Planet Depos®
We Make It Happen™

Transcript of James J. Moon, Ph.D.

Date: September 13, 2024
Case: BioNTech SE and Pfizer, Inc. -v- Moderna TX, Inc. (PTAB)

Planet Depos
Phone: 888.433.3767
Email: transcripts@planetdepos.com
www.planetdepos.com

Moderna 2254
BioNTech-Pfizer v. Moderna
IPR2023-01359

1

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

BIONTECH SE AND PFIZER INC.,

Petitioners,

v.

MODERNA TX, INC.,

Patent Owner.

IPR2023-01359

U.S. Patent 10,933,127

DEPOSITION OF JAMES J. MOON, PH.D.

Washington, D.C.

Friday, September 13, 2024

9:05 a.m.

Job No. 553401

Pages 1 - 90

Reported by: Joan V. Cain

2

Deposition of JAMES J. MOON, PH.D., held at the law offices of:

WILLIAMS & CONNOLLY LLP
680 Maine Ave Southwest
Washington, D.C. 20024
(202) 434 5000

Pursuant to Notice, before Joan V. Cain, Court Reporter and Notary Public in and for the District of Columbia.

3

A P P E A R A N C E S

ON BEHALF OF PETITIONER BIONTECH SE:

RYAN MEUTH, ESQUIRE
ASHLEY N. MAYS-WILLIAMS, Ph.D., ESQUIRE
PAUL HASTINGS, LLP
200 Park Avenue
New York, New York 10166
Telephone: (212) 318-600
E-mail: ryanmeuth@paulhastings.com
ashleymayswilliams@paulhastings.com

-AND-

CHETAN R. BANSAL, ESQUIRE
PAUL HASTINGS, LLP
2050 M Street, Northwest
Washington, D.C. 20036
Telephone: (202) 551-1700
Email: chetanbansal@paulhastings.com

4

A P P E A R A N C E S C O N T I N U E D

ON BEHALF OF PETITIONER PFIZER INC.:

MICHAEL XUN LIU, ESQUIRE
KATHRYN SCHLECKSER KAYALI, ESQUIRE
WILLIAMS & CONNOLLY LLP
680 Maine Avenue, Southwest
Washington, D.C. 20024
Telephone: (202) 434-5000
E-mail: mliu@wc.com
kkayali@wc.com

ON BEHALF OF PATENT OWNER MODERNA TX, INC.:

ANDREW J. DANFORD, ESQUIRE
WILMER CUTLER PICKERING HALE AND DORR LLP
60 State Street
Boston, Massachusetts 02109
Telephone: (617) 526-6000
E-mail: andrew.danford@wilmerhale.com

5

A P P E A R A N C E S C O N T I N U E D

ALSO PRESENT:

Rebecca Hilger, Esquire, BioNTech SE
Jacob D. Moore, Ph.D., Esquire
Senior Counsel, Intellectual Property
Moderna TX, Inc.

6

C O N T E N T S

EXAMINATION OF JAMES J. MOON, PH.D. PAGE
By Mr. Danford 9

E X H I B I T S

BIONTECH-PFIZER PREVIOUSLY MARKED EXHIBITS

		REFERENCED
EXHIBIT 1004	Declaration of James J. Moon, Ph.D. for U.S. Patent No. 10,933,127, 8/25/23	10
EXHIBIT 1004	Declaration of James J. Moon, Ph.D. for U.S. Patent No. 10,702,600, 8/25/23	10
EXHIBIT 1009	U.S. Patent Application Publication No. US 2013/0266640 A1	33
EXHIBIT 1010	International Patent Application No. WO 2012/006369 A2, 1/12/12	68

7

E X H I B I T S C O N T I N U E D

BIONTECH-PFIZER PREVIOUSLY MARKED EXHIBITS

		REFERENCED
EXHIBIT 1161	Responsive Declaration of James J. Moon, Ph.D. for U.S. Patent No. 10,933,127, 8/30/24	10
EXHIBIT 1161	Responsive Declaration of James J. Moon, Ph.D. for U.S. Patent No. 10,702,600, 8/30/24	10

8

E X H I B I T S C O N T I N U E D

MODERNA PREVIOUSLY MARKED EXHIBITS

		REFERENCED
EXHIBIT 2024	Scholarly Article: A Novel, Disruptive Vaccination Technology, Self-Adjuvanted RNActive Vaccines, Kallen, et al., October 2013	49
EXHIBIT 2077	Scholarly Article: Biomaterials for Nanoparticle Vaccine Delivery Systems, Sahdev, et al., 5/22/14	79
EXHIBIT 2078	Scholarly Article: Non-viral COVID-19 Vaccine Delivery Systems, Moon, et al., 10/10/20	74

9

1 P R O C E E D I N G S
2 - - -
3 9:05 a.m. EDT
4 September 13, 2024
5 - - -
6 Whereupon,
7 JAMES J. MOON, PH.D.,
8 having been duly sworn under penalties of perjury by
9 the Notary Public, was examined and did testify as
10 follows:
11 EXAMINATION BY COUNSEL FOR PATENT OWNER
12 MODERNA TX, INC.
13 BY MR. DANFORD:
14 Q Good morning. Could you please state your
15 name for the record.
16 **A James Moon.**
17 Q Dr. Moon, it's nice to meet you. My name's
18 Andrew Danford. I'm one of the lawyers representing
19 Moderna.
20 You understand that you're under oath?
21 **A Yes.**
22 Q And is there any reason that you cannot

10

1 provide complete and accurate testimony today?
2 **A No.**
3 Q I see you've brought some materials with
4 you. What did you bring with you today?
5 **A These are declaration -- the original**
6 **declaration for patent '127 and the responsive**
7 **declaration for the same patent. The original**
8 **declaration for '600 patent, as well as my**
9 **responsive declaration for the same.**
10 Q Okay. And those are clean copies of those
11 declarations?
12 **A Yes, they are.**
13 Q Did you bring any other materials with you
14 today?
15 **A No.**
16 Q So let me start by asking about the
17 original declarations that you submitted. You
18 submitted those declarations back in August of 2023,
19 correct?
20 **A Yes, they were submitted back in August of**
21 **2023.**
22 Q You've reviewed those declarations since

11

1 submitting them, correct?
2 **A Yes, I have reviewed them.**
3 Q And you stand by what you said in your
4 August 2023 declarations for these proceedings?
5 **A Yes.**
6 Q Now, you previously gave a deposition in
7 this proceeding, correct?
8 **A Yes, I have.**
9 Q And have you reviewed the transcript of
10 your deposition testimony?
11 **A Yes, I have.**
12 Q And do you stand by what you said at your
13 prior deposition in this proceeding?
14 **A Yes.**
15 Q Okay. And now you've also submitted
16 responsive declarations in these proceedings,
17 correct?
18 **A Yes.**
19 Q And you stand by what you said in those
20 responsive declarations?
21 **A Yes.**
22 Q So let me direct your attention to your

12

1 responsive declaration and around paragraph 10.
2 **A For which patent?**
3 Q I think it doesn't matter. Whichever one
4 you have convenient to you.
5 **A Okay. I'm looking at paragraph 10.**
6 Q All right. And this is in a section of
7 your responsive declaration that discusses your
8 background and qualifications, correct?
9 **A In this paragraph, I discuss my background**
10 **and expertise in delivery of nucleic acids.**
11 Q And you specifically discuss your
12 postdoctoral work on the design and development of
13 nanoparticles for vaccine applications, correct?
14 **A Yes. I stated here: "For example, during**
15 **my postdoctoral work, I focused primarily on the**
16 **design and development of nanoparticles for vaccine**
17 **applications."**
18 Q What vaccines did your postdoctoral work
19 relate to?
20 **A As I mentioned in the other sentence: "I**
21 **designed and developed various nanoparticles,**
22 **including lipid-based nanoparticles, to deliver**

13

1 **immunogens and immunostimulatory agents for**
2 vaccination against the various pathogens (including
3 malaria sporozoites...HIV) and cancer.
4 Q And were any of those vaccines nucleic acid
5 vaccines?
6 **A I've worked with nucleic acids during my**
7 **postdoctoral work, and that is one of the -- and**
8 **I've published on the use of nanoparticles for**
9 **delivering nucleic acids.**
10 Q Sure. And just focusing on the vaccines,
11 and you mention them in paragraph 10, and you gave
12 some examples of what the targets for those vaccines
13 were.
14 Were any of those vaccines nucleic acid
15 vaccines?
16 **A I worked on many different vaccine**
17 **formulations over the years, including peptides,**
18 **proteins, as well as nucleic acid-based vaccines.**
19 Q Which nucleic acid-based vaccines have you
20 worked on?
21 **A Could you specify your question?**
22 Q Sure.

14

1 You said that you've worked on nucleic acid
2 vaccines, correct?
3 **A Yes, I've worked on nucleic acid vaccines.**
4 Q What are those nucleic acid vaccines that
5 you've worked on?
6 **A I've worked on nucleic acid vaccines,**
7 **including mRNA.**
8 Q And what was the disease that was being
9 targeted by that nucleic acid vaccine that you
10 worked on?
11 **A I've worked on nucleic acid vaccines for**
12 **cancer, as well as other diseases.**
13 Q And when did you do that work on those
14 nucleic acid vaccines?
15 **A I've worked on many different projects over**
16 **the years on many different vaccine areas, and, in**
17 **particular, against malaria sporozoites and HIV.**
18 Q The malaria sporozoites and HIV vaccines
19 were nucleic acid vaccines?
20 **A In particular, during my postdoctoral work,**
21 **we used peptides and proteins for malaria**
22 **sporozoites and HIV, but I also worked on nucleic**

15

1 **acid delivery technologies during my postdoctoral**
2 **work.**
3 Q Okay. But those nucleic acid delivery
4 technologies were not in connection with a
5 particular vaccine project, correct?
6 MR. LIU: Objection. Form.
7 THE WITNESS: Over the years, I've worked
8 on lipid-based nanoparticles for delivering nucleic
9 acids as well. And they are targeted against
10 cancer, as well as other diseases.
11 BY MR. DANFORD:
12 Q When you described the vaccines against
13 cancer in paragraph 10, were you talking about
14 nucleic acid-based vaccines?
15 **A Yes, I've worked on nucleic acid -- nucleic**
16 **acid-based nanoparticle vaccines for various**
17 **diseases, including cancer.**
18 Q Okay. And what was your role with respect
19 to that research?
20 **A I supervise my research lab as a principal**
21 **investigator. So, therefore, I oversee all aspects**
22 **of the research, including the design of the**

16

1 **vaccines, in vitro work, in vivo work, as well as**
2 **interpretation of the data from those experiments.**
3 Q Let me just try to get more specific.
4 How many nucleic acid vaccines have you
5 personally worked on?
6 **A Could you specify your question?**
7 Q Sure.
8 Did you have -- have you had personal
9 involvement in developing a nucleic acid vaccine?
10 **A Yes. I have designed and directed my**
11 **research group to perform research on nucleic**
12 **acid-based vaccines.**
13 Q And how many nucleic acid-based vaccines
14 have you personally been involved with the research
15 for?
16 **A There are many different nucleic acid-based**
17 **formulations that I have worked on. I'm not able to**
18 **count all the numbers at this moment.**
19 Q All right. But not focusing on the
20 formulations, but on specific vaccine candidates,
21 how many specific vaccine candidates using nucleic
22 acid technologies have you personally worked on?

17

1 **A It's too many to count because, in my**
2 **research, we begin the study by screening different**
3 **nucleic acid-based formulations for subsequent in**
4 **vivo and in vitro work. So we screen many different**
5 **candidates and then select them for subsequent**
6 **animal studies.**
7 Q What type of nucleic acids have you --
8 strike that.
9 When you've personally been involved in the
10 work on a nucleic acid vaccine, what type of nucleic
11 acids were used with those vaccines?
12 **A I have used mRNA-based vaccines**
13 **encapsulated in lipid-based nanoparticles for**
14 **various biomedical applications, including vaccines.**
15 Q Besides mRNA, have you had experience
16 personally working on any other -- vaccines using
17 other nucleic acid technologies?
18 **A I've worked on siRNA-based systems, but the**
19 **target application was very broad, not necessarily**
20 **solely focused on vaccines.**
21 Q Is siRNA used for vaccination?
22 **A In general, siRNA is not widely used for**

18

1 **vaccination, but we were developing a platform --**
2 **lipid-based nanoparticles, as well as other**
3 **nanoparticles for delivering siRNA.**
4 Q As of 2015, what types of nucleic acids
5 were being studied for use as vaccines?
6 **A I know at least self-amplifying RNA, as**
7 **well as mRNA were candidates that we examined for**
8 **vaccine applications as of 2015.**
9 Q What about DNA? Was DNA being studied for
10 use as a vaccine as of 2015?
11 **A Yes. DNA-based vaccines were one of the**
12 **candidates for vaccine applications as of 2015.**
13 Q Can you think of any other type of nucleic
14 acid that would have been studied as of 2015 as a
15 vaccine candidate?
16 **A I think those three are the most prominent**
17 **nucleic acid-based vaccine candidates as of 2015.**
18 Q And have you ever personally worked on a
19 DNA vaccine?
20 **A Yes, I've worked on DNA-based vaccine**
21 **platforms.**
22 Q What was the -- strike that.

19

1 When did you do that work?
2 **A During my postdoctoral work, one of the**
3 **projects were using DNA-based nanoparticles for**
4 **transfection.**
5 Q Besides that work, have you ever personally
6 conducted research on a DNA-based vaccine?
7 **A Yes, we have designed other lipid-based**
8 **nanoparticles and tested them using DNA plasmid as a**
9 **potential vaccine candidates.**
10 Q Now, you also mentioned saRNA. Do you
11 recall that?
12 **A Yes, I mentioned self-amplifying RNA was**
13 **one of the candidates for vaccine applications as of**
14 **2015.**
15 Q And have you personally worked on an saRNA
16 vaccine?
17 **A I have not worked on saRNA vaccine.**
18 Q Are you familiar with what saRNA is?
19 **A I'm familiar with what saRNA is.**
20 Q What is saRNA?
21 **A As the name suggests, self-amplifying RNA**
22 **is able to replicate itself within cells, producing**

20

1 **proteins as a result of transfection.**
2 Q How is saRNA different from mRNA?
3 **A saRNA is a type of mRNA.**
4 Q Does saRNA function differently from mRNA?
5 MR. LIU: Objection. Foundation. Form.
6 THE WITNESS: As I mentioned, saRNA is a
7 type of mRNA, and I described what saRNA does. So
8 saRNA is, yeah, a type of mRNA.
9 BY MR. DANFORD:
10 Q And when you -- you were talking about mRNA
11 vaccines that you've done in your own research,
12 correct? You said that you had worked on mRNA
13 vaccines?
14 **A Yes, I've worked on mRNA vaccines.**
15 Q Okay. And those mRNA vaccines didn't have
16 the self-replication feature of saRNA, correct?
17 **A The mRNA candidates that I've worked on did**
18 **not have self-amplifying function of saRNA.**
19 Q Now, in paragraph 12 of your responsive
20 declaration, you mention work on Simian
21 Immunodeficiency Virus.
22 Do you see that?

