS-CoV-2 pandemic has made other health security strategies for a range of potential threats, like public health messaging, more familiar. Our public health infrastructure is vital in protecting against biological threats, many of which come in the form of human pathogens.

Slide 16

Another set of safeguards that we have in maintaining the safety and security of research laboratories working to understand highly dangerous human and animal pathogens.

We have developed and refined an increasingly sophisticated system of facility biosafety levels, which are assigned depending on how dangerous the pathogen being researched is and whether or not we have existing tools to counter it. One of the highest biosafety level labs here is shown on the right, which includes many different elements that protect both the researchers working within the lab, and the communities in which these labs are situated. Securing these facilities is itself an interesting and important design challenge.

Slide 17

There are also policies that have been put in place to try to deal with the dual-use dilemma around potentially risky research. One approach has outlined both the most dangerous known biological agents, as well as dangerous experiments—for example, research that might take a dangerous biological agent and modify it to escape known countermeasures. Lists become less effective over time unless they are updated regularly and they also need to adapt to our increasing ability to understand and engineer living systems; how we define the landscape of security concerns is an ongoing challenge and something that we actively work on in my group.
Slide 18
Innovations in biotechnology in science and engineering also are enabling us to come up with new tools to both understand and mitigate biological threats. You may have received one of the new MRNA vaccines. That’s a new vaccine technology now deployed in many places across the world in response to SARS-CoV-2, one of which recently received full FDA approval in the U.S. It’s a remarkable achievement. This can open up the possibility for other vaccines against other threats. We can also imagine other types of vaccines and therapies that could be developed. How might these technologies might change the ways we respond to future pandemics.

Slide 19
One thing these technologies may enable us to do is completely eliminate some types of biological threats. One historical example is smallpox, one of the pathogens we mentioned earlier, which thanks to a huge global campaign was successfully eradicated by 1980.

New vaccine strategies alongside preventative policies like the Biological Weapons Convention and strategies to address dual use concerns may enable us to potentially avoid even more potential threats.

Slide 20
Which leads me to my last point, and one of the reasons that we’re here today is because the most important defenses we have against biological threats are people. We need great leaders and thinkers who are helping us to navigate towards a future where we are much safer and much more secure, and not more vulnerable. This is one of the reasons I am very grateful to be able to work with people like Katherine here as we think about what challenges we will need to face tomorrow. Katherine I would love if you help us think about what we should be doing here today and in the future.

Katherine Healzer:

Slide 21
Thank you, Dr. Palmer.

We live in an era where biological innovation and discovery have never been more prominent. When approached with optimism and humility, scientific discovery is one of the most powerful forces to improve human life. We should celebrate innovations that seek to make our planet safe, including technologies that help mitigate climate change, provide health diagnostics and screening, and prepare for the next pandemic. However, we must see each discovery through the lens of biosecurity to understand how these innovations may add to, not just subtract from, the threat landscape. Before the pandemic, biosecurity may have felt distant, but now we see how it touches all of us. We are all partners in protecting our planet and ensuring that future generations have a healthy and safe place to live.
Slide 22

As students and community members, how can we help? By conducting data-driven science, we can help craft innovative solutions to the issues that threaten our welfare and the security of our world. Biosecurity also depends on social responsibility; and there are four strategies we can participate in at any level. Starting with global health security, you can do your part by getting vaccinated and sharing accurate information from reliable sources with others and on social media to help protect your communities. You can form a community team or school club to learn about biosecurity and how you can help prepare for, respond to, and recover from public health threats.

You can also learn about biology and biotechnology. For example, you can participate as a team Member in iGEM, an international competition dedicated to the advancement of synthetic biology through fostering the values of community, collaboration, and security.

Finally, you can stay informed on new developments in the life sciences and biotechnology, and consider how they relate to issues in your local community. Think globally and act locally.

For those interested in a career in biosecurity, the good news is that it occurs at the intersection of so many different fields of study, including bioengineering, policy, medicine, ethics, law, and so many more, and you can contribute to the field from each of these different disciplines.

End slide

Thanks Katherine and thank you for having us today. I hope that you have learned how much biological threats have shaped our world not only today but in our past. And how we need to continue to attend to them in the future and how biology itself can be an important tool in our toolbox as we look to shaping a future in which biology makes us more safe, more secure and live better lives and not a biological threat that is making us more vulnerable. Thank you so much!