21

1 A **Yes, I see that.**
2 Q And that was another vaccine candidate that
3 you worked on?
4 A **Yes, that was another candidate that my lab**
5 **has worked on.**
6 Q And was the Simian Immunodeficiency Virus a
7 nucleic acid vaccine?
8 A **No, it was not nucleic acid-based vaccine.**
9 Q What was the technology used in the Simian
10 Immunodeficiency Virus vaccine?
11 A **It was a peptide-based vaccine delivery**
12 **platform based on lipid nanoparticles.**
13 Q Now, you provided a technology overview in
14 your original declaration submitted in this
15 proceeding, correct?
16 A **Yes, I have provided technology overview in**
17 **the original report.**
18 Q Okay. And that technology overview
19 addressed lipid nanoparticle delivery technologies,
20 correct?
21 A **Yes, I discussed lipid-based nanoparticles**
22 **in the technology overview section of my original**

22

1 **report.**
2 Q Why did your technology overview address
3 lipid nanoparticle technology?
4 A **Lipid nanoparticles are promising**
5 **candidates for vaccine applications, including for**
6 **nucleic acid-based vaccines; therefore, I covered**
7 **this technology in my technology overview section.**
8 Q Now, were lipid nanoparticles, as of 2015,
9 the only delivery technology for nucleic acids that
10 was known?
11 A **There were other candidates for delivery of**
12 **nucleic acids as of 2015.**
13 Q And you did not discuss any of those other
14 delivery technologies in your original declaration,
15 correct?
16 A **As of 2015, lipid-based nanoparticle was**
17 **one of the most prominent candidate for nucleic acid**
18 **delivery, so I covered LNPs in my original report.**
19 Q And you did not discuss any other delivery
20 technologies that were known as of 2015 for nucleic
21 acids, correct?
22 MR. LIU: Objection. Asked and answered.

23

1 THE WITNESS: In paragraph 24 I mention
2 SNALPs, solid nucleic acid lipid particles, which
3 were a family of LNPs, and I also mention liposomes,
4 which are lipid-based nanoparticles, and liposomes
5 and LNPs are terminologies that have been used
6 interchangeably in the past.
7 I also mentioned, in paragraph 25,
8 nanostructured lipid carriers, NLCs, and cubosomes.
9 Once again, LNPs were one of the most prominent
10 technologies for delivering nucleic acid as of 2015.
11 So that's reason why I covered LNPs in my report.
12 BY MR. DANFORD:
13 Q Now, in 2015, a person of ordinary skill in
14 the art would have been aware of other delivery
15 technologies for nucleic acids besides lipid
16 nanoparticles, correct?
17 A **A POSA, as of 2015, would have understood**
18 **that there are various candidates for delivery of**
19 **nucleic acids.**
20 Q Okay. What were some of those other
21 candidates that were not lipid nanoparticle
22 technologies that would have been available to a

24

1 person of ordinary skill in the art as of 2015?
2 A **There were research groups that are using**
3 **other polymer systems for delivering nucleic acids.**
4 Q Is PLGA an example of a polymer system for
5 delivering nucleic acids?
6 A **There were some groups using PLGA as a**
7 **delivery of drug delivery applications. A subset of**
8 **the groups may have used PLGA for delivering nucleic**
9 **acids. But what I meant by polymer systems were**
10 **more general than PLGA. There are many groups that**
11 **are using cationic polymers, positively charged**
12 **polymers, to deliver nucleic acids.**
13 Q And as of 2015, those polymer-based
14 technologies were being studied by many groups,
15 correct?
16 A **There were research groups that were using**
17 **polymer-based systems for delivering nucleic acids**
18 **as of 2015.**
19 Q Okay. And besides those polymer-based
20 technologies, what other delivery technologies for
21 nucleic acids would have been known to a person of
22 ordinary skill in the art in 2015?

25

1 **A Some research groups were using cationic**
2 **peptides to deliver nucleic acids. Some were using**
3 **protamine for delivering nucleic acids as of 2015.**
4 Q Is protamine a cationic peptide?
5 **A Protamine is a cationic peptide-based**
6 **polymer that have been used for delivering primarily**
7 **DNA.**
8 Q And those cationic peptide-based delivery
9 systems would have been known as a potential
10 technology for delivering nucleic acids to a person
11 of ordinary skill in 2015, correct?
12 MR. LIU: Objection. Form.
13 THE WITNESS: As I mentioned, as a POSA
14 back in 2015, you'd have understood that there were
15 many candidates for delivering nucleic acids,
16 including those candidates that I mentioned, but LNP
17 was one of the most prominent technologies among
18 them.
19 BY MR. DANFORD:
20 Q Why didn't you discuss those other delivery
21 technologies that would have been known to a person
22 of ordinary skill in the art in your technology

26

1 overview?
2 **A As I wrote in paragraph 19 of my original**
3 **report, when I presented the lipid nanoparticle**
4 **technologies, I stated that: "This section is not**
5 **intended to be technically comprehensive, but rather**
6 **provide a foundation for the [sic] better**
7 **understanding of [sic] disclosures related to the**
8 **[sic] lipid delivery systems in the '127 patent and**
9 **prior art, including certain terminology."**
10 Q Did you not think that it would be
11 important to discuss all of the options that would
12 have been available to a person of ordinary skill in
13 the art as of 2015?
14 MR. LIU: Objection. Objection, form.
15 Asked and answered.
16 THE WITNESS: As I wrote here: "This
17 section is not intended to be technically
18 comprehensive, but rather provide a foundation for
19 better understanding the disclosures related to
20 lipid delivery systems in the '127 patent and prior
21 art, including certain terminology."
22 BY MR. DANFORD:

27

1 Q So you focused on lipid nanoparticle
2 technology because that was what was disclosed in
3 the '127 patent?
4 MR. LIU: Objection. Mischaracterizes the
5 witness's testimony.
6 THE WITNESS: "This section is not intended
7 to be technically comprehensive..." and I covered
8 LNP because it's -- it was considered one of the
9 most prominent technologies for nucleic acid
10 delivery.
11 BY MR. DANFORD:
12 Q Now, if we could go back to your reply
13 declaration, and specifically I'm looking at
14 paragraph 21.
15 **A Okay.**
16 Q In paragraph 21 you respond to the opinions
17 that were offered by Dr. Warren Chan in these
18 proceedings, correct?
19 **A Here in this paragraph, I provided my**
20 **assessment of Dr. Chan's focus on other delivery**
21 **technologies.**
22 Q And it's your opinion that those other

28

1 delivery technologies are not relevant to whether
2 Schrum discloses a lipid nanoparticle mRNA vaccine,
3 correct?
4 **A Schrum disclosed a lipid-based**
5 **nanoparticles for our mRNA vaccine.**
6 Q And it's your opinion that those other
7 delivery technologies that were known in the field
8 are not relevant, correct?
9 MR. LIU: Objection. Mischaracterizes the
10 document.
11 THE WITNESS: "As discussed in my original
12 declaration and below, Schrum expressly instructs
13 the POSA to use lipid nanoparticles as a delivery
14 vehicle for mRNA vaccines."
15 BY MR. DANFORD:
16 Q And it's your opinion that the availability
17 of other delivery technologies is not relevant to
18 whether Schrum discloses a lipid nanoparticle mRNA
19 vaccine, correct?
20 **A As it relates to patent '127, it is my**
21 **opinion that Schrum already disclosed lipid**
22 **nanoparticles for mRNA-based vaccines.**

29

1 Q And why is it that you say -- why is it
2 that you qualified your answer as it relates to the
3 '127 patent?
4 **A As I wrote in my report -- original report,**
5 **paragraph 19, I intended to provide a foundation for**
6 **better understanding the disclosures related to**
7 **lipid delivery systems in the '127 patent and prior**
8 **art, including certain terminology.**
9 Q So your review of the prior art focused on
10 what the '127 patent disclosed, correct?
11 MR. LIU: Objection. Form.
12 Mischaracterized the witness's testimony.
13 THE WITNESS: I reviewed LNPs because LNPs
14 were considered most prominent drug delivery
15 platform for mRNA as of 2015.
16 BY MR. DANFORD:
17 Q Now, you agree that Schrum discloses
18 delivery technologies other than lipid
19 nanoparticles, correct?
20 **A Schrum discloses other technologies other**
21 **than LNPs.**
22 Q And a person of ordinary skill in the art

30

1 reading Schrum would have to choose between the
2 different delivery technologies that are disclosed
3 in that reference, correct?
4 **A A POSA reading Schrum would have understood**
5 **LNPs are prominently featured and discussed in the**
6 **examples in Schrum, but there are other technologies**
7 **that are disclosed in Schrum.**
8 Q And a person of ordinary skill in the art
9 would consider the entirety of Schrum's disclosure,
10 correct?
11 **A A POSA would read entirety of Schrum to**
12 **understand what's being disclosed.**
13 Q And upon reading the entirety of Schrum, a
14 person of ordinary skill in the art would have to
15 choose among the different delivery technologies
16 that are disclosed within that reference, correct?
17 MR. LIU: Objection. Asked and answered.
18 THE WITNESS: Yeah, a POSA would read
19 entirety of Schrum and understand there are
20 different technologies disclosed in Schrum, but it's
21 my opinion that LNP was one of -- the most prominent
22 technology discussed in Schrum.

31

1 BY MR. DANFORD:
2 Q Is it your opinion that the only delivery
3 technology that a person of ordinary skill in the
4 art would have considered for an mRNA vaccine was
5 lipid nanoparticles?
6 **A As I mentioned, there are other drug**
7 **delivery technologies other than LNPs that were**
8 **considered for nucleic acid delivery applications.**
9 Q So you wouldn't agree that lipid
10 nanoparticles were the only delivery technology that
11 a person of ordinary skill in the art would have
12 considered as of 2015, correct?
13 MR. LIU: Objection. Form.
14 THE WITNESS: As of 2015, a POSA would
15 consider various technologies, including LNP, for
16 delivering nucleic acids.
17 BY MR. DANFORD:
18 Q So nucleic acids would be among the things
19 that a person of ordinary skill would have
20 considered, but they would not have been the only
21 thing that a person of ordinary skill in the art
22 would have considered, correct?

32

1 MR. LIU: Objection. Form.
2 THE WITNESS: Could you repeat the
3 question?
4 BY MR. DANFORD:
5 Q LNPs would have been among the delivery
6 technologies that a person of ordinary skill in the
7 art would have considered as of 2015, but LNPs would
8 not have been the only delivery technology that a
9 person of skill in the art would have considered at
10 that time, correct?
11 **A As I mentioned, there were technologies --**
12 **various technologies that had been considered for**
13 **nucleic acid delivery, but LNP was considered one of**
14 **the top candidates as of 2015.**
15 Q Are you familiar with sustained-release
16 formulations?
17 **A Yes, I'm familiar with sustained-release**
18 **formulations.**
19 Q What is a sustained-release formulation?
20 **A As the name suggests, those technologies**
21 **aim to prolong the release of drugs over long period**
22 **of time.**

33

1 Q Are lipid nanoparticles a sustained release
2 technology for mRNA?
3 **A Sustained-release formulations usually**
4 **refer to polymer-based formulations, and as for**
5 **whether LNP fits into that category, I'll have to**
6 **look at exact composition of matter for the LNPs.**
7 **But, in general, LNPs are not considered**
8 **sustained-release formulations.**
9 Q Why don't I put the Schrum reference --
10 I've handed you what's been previously marked in
11 these proceedings as Exhibit 1009.
12 Do you have Exhibit 1009 before you?
13 **A Yes, I see Exhibit 1009.**
14 Q Exhibit 1009 is the Schrum reference,
15 correct?
16 **A Yes, I see Schrum in Exhibit 1009.**
17 Q And this is one of the references that you
18 reviewed in connection with your work for this case?
19 **A Yes, I reviewed this in preparation for my**
20 **report.**
21 Q And you reviewed the Schrum reference in
22 its entirety, correct?

34

1 **A Yes, I reviewed the entire document**
2 **provided here.**
3 Q I want to direct your attention to
4 paragraph 363. If you're looking at the numbers at
5 the top, it's 70. If you're looking at the bottom,
6 it's page 74 of 363.
7 **A Three hundred?**
8 Q 363.
9 **A Okay.**
10 Q And this is a section of the Schrum patent
11 under the heading "Formulations," correct?
12 **A Yes, I see heading "Formulations."**
13 Q And the first sentence of that paragraph
14 states: "The modified nucleic acid, and mmRNA of
15 the invention can be formulated using one or more
16 excipients to" -- there's a colon and then a list of
17 objectives of the formulation.
18 Do you see that?
19 **A Yes, I see that.**
20 Q All right. And the third objective that's
21 listed is to: "Permit the sustained or delayed
22 release (e.g., form a depot formulation of the

35

1 modified nucleic acid, or mmRNA)."
2 Do you see that?
3 **A Yes, I see that.**
4 Q And that goal of obtaining sustained or
5 delayed release is not something that you could
6 achieve with a lipid nanoparticle delivery system,
7 correct?
8 **A Could you repeat the question again?**
9 Q Sure.
10 The goal of obtaining sustained or delayed
11 release is not something that you could achieve with
12 a lipid nanoparticle delivery system, correct?
13 **A That's pretty broad statement, and before**
14 **making my opinion, I'd like to review the data.**
15 Q Are you aware of any example of a sustained
16 or delayed release formulation using lipid
17 nanoparticles?
18 **A One can imagine LNPs could be designed to**
19 **achieve sustained or delayed release, and some**
20 **research groups are trying to achieve sustained or**
21 **delayed release using mRNA.**
22 Q In your declaration, you discuss a

36

1 four-component lipid nanoparticle system, correct?
2 **A Yes, I discuss four-lipid component LNPs.**
3 Q Are you aware of anyone who's ever used one
4 of those four-component lipid nanoparticle delivery
5 systems for a sustained-release formulation?
6 **A I attend many conferences and read papers,**
7 **and I may have come across mRNA-based systems that**
8 **sustain or delay release, but as for which**
9 **technology, I'll need to review the reference to**
10 **give you the answer for whether LNPs were used to**
11 **achieve sustained or delayed release of mRNA.**
12 Q Are you familiar with the term "synthetic
13 nanocarrier"?
14 **A Yes, I'm familiar with the term "synthetic**
15 **nanocarrier."**
16 Q What is a synthetic nanocarrier?
17 **A That refers to nanoparticles that are**
18 **synthesized and designed for delivering drugs.**
19 Q Can synthetic nanocarriers be used with
20 mRNA?
21 **A Yes, synthetic nanocarriers could be used**
22 **with mRNA.**

37

1 Q Okay. And the four-component lipid
2 nanoparticle system that you discuss in your
3 declaration does not involve any synthetic
4 nanocarriers, correct?
5 A Synthetic nanocarrier is a very broad term
6 that describes any nanostructures for drug delivery
7 applications. So it's hard to say LNP does not fall
8 into synthetic nanocarriers.
9 Q The Schrum reference discusses synthetic
10 nanocarriers, correct?
11 A Could you point me to the exact place?
12 Q Sure.
13 Why don't you turn to paragraph 432.
14 A Okay.
15 Q And do you see the paragraph 432 discusses
16 synthetic nanocarriers?
17 A Yes.
18 Q And the Schrum reference cites other patent
19 publications describing synthetic nanocarriers,
20 correct?
21 A Yeah, I see that they cited other
22 references.

38

1 Q Have you gone to look to see what those
2 other cited references disclose?
3 A I don't recall whether I went to check all
4 these references, but in reviewing Schrum, I
5 reviewed references.
6 Q Okay. And do you know whether any of the
7 references in this paragraph refer to lipid
8 nanoparticles?
9 A I don't remember whether these exact
10 references refer to LNPs, but it's clear Schrum
11 mentions LNPs in other sections.
12 Q Okay. And you agree that Schrum discloses
13 delivery technologies other than lipid
14 nanoparticles, correct?
15 MR. LIU: Objection. Asked and answered.
16 THE WITNESS: Schrum discloses LNPs
17 prominently, as well as other drug delivery
18 technologies, including PLGA microspheres.
19 BY MR. DANFORD:
20 Q Are PLGA microspheres an example of a
21 synthetic nanocarrier?
22 A Yes, PLGA nanoparticles would be classified

39

1 as synthetic nanocarrier.
2 Q And the first sentence of paragraph 432 of
3 Schrum states that: "...the synthetic nanocarrier
4 may be formulated for use as a vaccine," correct?
5 A I see that sentence.
6 Q And you agree that a person of ordinary
7 skill in the art could follow the teachings of
8 Schrum to develop a vaccine using a synthetic
9 nanocarrier, correct?
10 A Reading the sentence, POSA would understand
11 that synthetic nanocarriers, including LNPs and
12 PLGA, may be formulated for use as a vaccine.
13 Q Now, you're familiar with the
14 term "encapsulation" in the context of drug
15 delivery, correct?
16 A Yes, I'm familiar with the term
17 "encapsulation."
18 Q What does encapsulation refer to?
19 A Encapsulation usually refers to loading
20 drugs within the formulations.
21 Q Are you familiar with the term
22 "encapsulation efficiency"?

40

1 A Yes, I'm familiar with the
2 term "encapsulation efficiency."
3 Q What is encapsulation efficiency?
4 A That term usually quantifies percent of the
5 drug that's loaded or encapsulated into the carrier.
6 Q Is loading efficiency another term for the
7 same concept?
8 A Yes, those are sometimes used
9 interchangeably.
10 Q Did you review what the Schrum reference
11 disclosed regarding encapsulation of mRNA using
12 PLGA?
13 A I reviewed sections in Schrum where they --
14 where they described using PLGA for mRNA delivery.
15 Q Why don't we look at one of those sections.
16 If you could turn to paragraph 973 of Schrum.
17 MR. LIU: I don't know how long this is
18 going to take, but I just wanted to see if there's a
19 good point for a break.
20 MR. DANFORD: Yeah, let me just finish this
21 up. Because then we can put the reference aside.
22 THE WITNESS: Okay. 973.

41

1 BY MR. DANFORD:
2 Q This is example 15 in the Schrum reference,
3 correct?
4 **A Yes.**
5 Q And the title of that example is "PLGA
6 Microsphere Formulations," correct?
7 **A Correct.**
8 Q And this example in the Schrum reference
9 relates to PLGA microspheres, correct?
10 **A Yes, I see the title "PLGA Microspheres."**
11 Q And this example doesn't involve lipid
12 nanoparticle formulations of mRNA, correct?
13 **A I'll have to read the whole section to**
14 **answer that question.**
15 Q Why don't you familiarize yourself with
16 example 15, and then we can talk about it.
17 **A Okay.**
18 **Okay.**
19 Q Example 15 does not involve lipid
20 nanoparticle formulations, correct?
21 **A I didn't see lipid nanoparticles in example**
22 **15.**

42

1 Q Okay. Now, if you turn to paragraph 982,
2 this section of Schrum discloses the encapsulation
3 efficiency for PLGA formulations of mRNA, correct?
4 **A It discusses loading and encapsulation**
5 **efficiency.**
6 Q And Table 23 beneath that paragraph
7 provides some data on encapsulation efficiency for
8 those PLGA formulations, correct?
9 **A I see encapsulation efficiency reported in**
10 **Table 23.**
11 Q Okay. And Table 23 shows that formulation
12 A achieved encapsulation efficiency of 97.1 percent,
13 correct?
14 **A I see 97.1 percent reported in row A.**
15 Q Schrum discloses that it's possible to
16 encapsulate mRNA using PLGA, correct?
17 **A Schrum shows that PLGA can be used to load**
18 **mRNA.**
19 Q And you agree that a person of ordinary
20 skill in the art would be able to apply Schrum's
21 teachings with respect to PLGA, correct?
22 MR. LIU: Objection, form.

43

1 THE WITNESS: A POSA reading this would
2 have understood how to use PLGA to load mRNA.
3 MR. DANFORD: We can take a break.
4 (Recessed at 10:18 a.m.)
5 (Reconvened at 10:34 a.m.)
6 BY MR. DANFORD:
7 Q Dr. Moon, I just want to come back to your
8 background. We talked earlier about your research
9 on nucleic acid vaccines.
10 Do you recall that?
11 **A Yes, I recall that.**
12 Q Has any of your research on nucleic acid
13 vaccines resulted in publications?
14 **A There are many projects that are ongoing in**
15 **my lab that uses nucleic acids for vaccine**
16 **applications, including mRNA, and we are getting**
17 **ready to publish them soon.**
18 **As for other past projects, whether I**
19 **published them or not, I'll have to review my**
20 **publications. But there are certainly at least**
21 **several manuscripts that we are working on now.**
22 Q And those would be manuscripts relating to

44

1 ongoing work in your lab, correct?
2 **A Those are ongoing work in my lab.**
3 Q And --
4 **A As for prior work, I'll have to review my**
5 **publications to see if we published nucleic**
6 **acid-based vaccines in the past.**
7 Q Do you consider yourself to be an expert in
8 immunology?
9 **A In my lab, we study vaccines and vaccine**
10 **delivery systems.**
11 Q Have you ever measured the immune response
12 to a vaccine?
13 **A Yes. We routinely measure vaccine response**
14 **using animal models.**
15 Q And how do you measure the immune response
16 to a vaccine?
17 **A We immunize animals, for example, collect**
18 **their blood, and analyze their immune cells using**
19 **flow cytometry. We also analyze serum for antibody**
20 **titers, and we also dissect animals and analyze**
21 **various lymphatic tissues for immune activation**
22 **signal.**

45

1 Q And when doing those analyses, what are you
2 looking for?
3 **A We are looking for signs of innate immune**
4 **activation, activation of T-cells and B-cells in**
5 **general.**
6 Q Are there different types of immune
7 responses that a vaccine can induce?
8 **A Could you specify?**
9 Q Sure.
10 You mentioned that you're looking for
11 innate immune activation. What is that?
12 MR. LIU: I'll object to this line of
13 questions as outside the scope of his responsive
14 declaration.
15 THE WITNESS: So vaccines needs to activate
16 innate immune cells for mounting strong immune
17 response, and activation of innate immune activation
18 generally leads to strong T-cell and B-cell
19 activation. So in vaccine studies, we study all of
20 these holistically.
21 BY MR. DANFORD:
22 Q And it's possible that you would see innate

46

1 immune activation without seeing a response in
2 T-cells or B-cells, correct?
3 MR. LIU: Same objection. Outside the
4 scope.
5 THE WITNESS: I guess it depends on the
6 vaccine type, but it's certainly feasible that you
7 get innate immune activation without T-cell
8 activation.
9 BY MR. DANFORD:
10 Q Is inflammation an immune response?
11 **A Inflammation is usually our body's response**
12 **to -- immunological response to external stimuli.**
13 Q And when doing these -- when measuring the
14 immune response to a vaccine, do you look to see
15 whether the vaccine causes inflammation?
16 **A In that context of a vaccine development,**
17 **you'd examine innate immune activation, T-cell**
18 **activation, B-cell activation, and when --**
19 **generally, when you refer to inflammation, that's**
20 **side effects in the studying of vaccines.**
21 Q In the studies that you've done, have you
22 done any testing to determine whether the vaccine

47

1 causes inflammation?
2 **A Yes, we have done that.**
3 Q And what do you look for to determine
4 whether a vaccine causes inflammation?
5 **A For example, in animal studies, you can**
6 **examine the injection sites for any signs of**
7 **swelling, redness. You can also section tissues and**
8 **study immune cell infiltrates into skin. You could**
9 **also collect blood and analyze for markers of**
10 **inflammation.**
11 Q And is inflammation an immune response?
12 **A Inflammation is generally thought to be**
13 **driven by post-immune response.**
14 Q And you could observe inflammation without
15 activating T-cells or B-cells, correct?
16 MR. LIU: Objection. Asked and answered.
17 Outside the scope.
18 THE WITNESS: That's a very general
19 statement that I need to review data for.
20 BY MR. DANFORD:
21 Q Okay. But as a general proposition, that
22 is possible, that you could see one type of immune

48

1 response without observing another, correct?
2 MR. LIU: Objection. Asked and answered.
3 Outside the scope.
4 THE WITNESS: I assume some vaccines could
5 elicit various immune responses, yeah.
6 BY MR. DANFORD:
7 Q Now, let's come back to talk about some of
8 the delivery technologies we've been talking about.
9 One that you mentioned earlier is protamine,
10 correct?
11 **A Yes, I mentioned protamine.**
12 Q Okay. And protamine is a different
13 delivery technology from lipid nanoparticles,
14 correct?
15 **A Protamine is a different drug delivery**
16 **platform than LNPs.**
17 Q And by 2015, protamine had been used to
18 formulate mRNA vaccines for infectious disease,
19 correct?
20 **A I'll have to check references on that, but**
21 **I know protamine had been used to deliver DNA by**
22 **2025 -- I mean 2015.**

49

1 Q 2015.
2 **A Yeah.**
3 Q I'll just hand you this document, which has
4 been previously marked as Exhibit 2024 in these
5 proceedings.
6 Do you recognize Exhibit 2024?
7 **A I see this is a research article from**
8 **CureVac.**
9 Q The date of this article is October 2013,
10 correct?
11 **A This was published in October 2013.**
12 Q And the title of the article is "A Novel,
13 Disruptive Vaccination Technology," correct?
14 **A I see that as a title.**
15 Q And if you look at the Abstract, the
16 Abstract describes the vaccine that they had
17 developed at CureVac, correct?
18 **A I see they report a vaccine candidate in**
19 **the Abstract.**
20 Q Okay. And the article describes the
21 vaccine candidate as having mRNA that's complexed
22 with protamine, correct?

50

1 **A The Abstract says they are complexed with a**
2 **protamine.**
3 Q And you understand that that's describing a
4 protamine-based delivery system, correct?
5 **A I have to review the whole document, but it**
6 **seems to suggest that they are using protamine to**
7 **complex with mRNA.**
8 Q And this mRNA vaccine was for influenza,
9 correct?
10 **A I see they tested this in influenza models,**
11 **in preclinical models.**
12 Q And this article refers to the vaccine that
13 CureVac was working on as: "...an enticing novel
14 approach to vaccination," correct?
15 **A Where does it say that?**
16 Q In the first sentence of the Abstract.
17 **A I think they're just generally saying**
18 **nucleotide-based vaccines are enticing vaccine**
19 **candidates.**
20 Q And that would include the vaccine
21 candidate that CureVac had developed here, correct?
22 **A As to whether their exact formulation is**

51

1 **enticing, could you refer me to their reports where**
2 **they say that?**
3 Q Well, let me just ask you this: A person
4 of ordinary skill in the art would have been aware
5 of the work done by CureVac to develop an mRNA
6 vaccine using protamine-based technology, correct?
7 **A Yeah, a POSA would have been aware of this**
8 **technology for mRNA delivery.**
9 Q If we could go back to your reply
10 declaration, and I'd like to direct your attention
11 to paragraph 67, please.
12 **A Okay.**
13 Q And in this paragraph, you respond to
14 Dr. Chan's opinions regarding motivation to combine
15 and reasonable expectation of success, correct?
16 **A In this paragraph, I'm stating that a POSA**
17 **would have good reason to formulate mRNA in LNP.**
18 Q And at the end of the paragraph, you state
19 that: "...a POSA would reasonably expect to
20 successfully encapsulate the immunogen-encoding mRNA
21 in a lipid nanoparticle system and to use such a
22 formulation for vaccine applications to induce an

52

1 immune response," correct?
2 **A Yes, I stated that in paragraph 67.**
3 Q And what do you mean when you say that the
4 formulation would induce an immune response?
5 **A A POSA would have understood that when you**
6 **use lipid nanoparticles encapsulating mRNA-encoding**
7 **immunogen, that such platform would induce an immune**
8 **response and that could be measured in, for example,**
9 **animal studies where you collect their blood and**
10 **analyze antibody responses or T-cell responses.**
11 Q Are you aware of any published data as of
12 2015 showing the immune response to a
13 betacoronavirus spike protein encoded by an mRNA
14 vaccine?
15 **A I don't recall any particular paper**
16 **mentioning such results against betacoronavirus as**
17 **of 2015, but I can also say that Schrum used mRNA**
18 **LNPs to successfully translate proteins, and in**
19 **animals, and Schrum also discloses that such system**
20 **can be used for vaccination in Schrum document.**
21 Q There's no data in Schrum showing the
22 immune response to a betacoronavirus spike protein,

53

1 correct?
2 **A In disclosure -- well, in paragraph 397**
3 **Schrum says LNPs loaded with mRNA-encoding immunogen**
4 **could be used for vaccines, and as for whether they**
5 **provided data for that, I don't recall examples**
6 **where they report that.**
7 Q If we could turn to paragraph 98 of your
8 responsive declaration.
9 **A Okay.**
10 Q And this is another paragraph in which you
11 discuss a reasonable expectation of success,
12 correct?
13 **A Yes, I discuss reasonable expectation of**
14 **success.**
15 Q Now, reasonable expectation of success was
16 not an issue that you addressed in your original
17 declaration, correct?
18 MR. LIU: Objection. Mischaracterizes the
19 witness's testimony.
20 THE WITNESS: In my original report, I
21 cited Schrum, as well as Geall, and stated that a
22 POSA reading those documents would have understood

54

1 that LNP delivering nucleic acids could be used as
2 vaccines.
3 BY MR. DANFORD:
4 Q You didn't provide any opinion in your
5 original report that a person of ordinary skill in
6 the art would have had a reasonable expectation of
7 success in producing an immune response, correct?
8 MR. LIU: Same objection.
9 THE WITNESS: As I wrote in paragraph 51 of
10 my original report: "Schrum discloses compositions
11 comprising modified nucleic acids encoding a protein
12 formulated in and delivered via a nanoparticle.
13 Specifically, Schrum teaches that '[t]he modified
14 nucleic acid molecules and mmRNA...of the invention
15 can be formulated using one or more...lipid
16 nanoparticles.' Schrum further teaches that 'the
17 lipid nanoparticle may be formulated for use in a
18 vaccine such as, but not limited to, against a
19 pathogen,'" paragraph 397.
20 BY MR. DANFORD:
21 Q Paragraph 51 of your original report
22 doesn't use the words "reasonable expectation of

55

1 success," correct?
2 **A As to whether I used the exact**
3 **word "expectation of success" in my original report,**
4 **I didn't use that word in that paragraph, but**
5 **overall, I was stating that looking at Schrum, a**
6 **POSA would understand that Schrum is teaching a POSA**
7 **how to use lipid nanoparticles formulated for use in**
8 **a vaccine, such as, but not limited to, against a**
9 **pathogen as taught in paragraph 397.**
10 Q So let's come back to your reply
11 declaration, paragraph 98, where you say that a POSA
12 would reasonably expect that administration of such
13 a composition would result in expression of the
14 betacoronavirus spike protein which would induce
15 some level of an immune response to that encoded
16 immunogen.
17 Do you see that?
18 **A In paragraph 98, I said: "Instead, a POSA**
19 **would have reasonably expected to induce some level**
20 **of immune response using an mRNA vaccine formulated**
21 **in a lipid nanoparticle system."**
22 MR. LIU: Slow down for the court reporter.

56

1 THE WITNESS: Okay.
2 BY MR. DANFORD:
3 Q What do you mean when you say, would induce
4 some level of an immune response to that encoded
5 immunogen?
6 **A Immune response could be measured by**
7 **various means, for example, antibody responses**
8 **against a vaccine candidate or T-cell activation or**
9 **other combinations.**
10 Q And you don't specify in your declaration
11 what that immune response would be, correct?
12 **A On immune response, this, again, can be any**
13 **of these, including antibody responses, T-cell**
14 **activation, and/or B-cell activation, and if you get**
15 **any of these, you could say you get immune response.**
16 Q Is it your opinion that simply expressing
17 an immunogen will always result in a protected
18 immune response?
19 **A Could you define "protected immune**
20 **response"?**
21 Q Sure.
22 When developing a vaccine, what type of

57

1 immune response are you looking for?
2 **A In general, any immune activation,**
3 **including B-cells, antibody response, or T-cells,**
4 **would be considered immune response after**
5 **vaccination.**
6 Q And which of those immune responses provide
7 protection against the disease?
8 MR. LIU: Objection. Form.
9 THE WITNESS: It depends on the pathogens,
10 but in general, if you get any of those responses,
11 you'd say that's a vaccine candidate.
12 BY MR. DANFORD:
13 Q And is it your opinion that simply
14 expressing an antigen will always result in inducing
15 either an antibody response, a T-cell response, or a
16 B-cell response?
17 **A As I wrote below in that paragraph,**
18 **Dr. Fuller stated that: "It's just basic**
19 **fundamental nucleic acid vaccine biology that when**
20 **you have a DNA or an RNA vaccine...you could**
21 **validate that it expresses a protein in vitro, then**
22 **the hypothesis is that if you inject that DNA or RNA**

58

1 **vaccine into an animal, the muscle cell, or in the**
2 **case of gene gun delivery, the skin cell, will**
3 **express that antigen. You can give that antigen to**
4 **express in animal, and the hypothesis is that it**
5 **will elicit an immune response."**
6 Q Is it your opinion that a hypothesis is the
7 same as a reasonable expectation of success?
8 **A A POSA would expect to get immune response**
9 **using mRNA that expresses antigen.**
10 Q Is it your opinion that delivering mRNA
11 that expresses antigen will always result in an
12 immune response?
13 **A A POSA would have reasonable expectation of**
14 **success that when they used mRNA that encodes**
15 **antigens and if they used that to vaccinate or treat**
16 **animals, you'd expect some kind of immune response.**
17 Q And what is that opinion based on? What
18 disclosure in the art as of 2015 are you basing that
19 statement on?
20 **A As Dr. Fuller mentions here, it's just the**
21 **basic fundamental nucleic acid vaccine biology that**
22 **when you have DNA or RNA vaccine that could express**

59

1 **an antigen, then you expect to get some kind of**
2 **immune response in vivo in animals.**
3 Q Putting aside Dr. Fuller's testimony, are
4 you aware of any disclosure in the prior art that
5 supports that opinion?
6 **A I'm aware of at least Geall, where they**
7 **used LNPs delivering nucleic acids and they elicited**
8 **immune responses in vivo.**
9 Q Besides Geall, are you aware of any other
10 disclosure in the prior art supporting that opinion?
11 **A I'm aware of at least the Geall that**
12 **supports that. There may be other references, but**
13 **I'm at least aware of Geall's statement.**
14 Q Why don't you turn to paragraph 44 of your
15 reply declaration.
16 In paragraph 44 you discuss Schrum's
17 working examples, correct?
18 **A Okay. Yeah, we are discussing Schrum's**
19 **working examples in paragraph 44.**
20 Q And you reviewed all of the working
21 examples in Schrum, correct?
22 **A I reviewed all working examples in Schrum.**

60

1 Q None of the working examples in Schrum
2 describe a vaccine, correct?
3 **A Schrum's working examples are focused on**
4 **LNPs delivering mRNA, resulting in strong protein**
5 **expression in vitro and in vivo, and in paragraph**
6 **397, Schrum teaches that the same formulation can be**
7 **used to deliver immunogen-encoding mRNA for vaccine**
8 **applications.**
9 Q So focusing just on the working examples,
10 none of those actually involve a vaccine, correct?
11 MR. LIU: Objection. Asked and answered.
12 THE WITNESS: Schrum is using mRNA encoding
13 various proteins in their working examples, and a
14 POSA reading that would have understood that mRNA
15 encoding immunogen could be used for vaccine
16 applications, and paragraph 397 further highlights
17 that.
18 BY MR. DANFORD:
19 Q Is it your opinion that the delivery of
20 mRNA for therapeutic uses and vaccine uses is
21 identical in all respects?
22 **A Looking at Schrum, a POSA would have**

61

1 **understood that LNP that works well for**
2 **protein-encoding mRNA could be readily used for**
3 **vaccine applications, and POSA would have gone to**
4 **the same LNP formulation disclosed in Schrum to test**
5 **vaccines, as taught by paragraph 397.**
6 Q So it's your opinion that the use of mRNA
7 for therapeutic purposes is completely the same as
8 using mRNA for a vaccine?
9 MR. LIU: Objection. Asked and answered.
10 Mischaracterized the witness's testimony.
11 THE WITNESS: A POSA would have understood
12 that LNP that works well for protein-encoding mRNA
13 would be also good candidate for vaccine
14 applications using immunogen-encoding mRNA.
15 BY MR. DANFORD:
16 Q Okay. And, respectfully, my question was:
17 It's your opinion that the delivery of mRNA for a
18 therapeutic use is completely the same as the
19 delivery of mRNA for a vaccine. Is that your
20 opinion?
21 MR. LIU: Objection. Asked and answered.
22 Mischaracterized the witness's testimony.

62

1 THE WITNESS: As I mentioned, a POSA would
2 have used the same lipid nanoparticles that works
3 well for protein-encoding mRNA as a starting point
4 to test vaccine encoding mRNA. There may be
5 additional tweaks the POSA would make to vaccines
6 work better, but a starting point would be the same
7 LNP because it works well for protein-encoding mRNA.
8 BY MR. DANFORD:
9 Q Are there differences between delivering
10 mRNA for a therapeutic use versus a vaccine?
11 MR. LIU: Objection. Form.
12 THE WITNESS: The top criteria -- one of
13 the criteria for successful mRNA-based applications
14 would be good protein expression, and if LNP that
15 works well for one form of mRNA-encoding protein,
16 that will give a reasonable expectation of success
17 for POSA looking for mRNA that works well for
18 vaccine applications.
19 BY MR. DANFORD:
20 Q But you agree that there are differences
21 between a therapeutic use and a vaccine use of mRNA,
22 correct?

63

1 **A A POSA would have used LNP as working well**
2 **for protein delivery applications to test vaccine**
3 **candidates and with the reasonable expectation of**
4 **success that you'd get immune response. You can do**
5 **further studies from there to make it better by**
6 **making tweaks, but a POSA would have started out**
7 **with the same LNP formulations.**
8 Q And let me just ask you this: For a
9 vaccine use of mRNA, the goal is to induce an immune
10 response, correct?
11 **A For vaccines you'd need to induce immune**
12 **response.**
13 Q For a therapeutic use of mRNA, the goal is
14 not to induce an immune response, correct?
15 **A For therapeutic use of mRNA, you want to**
16 **have good protein expression.**
17 Q An immune response against the therapeutic
18 would be problematic, correct?
19 **A In general, you don't want strong immune**
20 **responses to a protein you're trying to express,**
21 **but, once again, the same LNP that works well for**
22 **protein therapeutics would be a good candidate for a**

64

1 **POSA to test as a platform for vaccine delivery**
2 **applications, and that's what Schrum teaches in**
3 **paragraph 397.**
4 Q Let me direct you to paragraph 72 of your
5 reply declaration.
6 In this paragraph, you discuss increased
7 protein expression that Schrum showed for mRNA
8 formulated in LNPs versus lipoplexes, correct?
9 **A Here I discuss Schrum's example where they**
10 **use LNP and compare that to lipoplex.**
11 Q What is a lipoplex?
12 **A Lipoplex usually refers to lipid vesicles**
13 **that are complexed with mRNA or other nucleic acids.**
14 Q How is a lipoplex different from a lipid
15 nanoparticle?
16 **A A lipoplex does not usually have the four**
17 **lipid components that go into LNPs.**
18 Q Now, you state that: "A POSA would readily
19 recognize that achieving such an increase in the
20 protein expression achieved by mRNA administration
21 would be a significant benefit, as increased
22 immunogen expression could, in turn, improve vaccine

65

1 performance," correct?
2 **A Yes, I stated that there.**
3 Q And what do you mean when you say that:
4 "...increased immunogen expression could, in turn,
5 improve vaccine performance"?
6 **A For successful mRNA vaccine, you want mRNA**
7 **that encodes an immunogen and leads to strong**
8 **antigen expression as a first criterion for antigen**
9 **delivery in vivo. And in this example, Schrum is**
10 **teaching that LNP encapsulating mRNA results in very**
11 **strong protein production in vivo; therefore, a POSA**
12 **would readily recognize that achieving such an**
13 **increase in the protein expression achieved by mRNA**
14 **administration would be a significant benefit**
15 **because increased immunogen expression could, in**
16 **turn, improve vaccine performance by inducing immune**
17 **responses.**
18 Q How does increased immunogen expression
19 improve vaccine performance?
20 MR. LIU: Objection. Asked and answered.
21 THE WITNESS: When immunogen is expressed,
22 our immune cells will recognize the antigen and then

66

1 mount immune response. So for any vaccine
2 candidates, you want to expose immune cells to
3 immunogen so that you can mount immune responses.
4 And what this is teaching is that when you
5 use LNP encapsulating mRNA, you'd get very strong
6 protein production in vivo. Therefore, a POSA would
7 have understood that such LNP resulting in very
8 strong immunogen expression could be a good platform
9 for vaccine applications.
10 BY MR. DANFORD:
11 Q A person of ordinary skill in the art would
12 have been motivated to increase protein production
13 in order to improve vaccine performance, correct?
14 **A A POSA would have used technology that**
15 **results in strong immunogen expression as a basis to**
16 **develop vaccines.**
17 Q If we could turn to paragraph 86 of your
18 reply declaration.
19 In paragraph 86, you address what you
20 perceive to be several challenges for RNA delivery
21 applications using PLGA, correct?
22 **A I discuss challenges associated with the**

67

1 **PLGA for mRNA delivery in paragraph 86.**
2 Q Okay. And you don't cite any prior art
3 references describing those challenges, correct?
4 **A While I did not cite specific references in**
5 **paragraph 86, these are common knowledge among POSA**
6 **working on PLGA drug delivery fields.**
7 Q If you'd go to paragraph 88, you address
8 chitosan, correct?
9 **A Yes, I discuss chitosan.**
10 Q Okay. And you state that chitosan has
11 several major limitations when it comes to mRNA
12 delivery, correct?
13 **A Yes, I highlight several limitations.**
14 Q And you didn't cite any prior art
15 disclosing those limitations, correct?
16 **A I didn't cite references in this paragraph,**
17 **but it's widely known that chitosan has limitations**
18 **when it comes to delivering mRNA in the field of**
19 **drug delivery.**
20 Q In paragraph 89, you discuss protamine
21 delivery systems for mRNA, correct?
22 **A Yes, I discuss protamine.**

68

1 Q And you offer the opinion that there are
2 several disadvantages for the use of protamine
3 delivery for mRNA, correct?
4 **A Yes, I discuss limitations of protamine in**
5 **paragraph 89.**
6 Q You did not cite any prior art in paragraph
7 89 disclosing those disadvantages, correct?
8 **A Yeah, I didn't cite any particular**
9 **reference in paragraph 89 regarding protamine, but**
10 **these are widely known facts among drug delivery**
11 **scientists.**
12 MR. DANFORD: Why don't we take a break
13 before shifting topics here.
14 (Recessed at 11:31 a.m.)
15 (Reconvened at 11:46 a.m.)
16 BY MR. DANFORD:
17 Q Dr. Moon, I've handed you Exhibit 1010. Do
18 you recognize Exhibit 1010?
19 **A Yes, I recognize this document.**
20 Q What is Exhibit 1010?
21 **A It's an international patent application by**
22 **Geall.**

69

1 Q And Exhibit 1010 is one of the references
2 that you considered for this case, correct?
3 **A Yes.**
4 Q If you'd turn to page 31 of Exhibit 1010,
5 at line 3, do you see that there's a heading:
6 "Liposomal encapsulation"?
7 **A Could you repeat the page?**
8 Q It's 31 of the document. I guess it's 32
9 of 57, if you look at the bottom numbers.
10 **A Okay.**
11 Q Are you with me?
12 **A Yes.**
13 Q Okay. And there's a heading: "Liposomal
14 encapsulation," at line 3?
15 **A Yes.**
16 Q And the paragraph under that heading
17 describes liposomes made with four components,
18 correct?
19 **A I see four components listed here.**
20 Q What are the four components of the
21 liposome described in that paragraph?
22 **A So these four lipid components are**

70

1 **ionizable lipids, neutral lipid, cholesterol, and**
2 **PEGylated lipid.**
3 Q And you consider that four-component
4 liposome to be a lipid nanoparticle, correct?
5 **A So the term "liposomes" and "lipid**
6 **nanoparticles" have been used interchangeably over**
7 **the years, and looking at these four lipid**
8 **components, it seems they're describing lipid**
9 **nanoparticles -- what we now call as lipid**
10 **nanoparticles.**
11 Q So your opinion is that the Geall reference
12 discloses lipid nanoparticles, correct?
13 **A In this example, they are using lipid**
14 **nanoparticles.**
15 Q And what are the reasons that you consider
16 the liposomes disclosed in Geall to be lipid
17 nanoparticles?
18 **A In this paragraph shown in page 31, they**
19 **are using four lipid components: ionizable lipid,**
20 **neutral lipid, cholesterol, and PEG lipid to**
21 **encapsulate RNA using T mixer, and that's how,**
22 **generally, LNPs are used to formulate with RNA.**

71

1 Q Is it your opinion that every lipid
2 delivery technology with the same four components,
3 the ionizable lipid, the neutral lipid, cholesterol,
4 and PEG lipid made using a T mixer, is also a lipid
5 nanoparticle?
6 **A I'd have to review the exact formulation**
7 **you are referring to, but, in general, lipid**
8 **nanoparticles nowadays refer to those four lipid**
9 **components leading to nanoparticle system, and that**
10 **can be used for mRNA delivery.**
11 Q Your opinion is that the liposomes
12 disclosed in Geall are the same as the lipid
13 nanoparticles disclosed in the '600 and '127
14 patents, correct?
15 **A So Schrum is using the same lipid**
16 **nanoparticles that are in '127 and '600 patents.**
17 **And in this particular example provided by Geall,**
18 **they are using the same four lipid components to**
19 **formulate RNA into their lipid nanoparticles.**
20 Q So the answer is, yes, your opinion is that
21 the liposomes disclosed in Geall are the same as the
22 lipid nanoparticles disclosed in the '600 and '127

72

1 patents, correct?
2 **A The four lipid components used in this**
3 **particular example shown in Geall falls within the**
4 **specifications that is listed in '127 and '600**
5 **patents. In that patent, they describe four lipid**
6 **components that go into formulations of LNP and**
7 **their ratios, and in this particular example from**
8 **Geall, they are using LNP formulations that fall**
9 **within the specifications of that listed in '127 and**
10 **'600.**
11 Q Now, Pfizer and BioNTech's COVID-19 vaccine
12 uses a four-component LNP, correct?
13 **A Pfizer and BioNTech's COVID-19 vaccine uses**
14 **four lipid components.**
15 Q And those four lipid components are
16 ionizable lipid, a neutral lipid, cholesterol, and a
17 PEGylated lipid, correct?
18 **A The LNP in Pfizer and BioNTech vaccines use**
19 **ionizable lipids, neutral lipids, cholesterol, and**
20 **PEGylated lipid.**
21 Q Pfizer and BioNTech's COVID-19 vaccine uses
22 the same four components as the liposomes disclosed

73

1 in Geall, correct?
2 MR. LIU: Objection. Form. Foundation.
3 THE WITNESS: They are not the same.
4 BY MR. DANFORD:
5 Q Meaning, the individual lipids are
6 different, but the categories are the same?
7 **A Pfizer vaccine does not use the same LNP**
8 **formulation listed here in Geall reference.**
9 Q The Pfizer vaccine uses a cationic lipid,
10 correct?
11 **A My understanding is Pfizer vaccine uses an**
12 **ionizable lipid in their LNP.**
13 Q And the Pfizer vaccine uses a neutral lipid
14 in its LNP, correct?
15 MR. LIU: I'm just going to object to this
16 line of questions as outside the scope of his
17 responsive declaration.
18 THE WITNESS: Yeah, I was not asked to
19 review exact compositions of Pfizer vaccine's LNP.
20 BY MR. DANFORD:
21 Q But you are familiar with the composition
22 of Pfizer's COVID-19 vaccine LNP, correct?

74

1 **A I have not been asked to look at individual**
2 **components that go into LNPs within Pfizer vaccine.**
3 Q But you are familiar, through your work in
4 the field, with the components of Pfizer's LNP,
5 correct?
6 **A I have a general understanding of Pfizer's**
7 **LNP, but as to exact composition and the ratios of**
8 **each components and et cetera, I'll have to review**
9 **the relevant references on that.**
10 Q You've published papers describing the
11 composition of Pfizer's LNP, correct?
12 **A I have published many papers. In one of**
13 **the review articles we may have covered LNP**
14 **technology in Pfizer's vaccine, but as to specific**
15 **compositions and ratios, I'll need to rereview my**
16 **earlier work.**
17 Q Why don't I give you this. This has been
18 marked previously as Exhibit 2078.
19 Do you recognize Exhibit 2078?
20 **A Yes.**
21 Q And Exhibit 2078 is a review article on
22 which you are named as an author, correct?

75

1 **A Yes, I'm a senior author in this article.**
2 Q And this is the review article that you
3 were just speaking about?
4 **A Yes, this is a review article that I was**
5 **referring to.**
6 Q And if you'd turn to page 142 of the review
7 article, there's a figure 3 at the top of the page.
8 Do you see that?
9 **A Yes, I see that.**
10 Q And the figure illustrates the components
11 of lipid nanoparticles used in COVID-19 vaccines,
12 correct?
13 **A This is showing various potential**
14 **candidates for COVID-19 vaccine.**
15 Q Okay. And the lipid nanoparticle shown on
16 this -- in this figure contains four components,
17 correct?
18 **A We showed four lipid components in the top**
19 **panel of this figure.**
20 Q And those four lipid -- those four
21 components are the same as the four components from
22 the Geall liposomes that we were just looking at,

76

1 correct?
2 MR. LIU: Objection. Asked and answered.
3 THE WITNESS: So this is showing four
4 general categories of lipids that go into LNP
5 formulations.
6 BY MR. DANFORD:
7 Q And those four components are the
8 components that are used in Pfizer's LNP for its
9 COVID-19 vaccine, correct?
10 MR. LIU: Objection. Form. Foundation.
11 THE WITNESS: This is a general schematic
12 showing four lipid components that go into LNPs, but
13 as to what exactly Pfizer COVID-19 vaccine is
14 composed of, this figure is not intended to depict
15 that.
16 BY MR. DANFORD:
17 Q Do you agree that Geall discloses lipid
18 nanoparticles as used in Pfizer and BioNTech's
19 COVID-19 vaccine?
20 **A Geall is not using the exact same**
21 **formulation that is in Pfizer's COVID-19 vaccine.**
22 Q And what do you mean by that?

77

1 **A The identity of the four lipid components**
2 **may be different. The composition ratios of each**
3 **component may be different between Geall and Pfizer**
4 **LNP vaccines.**
5 Q Putting aside the ratios and the exact
6 identity of the components, do you agree that Geall
7 discloses that the nanoparticles is used in Pfizer
8 and BioNTech's COVID-19 vaccine?
9 MR. LIU: Objection. Asked and answered.
10 Outside the scope.
11 THE WITNESS: I have not been asked to
12 review what goes into the composition of LNP in
13 Pfizer vaccine, so without reviewing further
14 documents, I'm not able to answer that question.
15 BY MR. DANFORD:
16 Q If someone had said that Geall does not
17 disclose lipid nanoparticles as used in Pfizer and
18 BioNTech's COVID-19 vaccine, would you have any
19 basis to disagree with that statement?
20 **A Could you repeat the question?**
21 Q Yeah.
22 If someone had said Geall does not disclose

78

1 lipid nanoparticles as used in Pfizer and BioNTech's
2 COVID-19 vaccine, would you have any basis to
3 disagree with that statement?
4 **A As I mentioned, LNP described in the Geall**
5 **is not the same as what's in Pfizer vaccine.**
6 Q Now, we talked about chitosan earlier. Do
7 you recall that?
8 **A Yes, I recall that.**
9 Q And would you agree that chitosan had great
10 potential for vaccine delivery as of 2015?
11 **A There were a number of groups that were**
12 **examining chitosan for vaccine delivery**
13 **applications, including peptides or proteins as an**
14 **immunogen. So chitosan was one of the classes of**
15 **vaccine delivery platforms as of 2015.**
16 Q Chitosan had been studied for use of
17 delivery of nucleic acids -- correct? -- as of 2015?
18 **A There were research groups studying**
19 **chitosan for various drug delivery applications,**
20 **including nucleic acids as of 2015.**
21 Q Would you agree that chitosan, as of 2015,
22 had great potential for vaccine delivery?

79

1 **A As I mentioned, many research groups were**
2 **examining chitosan for various biomedical**
3 **applications, including vaccines.**
4 Q If someone had said, "Chitosan has great
5 potential for vaccine delivery," would you have
6 disagreed with them and said, "No, that's not right.
7 It doesn't have any potential"?
8 MR. LIU: Objection. Form.
9 THE WITNESS: As I mentioned, there were
10 many -- there are still many research groups using
11 chitosan for various biomedical applications,
12 including vaccines.
13 BY MR. DANFORD:
14 Q As of 2015, PLGA was a promising vaccine
15 delivery candidate, correct?
16 **A Similar to chitosan, as of 2015, many**
17 **research groups were examining PLGA for various drug**
18 **delivery applications, including vaccines.**
19 Q Let me hand you a document that's
20 previously been marked as Exhibit 2077.
21 Do you recognize Exhibit 2077?
22 **A Yes. It's a review article from my**

80

1 **laboratory.**
2 Q And you're one of the authors on this
3 review article, correct?
4 **A Yes.**
5 Q And this review article was published in
6 2014, correct?
7 **A Yes, this was published in 2014.**
8 Q And this review article is an accurate
9 assessment of the state of the art for vaccine
10 delivery in 2014, correct?
11 **A Yes, this is an accurate overview of the**
12 **review -- overview of the vaccine delivery field,**
13 **focusing on nanoparticles.**
14 Q And in 2014 this review article that you
15 published discussed many different vaccine delivery
16 technologies, correct?
17 **A Yes, we discussed the various vaccine**
18 **delivery platforms in this review article.**
19 Q Why did you discuss the different delivery
20 platforms in this article that you published in
21 2014?
22 **A We provided an overview of various drug**

81

1 **delivery nanoparticles that could be used for**
2 **vaccine applications in this review article.**
3 Q And a person of ordinary skill in the art
4 in 2015 would have been aware of all of the delivery
5 technologies that you discuss in your review
6 article, correct?
7 **A A POSA would have understood various**
8 **technologies are there, and in this review article,**
9 **we aimed to showcase some of those lipid**
10 **nanoparticle systems for vaccine applications.**
11 Q And you discussed more than lipid
12 nanoparticle delivery systems, correct?
13 **A In addition to lipid nanoparticle systems,**
14 **we discussed other biomaterials, including chitosan**
15 **and other polymers.**
16 Q And in 2014 you stated that chitosan had
17 great potential for vaccine delivery, correct?
18 **A Could you point me to the exact place?**
19 Q Yeah. I'm on page 2570 --
20 **A Okay.**
21 Q -- the right-hand column, last full
22 paragraph on the page.

82

1 **A The last paragraph of page 2570?**
2 Q Correct.
3 **A There we said: "These studies suggest**
4 **great potential of chitosan based nano/micro**
5 **particles for vaccine delivery."**
6 Q And that was an accurate assessment of the
7 state of the art at the time, correct?
8 **A Yes, as of 2014 people were looking at**
9 **chitosan as a vaccine delivery platform, and they**
10 **had great potential.**
11 Q And that remained true as of 2015, correct?
12 **A That is true as of 2015.**
13 Q Now, in your reply declaration, we looked
14 at a discussion that you provided earlier about some
15 of the downsides of chitosan-based delivery,
16 correct?
17 **A Yes. In paragraph 88 I outlined challenges**
18 **associated with chitosan-based mRNA delivery.**
19 Q Your 2014 review article does not describe
20 any of those supposed challenges with chitosan-based
21 delivery, correct?
22 **A In the last sentence of that page, 2570, on**

83

1 **the right column, last sentence, it says: "We**
2 **expect that future studies focused on addressing low**
3 **aqueous solubility at physiological conditions,**
4 **irregular particle size distribution, and low target**
5 **specificity can lead to highly effective vaccine**
6 **formulations," basically, outlining what the**
7 **remaining challenges are for chitosan-based**
8 **vaccines.**
9 **And also, this is an overview review**
10 **article that summarizes use of chitosan for various**
11 **vaccine delivery applications, not limited to mRNA.**
12 Q Is it your opinion that those other vaccine
13 delivery applications besides mRNA would have been
14 irrelevant to a person of ordinary skill in the art
15 seeking to deliver mRNA?
16 **A A POSA as of 2015 would have understood**
17 **that chitosan has pros and cons for vaccine delivery**
18 **applications, and when it comes to mRNA delivery,**
19 **chitosan has challenges, as I outlined in paragraph**
20 **88, and it was clear from prior art and others by**
21 **2015 that LNPs are very attractive drug delivery**
22 **platforms for nucleic acids, including mRNA.**

84

1 Q Now, this review article you published in
2 2014 also discusses PLGA, correct?
3 **A Yes, we covered PLGA as a potential vaccine**
4 **delivery platform.**
5 Q And you stated at the time that: "PLGA
6 based micro/nanoparticles have emerged as promising
7 vaccine delivery candidates due to their current
8 clinical usage, biodegradable nature, ability to
9 prolong antigen release and co-encapsulate antigen
10 and immunopotentiator," correct?
11 **A I stand by that statement saying PLGA is a**
12 **promising vaccine delivery candidate, but the focus**
13 **of this review was using PLGA for peptide and**
14 **protein-based vaccines, not mRNA-based vaccines.**
15 Q Is it your opinion that protein-based
16 vaccines are irrelevant to mRNA-based vaccines?
17 MR. LIU: Objection. Form.
18 THE WITNESS: A POSA reading this review
19 article, as well as the state of art as of 2015,
20 would have understood PLGA has certain pros and cons
21 in terms of mRNA delivery, and the limitations of
22 PLGA for mRNA delivery are listed in my report,

85

1 paragraph 86.
2 BY MR. DANFORD:
3 Q You didn't describe any of the limitations
4 of PLGA delivery from paragraph 86 in this 2014
5 review article, correct?
6 **A The focus of this review article,**
7 **especially on PLGA, was to provide overview of PLGA**
8 **for delivering peptide and protein antigens.**
9 MR. DANFORD: All right. Could we just
10 take a short break?
11 MR. LIU: Sure. We can go off the record.
12 (Recessed at 12:29 p.m.)
13 (Reconvened at 12:32 p.m.)
14 BY MR. DANFORD:
15 Q If you could pull out Exhibit 2077 again,
16 that we were looking at just before we took a break,
17 and if you'd go to page 2566, do you see that
18 there's a heading: "Lipid-Based Delivery Vehicles"?
19 **A Yes.**
20 Q And beneath that heading, you have a
21 smaller heading for: "Liposomes"?
22 **A Yes.**

86

1 Q And then if you'd turn to the next page,
2 there, at the bottom of the page, is a smaller
3 heading for: "Lipid-Based Nanoparticles."
4 Do you see that?
5 **A Yes.**
6 Q Why do you have liposomes and lipid-based
7 nanoparticles as two separate headings in this
8 article?
9 **A Okay. So liposomes and lipid-based**
10 **nanoparticles are terms that have been used**
11 **interchangeably over the years, and their**
12 **definitions have evolved over the years. And what**
13 **we call nowadays as lipid nanoparticles, usually**
14 **refers to those four lipid components that go into**
15 **using mRNA delivery.**
16 Q As of 2015, would a person of ordinary
17 skill in the art have understood that there was any
18 difference between liposomes and lipid
19 nanoparticles?
20 **A Once again, these were terms that were used**
21 **interchangeably by various scientists in the field.**
22 **Some used the term "liposomes." Some used the**

87

1 **term "lipid nanoparticles." Some used "lipid-based**
2 **nanoparticles."**
3 **So these are terms that have been used**
4 **interchangeably over the years.**
5 Q And if they're interchangeable, why did you
6 have them as two separate sections in this 2014
7 review article?
8 **A As to why we exactly divided it up into**
9 **these, I don't recall the exact reason. But what I**
10 **can tell you is some groups used liposomes and lipid**
11 **nanoparticles interchangeably. So one needs to look**
12 **at the lipid components, as well as the way they are**
13 **formulated, to understand what they're referring to**
14 **is LNPs nowadays.**
15 Q Okay. I don't have anything further.
16 MR. LIU: We don't have any questions for
17 you either, Dr. Moon.
18 THE COURT REPORTER: Mr. Liu, are you
19 purchasing the final transcript and a rough draft?
20 MR. LIU: Yes and regular on the final.
21 THE COURT REPORTER: And for you?
22 MR. MEUTH: Same.

88

1 THE COURT REPORTER: So regular and a
2 rough?
3 MR. MEUTH: Yes, please.
4 (Signature having not been discussed,
5 the deposition of James J. Moon, Ph.D. was concluded
6 at 12:40 p.m. EDT.)
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22

89

1 CERTIFICATE OF SHORTHAND REPORTER - NOTARY PUBLIC
2
3 I, JOAN V. CAIN, court reporter and Notary
4 Public within and for the District of Columbia do
5 hereby certify:
6
7 That JAMES J. MOON, PH.D., the
8 witness whose deposition is hereinbefore set forth,
9 was duly sworn by me before the commencement of such
10 deposition and that such deposition was taken before
11 me and is a true record of the testimony given by
12 such witness.
13
14 I further certify that the adverse
15 parties, PETITIONERS BIONTECH SE AND PFIZER INC.,
16 were represented by counsel at the deposition.
17
18 I further certify that the deposition of
19 JAMES J. MOON, PH.D., occurred at the offices of
20 WILLIAMS & CONNOLLY LLP, 680 MAINE AVE SOUTHWEST,
21 WASHINGTON, D.C. 20024, on FRIDAY,
22 SEPTEMBER 13, 2024, commencing at 9:05 A.M. to 12:40

90

1 P.M. EDT.
2
3 I further certify that I am not related to
4 any of the parties to this action by blood or
5 marriage, I am not employed by or an attorney to any
6 of the parties to this action, and that I am in no
7 way interested, financially or otherwise, in the
8 outcome of this matter.
9
10 IN WITNESS WHEREOF, I have hereunto set
11 my hand and affixed my notarial seal this 18th day
12 of September 2024.
13
14 My Commission Expires: July 31, 2029
15
16
17
18 Joan V. Cain
19 NOTARY PUBLIC IN AND FOR
20 THE DISTRICT OF COLUMBIA
21
22

A
a1 6:18
a2 6:21
ability 84:8
able 16:17, 19:22, 42:20, 77:14
about 10:16, 15:13, 18:9, 20:10, 41:16, 43:8, 48:7, 48:8, 75:3, 78:6, 82:14
abstract 49:15, 49:16, 49:19, 50:1, 50:16
accurate 10:1, 80:8, 80:11, 82:6
achieve 35:6, 35:11, 35:19, 35:20, 36:11
achieved 42:12, 64:20, 65:13
achieving 64:19, 65:12
acid 13:4, 13:14, 14:1, 14:3, 14:4, 14:6, 14:9, 14:11, 14:14, 14:19, 15:1, 15:3, 15:15, 16:4, 16:9, 16:22, 17:10, 17:17, 18:14, 21:7, 22:17, 23:2, 23:10, 27:9, 31:8, 32:13, 34:14, 35:1, 43:9, 43:12, 54:14, 57:19, 58:21
acid-based 13:18, 13:19, 15:14, 15:16, 16:12, 16:13, 16:16, 17:3, 18:17, 21:8, 22:6, 44:6
acids 12:10, 13:6, 13:9, 15:9, 17:7, 17:11, 18:4, 22:9, 22:12, 22:21, 23:15, 23:19, 24:3, 24:5, 24:9, 24:12, 24:17, 24:21, 25:2, 25:3, 25:10, 25:15, 31:16, 31:18, 43:15, 54:1, 54:11, 59:7, 64:13, 78:17, 78:20, 83:22
across 36:7
action 90:4, 90:6
activate 45:15
activating 47:15
activation 44:21, 45:4, 45:11, 45:17, 45:19, 46:1, 46:7, 46:8, 46:17, 46:18, 56:8, 56:14, 57:2
actually 60:10
addition 81:13
additional 62:5
address 22:2, 66:19, 67:7
addressed 21:19, 53:16
addressing 83:2
administration 55:12, 64:20, 65:14
adverse 89:14
affixed 90:11
after 57:4
again 23:9, 35:8, 56:12, 63:21, 85:15, 86:20
against 13:2, 14:17, 15:9, 15:12, 52:16, 54:18, 55:8, 56:8, 57:7, 63:17
agents 13:1
agree 29:17, 31:9, 38:12, 39:6, 42:19, 62:20, 76:17, 77:6, 78:9, 78:21
aim 32:21
aimed 81:9
al 8:7, 8:13, 8:17
all 12:6, 15:21, 16:18, 16:19, 26:11, 34:20, 38:3, 45:19, 59:20, 59:22, 60:21, 81:4, 85:9
already 28:21
also 5:3, 11:15, 14:22, 19:10, 23:3, 23:7, 44:19, 44:20, 47:7, 47:9, 52:17, 52:19, 61:13, 71:4, 83:9, 84:2
always 56:17, 57:14, 58:11
among 25:17, 30:15, 31:18, 32:5, 67:5, 68:10
analyses 45:1
analyze 44:18, 44:19, 44:20, 47:9, 52:10
andrew 4:14, 4:19, 9:18
animal 17:6, 44:14, 47:5, 52:9, 58:1, 58:4
animals 44:17, 44:20, 52:19, 58:16, 59:2
another 21:2, 21:4, 40:6, 48:1, 53:10
answer 29:2, 36:10, 41:14, 71:20, 77:14
answered 22:22, 26:15, 30:17, 38:15,

47:16, 48:2, 60:11, 61:9, 61:21, 65:20, 76:2, 77:9
antibody 44:19, 52:10, 56:7, 56:13, 57:3, 57:15
antigen 57:14, 58:3, 58:9, 58:11, 59:1, 65:8, 65:22, 84:9
antigens 58:15, 85:8
any 9:22, 10:13, 13:4, 13:14, 17:16, 18:13, 22:13, 22:19, 35:15, 37:3, 37:6, 38:6, 43:12, 46:22, 47:6, 52:11, 52:15, 54:4, 56:12, 56:15, 57:2, 57:10, 59:4, 59:9, 66:1, 67:2, 67:14, 68:6, 68:8, 77:18, 78:2, 79:7, 82:20, 85:3, 86:17, 87:16, 90:4, 90:5
anyone 36:3
anything 87:15
appeal 1:3
application 6:16, 6:20, 17:19, 68:21
applications 12:13, 12:17, 17:14, 18:8, 18:12, 19:13, 22:5, 24:7, 31:8, 37:7, 43:16, 51:22, 60:8, 60:16, 61:3, 61:14, 62:13, 62:18, 63:2, 64:2, 66:9, 66:21, 78:13, 78:19, 79:3, 79:11, 79:18, 81:2, 81:10, 83:11, 83:13, 83:18
apply 42:20
approach 50:14
aqueous 83:3
areas 14:16
around 12:1
art 23:14, 24:1, 24:22, 25:22, 26:9, 26:13, 26:21, 29:8, 29:9, 29:22, 30:8, 30:14, 31:4, 31:11, 31:21, 32:7, 32:9, 39:7, 42:20, 51:4, 54:6, 58:18, 59:4, 59:10, 66:11, 67:2, 67:14, 68:6, 80:9, 81:3, 82:7, 83:14, 83:20, 84:19, 86:17
article 8:3, 8:9, 8:14, 49:7, 49:9, 49:12, 49:20, 50:12, 74:21, 75:1, 75:2, 75:4, 75:7, 79:22, 80:3, 80:5, 80:8, 80:14, 80:18, 80:20, 81:2, 81:6, 81:8, 82:19, 83:10, 84:1, 84:19, 85:5, 85:6, 86:8, 87:7
articles 74:13
ashley 3:5
ashleymayswilliams@paulhastings 3:11
aside 40:21, 59:3, 77:5
asked 22:22, 26:15, 30:17, 38:15, 47:16, 48:2, 60:11, 61:9, 61:21, 65:20, 73:18, 74:1, 76:2, 77:9, 77:11
asking 10:16
aspects 15:21
assessment 27:20, 80:9, 82:6
associated 66:22, 82:18
assume 48:4
attend 36:6
attention 11:22, 34:3, 51:10
attorney 90:5
attractive 83:21
august 10:18, 10:20, 11:4
author 74:22, 75:1
authors 80:2
availability 28:16
available 23:22, 26:12
ave 2:7, 89:20
avenue 3:7, 4:7
aware 23:14, 35:15, 36:3, 51:4, 51:7, 52:11, 59:4, 59:6, 59:9, 59:11, 59:13, 81:4

B

b-cell 45:18, 46:18, 56:14, 57:16
b-cells 45:4, 46:2, 47:15, 57:3
back 10:18, 10:20, 25:14, 27:12, 43:7, 48:7, 51:9, 55:10
background 12:8, 12:9, 43:8
bansal 3:15
based 21:12, 58:17, 82:4, 84:6
basic 57:18, 58:21
basically 83:6
basing 58:18

basis
66:15, 77:19, 78:2
because
17:1, 27:2, 27:8, 29:13, 40:21, 62:7, 65:15
been
9:8, 16:14, 17:9, 18:14, 23:5, 23:14, 23:22, 24:21, 25:6, 25:9, 25:21, 26:12, 31:20, 32:5, 32:8, 32:12, 33:10, 48:8, 48:17, 48:21, 49:4, 51:4, 51:7, 66:12, 70:6, 74:1, 74:17, 77:11, 78:16, 79:20, 81:4, 83:13, 86:10, 87:3, 88:4
before
1:3, 2:13, 33:12, 35:13, 68:13, 85:16, 89:9, 89:10
begin
17:2
behalf
3:3, 4:3, 4:13
being
14:8, 18:5, 18:9, 24:14, 30:12
below
28:12, 57:17
beneath
42:6, 85:20
benefit
64:21, 65:14
besides
17:15, 19:5, 23:15, 24:19, 59:9, 83:13
betacoronavirus
52:13, 52:16, 52:22, 55:14
better
26:6, 26:19, 29:6, 62:6, 63:5
between
30:1, 62:9, 62:21, 77:3, 86:18
biodegradable
84:8
biology
57:19, 58:21
biomaterials
8:10, 81:14
biomedical
17:14, 79:2, 79:11
biontech
1:5, 3:3, 5:4, 72:18, 89:15
biontech's
72:11, 72:13, 72:21, 76:18, 77:8, 77:18, 78:1
biontech-pfizer
6:6, 7:2
blood
44:18, 47:9, 52:9, 90:4
board
1:3
body's
46:11
boston
4:17
bottom
34:5, 69:9, 86:2
break
40:19, 43:3, 68:12, 85:10, 85:16
bring
10:4, 10:13
broad
17:19, 35:13, 37:5
brought
10:3

C

cain
1:22, 2:13, 89:3
call
70:9, 86:13
cancer
13:3, 14:12, 15:10, 15:13, 15:17
candidate
18:15, 21:2, 21:4, 22:17, 49:18, 49:21, 50:21, 56:8, 57:11, 61:13, 63:22, 79:15, 84:12
candidates
16:20, 16:21, 17:5, 18:7, 18:12, 18:17, 19:9, 19:13, 20:17, 22:5, 22:11, 23:18, 23:21, 25:15, 25:16, 32:14, 50:19, 63:3, 66:2, 75:14, 84:7
cannot
9:22
carrier
40:5
carriers
23:8
case
33:18, 58:2, 69:2
categories
73:6, 76:4
category
33:5
cationic
24:11, 25:1, 25:4, 25:5, 25:8, 73:9
causes
46:15, 47:1, 47:4
cell
47:8, 58:1, 58:2
cells
19:22, 44:18, 45:16, 65:22, 66:2
certain
26:9, 26:21, 29:8, 84:20
certainly
43:20, 46:6
certificate
89:1
certify
89:5, 89:14, 89:18, 90:3
cetera
74:8
challenges
66:20, 66:22, 67:3, 82:17, 82:20, 83:7, 83:19
chan
27:17
chan's
27:20, 51:14
charged
24:11
check
38:3, 48:20
chetan
3:15
chetanbansal@paulhastings
3:20
chitosan
67:8, 67:9, 67:10, 67:17, 78:6, 78:9,

78:12, 78:14, 78:16, 78:19, 78:21, 79:2, 79:4, 79:11, 79:16, 81:14, 81:16, 82:4, 82:9, 83:10, 83:17, 83:19
chitosan-based
82:15, 82:18, 82:20, 83:7
cholesterol
70:1, 70:20, 71:3, 72:16, 72:19
choose
30:1, 30:15
cite
67:2, 67:4, 67:14, 67:16, 68:6, 68:8
cited
37:21, 38:2, 53:21
cites
37:18
classes
78:14
classified
38:22
clean
10:10
clear
38:10, 83:20
clinical
84:8
co-encapsulate
84:9
collect
44:17, 47:9, 52:9
colon
34:16
columbia
2:15, 89:4, 90:20
column
81:21, 83:1
com
3:10, 3:11, 3:20, 4:10, 4:11, 4:19
combinations
56:9
combine
51:14
come
36:7, 43:7, 48:7, 55:10
comes
67:11, 67:18, 83:18
commencement
89:9
commencing
89:22
commission
90:14
common
67:5
compare
64:10
complete
10:1
completely
61:7, 61:18
complex
50:7
complexed
49:21, 50:1, 64:13
component
36:2, 77:3
components
64:17, 69:17, 69:19, 69:20, 69:22, 70:8, 70:19, 71:2, 71:9, 71:18, 72:2, 72:6, 72:14, 72:15, 72:22, 74:2, 74:4, 74:8, 75:10, 75:16, 75:18, 75:21, 76:7, 76:8, 76:12, 77:1, 77:6, 86:14, 87:12
composed
76:14
composition
33:6, 55:13, 73:21, 74:7, 74:11, 77:2, 77:12
compositions
54:10, 73:19, 74:15
comprehensive
26:5, 26:18, 27:7
comprising
54:11
concept
40:7
concluded
88:5
conditions
83:3
conducted
19:6
conferences
36:6
connection
15:4, 33:18
connolly
2:6, 4:6, 89:20
cons
83:17, 84:20
consider
30:9, 31:15, 44:7, 70:3, 70:15
considered
27:8, 29:14, 31:4, 31:8, 31:12, 31:20, 31:22, 32:7, 32:9, 32:12, 32:13, 33:7, 57:4, 69:2
contains
75:16
context
39:14, 46:16
convenient
12:4
copies
10:10
could
9:14, 13:21, 16:6, 27:12, 32:2, 35:5, 35:8, 35:11, 35:18, 36:21, 37:11, 39:7, 40:16, 45:8, 47:8, 47:14, 47:22, 48:4, 51:1, 51:9, 52:8, 53:4, 53:7, 54:1, 56:6, 56:15, 56:19, 57:20, 58:22, 60:15, 61:2, 64:22, 65:4, 65:15, 66:8, 66:17, 69:7, 77:20, 81:1, 81:18, 85:9, 85:15
counsel
5:6, 9:11, 89:16
count
16:18, 17:1
court
2:14, 55:22, 87:18, 87:21, 88:1, 89:3
covered
22:6, 22:18, 23:11, 27:7, 74:13, 84:3
covid
8:15, 72:11, 72:13, 72:21, 73:22, 75:11, 75:14, 76:9, 76:13, 76:19, 76:21, 77:8,

77:18, 78:2
criteria
62:12, 62:13
criterion
65:8
cubosomes
23:8
curevac
49:8, 49:17, 50:13, 50:21, 51:5
current
84:7
cutler
4:15
cytometry
44:19

D

danford
4:14, 6:3, 9:13, 9:18, 15:11, 20:9, 23:12, 25:19, 26:22, 27:11, 28:15, 29:16, 31:1, 31:17, 32:4, 38:19, 40:20, 41:1, 43:3, 43:6, 45:21, 46:9, 47:20, 48:6, 54:3, 54:20, 56:2, 57:12, 60:18, 61:15, 62:8, 62:19, 66:10, 68:12, 68:16, 73:4, 73:20, 76:6, 76:16, 77:15, 79:13, 85:2, 85:9, 85:14
danford@wilmerhale
4:19
data
16:2, 35:14, 42:7, 47:19, 52:11, 52:21, 53:5
date
49:9
day
90:11
declaration
6:8, 6:12, 7:4, 7:8, 10:5, 10:6, 10:7, 10:8, 10:9, 12:1, 12:7, 20:20, 21:14, 22:14, 27:13, 28:12, 35:22, 37:3, 45:14, 51:10, 53:8, 53:17, 55:11, 56:10, 59:15, 64:5, 66:18, 73:17, 82:13
declarations
10:11, 10:17, 10:18, 10:22, 11:4, 11:16, 11:20
define
56:19
definitions
86:12
delay
36:8
delayed
34:21, 35:5, 35:10, 35:16, 35:19, 35:21, 36:11
deliver
12:22, 24:12, 25:2, 48:21, 60:7, 83:15
delivered
54:12
delivering
13:9, 15:8, 18:3, 23:10, 24:3, 24:5, 24:8, 24:17, 25:3, 25:6, 25:10, 25:15, 31:16, 36:18, 54:1, 58:10, 59:7, 60:4, 62:9, 67:18, 85:8
depends
46:5, 57:9
depict
76:14
deposition
1:14, 2:1, 11:6, 11:10, 11:13, 88:5, 89:8, 89:10, 89:16, 89:18
depot
34:22
describe
60:2, 72:5, 82:19, 85:3
described
15:12, 20:7, 40:14, 69:21, 78:4
describes
37:6, 49:16, 49:20, 69:17
describing
37:19, 50:3, 67:3, 70:8, 74:10
design
12:12, 12:16, 15:22
designed
12:21, 16:10, 19:7, 35:18, 36:18
determine
46:22, 47:3
develop
39:8, 51:5, 66:16
developed
12:21, 49:17, 50:21
developing
16:9, 18:1, 56:22
development
12:12, 12:16, 46:16
difference
86:18
differences
62:9, 62:20
different
13:16, 14:15, 14:16, 16:16, 17:2, 17:4, 20:2, 30:2, 30:15, 30:20, 45:6, 48:12, 48:15, 64:14, 73:6, 77:2, 77:3, 80:15, 80:19
differently
20:4
direct
11:22, 34:3, 51:10, 64:4
directed
16:10
disadvantages
68:2, 68:7
disagree
77:19, 78:3
disagreed
79:6
disclose
38:2, 77:17, 77:22
disclosed
27:2, 28:4, 28:21, 29:10, 30:2, 30:7, 30:12, 30:16, 30:20, 40:11, 61:4, 70:16, 71:12, 71:13, 71:21, 71:22, 72:22
discloses
28:2, 28:18,

29:17, 29:20, 38:12, 38:16, 42:2, 42:15, 52:19, 54:10, 70:12, 76:17, 77:7
disclosing 67:15, 68:7
disclosure 30:9, 53:2, 58:18, 59:4, 59:10
disclosures 26:7, 26:19, 29:6
discuss 12:9, 12:11, 22:13, 22:19, 25:20, 26:11, 35:22, 36:2, 37:2, 53:11, 53:13, 59:16, 64:6, 64:9, 66:22, 67:9, 67:20, 67:22, 68:4, 80:19, 81:5
discussed 21:21, 28:11, 30:5, 30:22, 80:15, 80:17, 81:11, 81:14, 88:4
discusses 12:7, 37:9, 37:15, 42:4, 84:2
discussing 59:18
discussion 82:14
disease 14:8, 48:18, 57:7
diseases 14:12, 15:10, 15:17
disruptive 8:4, 49:13
dissect 44:20
distribution 83:4
district 2:15, 89:4, 90:20
divided 87:8
dna 18:9, 18:19, 19:8, 25:7, 48:21, 57:20, 57:22, 58:22
dna-based 18:11, 18:20, 19:3, 19:6
document 28:10, 34:1, 49:3, 50:5, 52:20, 68:19, 69:8, 79:19
documents 53:22, 77:14
doing 45:1, 46:13
done 20:11, 46:21, 46:22, 47:2, 51:5
dorr 4:15
down 55:22
downsides 82:15
dr 9:17, 27:17, 27:20, 43:7, 51:14, 57:18, 58:20, 59:3, 68:17, 87:17
draft 87:19
driven 47:13
drug 24:7, 29:14, 31:6, 37:6, 38:17, 39:14, 40:5, 48:15, 67:6, 67:19, 68:10, 78:19, 79:17, 80:22, 83:21
drugs 32:21, 36:18, 39:20
due 84:7
duly 9:8, 89:9
during 12:14, 13:6, 14:20, 15:1, 19:2

E

e 34:22
e-mail 3:10, 4:10, 4:19
each 74:8, 77:2
earlier 43:8, 48:9, 74:16, 78:6, 82:14
edt 9:3, 88:6, 90:1
effective 83:5
effects 46:20
efficiency 39:22, 40:2, 40:3, 40:6, 42:3, 42:5, 42:7, 42:9, 42:12
either 57:15, 87:17
elicit 48:5, 58:5
elicited 59:7
email 3:20
emerged 84:6
employed 90:5
encapsulate 42:16, 51:20, 70:21
encapsulated 17:13, 40:5
encapsulating 52:6, 65:10, 66:5
encapsulation 39:14, 39:17, 39:18, 39:19, 39:22, 40:2, 40:3, 40:11, 42:2, 42:4, 42:7, 42:9, 42:12, 69:6, 69:14
encoded 52:13, 55:15, 56:4
encodes 58:14, 65:7
encoding 54:11, 60:12, 60:15, 62:4
end 51:18
enticing 50:13, 50:18, 51:1
entire 34:1
entirety 30:9, 30:11, 30:13, 30:19, 33:22
especially 85:7
esquire 3:4, 3:5, 3:15, 4:4, 4:5, 4:14, 5:4, 5:5

et
8:7, 8:13, 8:16, 74:8
ever
18:18, 19:5, 36:3, 44:11
every
71:1
evolved
86:12
exact
33:6, 37:11, 38:9, 50:22, 55:2, 71:6, 73:19, 74:7, 76:20, 77:5, 81:18, 87:9
exactly
76:13, 87:8
examination
6:2, 9:11
examine
46:17, 47:6
examined
9:9, 18:7
examining
78:12, 79:2, 79:17
example
12:14, 24:4, 35:15, 38:20, 41:2, 41:5, 41:8, 41:11, 41:16, 41:19, 41:21, 44:17, 47:5, 52:8, 56:7, 64:9, 65:9, 70:13, 71:17, 72:3, 72:7
examples
13:12, 30:6, 53:5, 59:17, 59:19, 59:21, 59:22, 60:1, 60:3, 60:9, 60:13
excipients
34:16
exhibit
6:8, 6:12, 6:16, 6:19, 7:4, 7:8, 8:3, 8:9, 8:14, 33:11, 33:12, 33:13, 33:14, 33:16, 49:4, 49:6, 68:17, 68:18, 68:20, 69:1, 69:4, 74:18, 74:19, 74:21, 79:20, 79:21, 85:15
exhibits
6:6, 7:2, 8:2
expect
51:19, 55:12, 58:8, 58:16, 59:1, 83:2
expectation
51:15, 53:11, 53:13, 53:15, 54:6, 54:22, 55:3, 58:7, 58:13, 62:16, 63:3
expected
55:19
experience
17:15
experiments
16:2
expert
44:7
expertise
12:10
expires
90:14
expose
66:2
express
58:3, 58:4, 58:22, 63:20
expressed
65:21
expresses
57:21, 58:9, 58:11
expressing
56:16, 57:14
expression
55:13, 60:5, 62:14, 63:16, 64:7, 64:20, 64:22, 65:4, 65:8, 65:13, 65:15, 65:18, 66:8, 66:15
expressly
28:12
external
46:12

F

facts
68:10
fall
37:7, 72:8
falls
72:3
familiar
19:18, 19:19, 32:15, 32:17, 36:12, 36:14, 39:13, 39:16, 39:21, 40:1, 73:21, 74:3
familiarize
41:15
family
23:3
feasible
46:6
feature
20:16
featured
30:5
field
28:7, 67:18, 74:4, 80:12, 86:21
fields
67:6
figure
75:7, 75:10, 75:16, 75:19, 76:14
final
87:19, 87:20
financially
90:7
finish
40:20
first
34:13, 39:2, 50:16, 65:8
fits
33:5
flow
44:19
focus
27:20, 84:12, 85:6
focused
12:15, 17:20, 27:1, 29:9, 60:3, 83:2
focusing
13:10, 16:19, 60:9, 80:13
follow
39:7
follows
9:10
form
15:6, 20:5, 25:12, 26:14, 29:11, 31:13, 32:1, 34:22, 42:22, 57:8, 62:11, 62:15, 73:2, 76:10, 79:8, 84:17
formulate
48:18, 51:17, 70:22, 71:19
formulated
34:15, 39:4, 39:12, 54:12, 54:15, 54:17, 55:7, 55:20, 64:8, 87:13
formulation
32:19, 34:17,

34:22, 35:16, 36:5, 42:11, 50:22, 51:22, 52:4, 60:6, 61:4, 71:6, 73:8, 76:21
formulations 13:17, 16:17, 16:20, 17:3, 32:16, 32:18, 33:3, 33:4, 33:8, 34:11, 34:12, 39:20, 41:6, 41:12, 41:20, 42:3, 42:8, 63:7, 72:6, 72:8, 76:5, 83:6
forth 89:8
foundation 20:5, 26:6, 26:18, 29:5, 73:2, 76:10
four 64:16, 69:17, 69:19, 69:20, 69:22, 70:7, 70:19, 71:2, 71:8, 71:18, 72:2, 72:5, 72:14, 72:15, 72:22, 75:16, 75:18, 75:20, 75:21, 76:3, 76:7, 76:12, 77:1, 86:14
four-component 36:1, 36:4, 37:1, 70:3, 72:12
four-lipid 36:2
friday 1:16, 89:21
full 81:21
fuller 57:18, 58:20
fuller's 59:3
function 20:4, 20:18
fundamental 57:19, 58:21
further 54:16, 60:16, 63:5, 77:13, 87:15, 89:14, 89:18, 90:3
future 83:2

G

gave 11:6, 13:11
geall 53:21, 59:6, 59:9, 59:11, 68:22, 70:11, 70:16, 71:12, 71:17, 71:21, 72:3, 72:8, 73:1, 73:8, 75:22, 76:17, 76:20, 77:3, 77:6, 77:16, 77:22, 78:4
geall's 59:13
gene 58:2
general 17:22, 24:10, 33:7, 45:5, 47:18, 47:21, 57:2, 57:10, 63:19, 71:7, 74:6, 76:4, 76:11
generally 45:18, 46:19, 47:12, 50:17, 70:22
getting 43:16
give 36:10, 58:3, 62:16, 74:17
given 89:11
go 27:12, 51:9, 64:17, 67:7, 72:6, 74:2, 76:4, 76:12, 85:11, 85:17, 86:14
goal 35:4, 35:10, 63:9, 63:13
goes 77:12
going 40:18, 73:15
gone 38:1, 61:3
good 9:14, 40:19, 51:17, 61:13, 62:14, 63:16, 63:22, 66:8
great 78:9, 78:22, 79:4, 81:17, 82:4, 82:10
group 16:11
groups 24:2, 24:6, 24:8, 24:10, 24:14, 24:16, 25:1, 35:20, 78:11, 78:18, 79:1, 79:10, 79:17, 87:10
guess 46:5, 69:8
gun 58:2

H

hale 4:15
hand 49:3, 79:19, 90:11
handed 33:10, 68:17
hard 37:7
hastings 3:6, 3:16
heading 34:11, 34:12, 69:5, 69:13, 69:16, 85:18, 85:20, 85:21, 86:3
headings 86:7
held 2:1
here 12:14, 26:16, 27:19, 34:2, 50:21, 58:20, 64:9, 68:13, 69:19, 73:8
hereby 89:5
hereinbefore 89:8
hereunto 90:10
highlight 67:13
highlights 60:16
highly 83:5
hilger 5:4
hiv 13:3, 14:17, 14:18, 14:22
holistically 45:20
hundred 34:7
hypothesis 57:22, 58:4, 58:6

I

identical 60:21

identity
77:1, 77:6
illustrates
75:10
imagine
35:18
immune
44:11, 44:15, 44:18, 44:21, 45:3, 45:6, 45:11, 45:16, 45:17, 46:1, 46:7, 46:10, 46:14, 46:17, 47:8, 47:11, 47:22, 48:5, 52:1, 52:4, 52:7, 52:12, 52:22, 54:7, 55:15, 55:20, 56:4, 56:6, 56:11, 56:12, 56:15, 56:18, 56:19, 57:1, 57:2, 57:4, 57:6, 58:5, 58:8, 58:12, 58:16, 59:2, 59:8, 63:4, 63:9, 63:11, 63:14, 63:17, 63:19, 65:16, 65:22, 66:1, 66:2, 66:3
immunize
44:17
immunodeficiency
20:21, 21:6, 21:10
immunogen
52:7, 53:3, 55:16, 56:5, 56:17, 60:15, 64:22, 65:4, 65:7, 65:15, 65:18, 65:21, 66:3, 66:8, 66:15, 78:14
immunogen-encoding
51:20, 60:7, 61:14
immunogens
13:1
immunological
46:12
immunology
44:8
immunopotentiator
84:10
immunostimulatory
13:1
important
26:11
improve
64:22, 65:5, 65:16, 65:19, 66:13
inc
1:5, 1:8, 4:3, 4:13, 5:7, 9:12, 89:15
include
50:20
including
12:22, 13:2, 13:17, 14:7, 15:17, 15:22, 17:14, 22:5, 25:16, 26:9, 26:21, 29:8, 31:15, 38:18, 39:11, 43:16, 56:13, 57:3, 78:13, 78:20, 79:3, 79:12, 79:18, 81:14, 83:22
increase
64:19, 65:13, 66:12
increased
64:6, 64:21, 65:4, 65:15, 65:18
individual
73:5, 74:1
induce
45:7, 51:22, 52:4, 52:7, 55:14, 55:19, 56:3, 63:9, 63:11, 63:14
inducing
57:14, 65:16
infectious
48:18
infiltrates
47:8
inflammation
46:10, 46:11, 46:15, 46:19, 47:1, 47:4, 47:10, 47:11, 47:12, 47:14
influenza
50:8, 50:10
inject
57:22
injection
47:6
innate
45:3, 45:11, 45:16, 45:17, 45:22, 46:7, 46:17
instead
55:18
instructs
28:12
intellectual
5:6
intended
26:5, 26:17, 27:6, 29:5, 76:14
interchangeable
87:5
interchangeably
23:6, 40:9, 70:6, 86:11, 86:21, 87:4, 87:11
interested
90:7
international
6:19, 68:21
interpretation
16:2
invention
34:15, 54:14
investigator
15:21
involve
37:3, 41:11, 41:19, 60:10
involved
16:14, 17:9
involvement
16:9
ionizable
70:1, 70:19, 71:3, 72:16, 72:19, 73:12
ipr
1:11
irregular
83:4
irrelevant
83:14, 84:16
issue
53:16
itself
19:22

J

jacob
5:5
james
1:14, 2:1, 6:2, 6:8, 6:12, 7:5, 7:9, 9:7, 9:16, 88:5, 89:7, 89:19
joan
1:22, 2:13, 89:3
job
1:20
july
90:14

K

kallen
8:7

kathryn
4:5
kayali
4:5
kind
58:16, 59:1
kkayali@wc
4:11
know
18:6, 38:6, 40:17, 48:21
knowledge
67:5
known
22:10, 22:20, 24:21, 25:9, 25:21, 28:7, 67:17, 68:10

L

lab
15:20, 21:4, 43:15, 44:1, 44:2, 44:9
laboratory
80:1
last
81:21, 82:1, 82:22, 83:1
law
2:2
lawyers
9:18
lead
83:5
leading
71:9
leads
45:18, 65:7
least
18:6, 43:20, 59:6, 59:11, 59:13
let's
48:7, 55:10
level
55:15, 55:19, 56:4
limitations
67:11, 67:13, 67:15, 67:17, 68:4, 84:21, 85:3
limited
54:18, 55:8, 83:11
line
45:12, 69:5, 69:14, 73:16
lipid
21:12, 21:19, 22:3, 22:4, 22:8, 23:2, 23:8, 23:15, 23:21, 26:3, 26:8, 26:20, 27:1, 28:2, 28:13, 28:18, 28:21, 29:7, 29:18, 31:5, 31:9, 33:1, 35:6, 35:12, 35:16, 36:1, 36:4, 37:1, 38:7, 38:13, 41:11, 41:19, 41:21, 48:13, 51:21, 52:6, 54:15, 54:17, 55:7, 55:21, 62:2, 64:12, 64:14, 64:17, 69:22, 70:1, 70:2, 70:4, 70:5, 70:7, 70:8, 70:9, 70:12, 70:13, 70:16, 70:19, 70:20, 71:1, 71:3, 71:4, 71:7, 71:8, 71:12, 71:15, 71:18, 71:19, 71:22, 72:2, 72:5, 72:14, 72:15, 72:16, 72:17, 72:20, 73:9, 73:12, 73:13, 75:11, 75:15, 75:18, 75:20, 76:12, 76:17, 77:1, 77:17, 78:1, 81:9, 81:11, 81:13, 86:13, 86:14, 86:18, 87:1, 87:10, 87:12
lipid-based
12:22, 15:8, 17:13, 18:2, 19:7, 21:21, 22:16, 23:4, 28:4, 85:18, 86:3, 86:6, 86:9, 87:1
lipids
70:1, 72:19, 73:5, 76:4
lipoplex
64:10, 64:11, 64:12, 64:14, 64:16
lipoplexes
64:8
liposomal
69:6, 69:13
liposome
69:21, 70:4
liposomes
23:3, 23:4, 69:17, 70:5, 70:16, 71:11, 71:21, 72:22, 75:22, 85:21, 86:6, 86:9, 86:18, 86:22, 87:10
list
34:16
listed
34:21, 69:19, 72:4, 72:9, 73:8, 84:22
liu
4:4, 15:6, 20:5, 22:22, 25:12, 26:14, 27:4, 28:9, 29:11, 30:17, 31:13, 32:1, 38:15, 40:17, 42:22, 45:12, 46:3, 47:16, 48:2, 53:18, 54:8, 55:22, 57:8, 60:11, 61:9, 61:21, 62:11, 65:20, 73:2, 73:15, 76:2, 76:10, 77:9, 79:8, 84:17, 85:11, 87:16, 87:18, 87:20
llp
2:6, 3:6, 3:16, 4:6, 4:15, 89:20
lnp
25:16, 27:8, 30:21, 31:15, 32:13, 33:5, 37:7, 51:17, 54:1, 61:1, 61:4, 61:12, 62:7, 62:14, 63:1, 63:7, 63:21, 64:10, 65:10, 66:5, 66:7, 72:6, 72:8, 72:12, 72:18, 73:7, 73:12, 73:14, 73:19, 73:22, 74:4, 74:7, 74:11, 74:13, 76:4, 76:8, 77:4, 77:12, 78:4
lnps
22:18, 23:3, 23:5, 23:9,

23:11, 29:13, 29:21, 30:5, 31:7, 32:5, 32:7, 33:6, 33:7, 35:18, 36:2, 36:10, 38:10, 38:11, 38:16, 39:11, 48:16, 52:18, 53:3, 59:7, 60:4, 64:8, 64:17, 70:22, 74:2, 76:12, 83:21, 87:14
load
42:17, 43:2
loaded
40:5, 53:3
loading
39:19, 40:6, 42:4
long
32:21, 40:17
look
33:6, 38:1, 40:15, 46:14, 47:3, 49:15, 69:9, 74:1, 87:11
looked
82:13
looking
12:5, 27:13, 34:4, 34:5, 45:2, 45:3, 45:10, 55:5, 57:1, 60:22, 62:17, 70:7, 75:22, 82:8, 85:16
low
83:2, 83:4
lymphatic
44:21

M

made
69:17, 71:4
maine
2:7, 4:7, 89:20
major
67:11
make
62:5, 63:5
making
35:14, 63:6
malaria
13:3, 14:17, 14:18, 14:21
manuscripts
43:21, 43:22
many
13:16, 14:15, 14:16, 16:4, 16:13, 16:16, 16:21, 17:1, 17:4, 24:10, 24:14, 25:15, 36:6, 43:14, 74:12, 79:1, 79:10, 79:16, 80:15
marked
6:6, 7:2, 8:2, 33:10, 49:4, 74:18, 79:20
markers
47:9
marriage
90:5
massachusetts
4:17
materials
10:3, 10:13
matter
12:3, 33:6, 90:8
mays-williams
3:5
mean
48:22, 52:3, 56:3, 65:3, 76:22
meaning
73:5
means
56:7
meant
24:9
measure
44:13, 44:15
measured
44:11, 52:8, 56:6
measuring
46:13
meet
9:17
mention
13:11, 20:20, 23:1, 23:3
mentioned
12:20, 19:10, 19:12, 20:6, 23:7, 25:13, 25:16, 31:6, 32:11, 45:10, 48:9, 48:11, 62:1, 78:4, 79:1, 79:9
mentioning
52:16
mentions
38:11, 58:20
meuth
3:4, 87:22, 88:3
michael
4:4
micro
82:4, 84:6
microsphere
41:6
microspheres
38:18, 38:20, 41:9, 41:10
mischaracterized
29:12, 61:10, 61:22
mischaracterizes
27:4, 28:9, 53:18
mixer
70:21, 71:4
mliu@wc
4:10
mmrna
34:14, 35:1, 54:14
models
44:14, 50:10, 50:11
moderna
1:8, 4:13, 5:7, 8:2, 9:12, 9:19
modified
34:14, 35:1, 54:11, 54:13
molecules
54:14
moment
16:18
moon
1:14, 2:1, 6:2, 6:9, 6:13, 7:5, 7:9, 8:16, 9:7, 9:16, 9:17, 43:7, 68:17, 87:17, 88:5, 89:7, 89:19
moore
5:5
more
16:3, 24:10, 34:15, 54:15, 81:11
morning
9:14
most
18:16, 22:17, 23:9, 25:17, 27:9, 29:14, 30:21
motivated
66:12
motivation
51:14
mount
66:1, 66:3
mounting
45:16
mrna
14:7, 17:15, 18:7, 20:2,

20:3, 20:4, 20:7, 20:8, 20:10, 20:12, 20:14, 20:15, 20:17, 28:2, 28:5, 28:14, 28:18, 29:15, 31:4, 33:2, 35:21, 36:11, 36:20, 36:22, 40:11, 40:14, 41:12, 42:3, 42:16, 42:18, 43:2, 43:16, 48:18, 49:21, 50:7, 50:8, 51:5, 51:8, 51:17, 51:20, 52:13, 52:17, 55:20, 58:9, 58:10, 58:14, 60:4, 60:7, 60:12, 60:14, 60:20, 61:2, 61:6, 61:8, 61:12, 61:14, 61:17, 61:19, 62:3, 62:4, 62:7, 62:10, 62:17, 62:21, 63:9, 63:13, 63:15, 64:7, 64:13, 64:20, 65:6, 65:10, 65:13, 66:5, 67:1, 67:11, 67:18, 67:21, 68:3, 71:10, 82:18, 83:11, 83:13, 83:15, 83:18, 83:22, 84:21, 84:22, 86:15
mrna-based
17:12, 28:22, 36:7, 62:13, 84:14, 84:16
mrna-encoding
52:6, 53:3, 62:15
muscle
58:1

N

name
9:15, 19:21, 32:20
name's
9:17
named
74:22
nano
82:4
nanocarrier
36:13, 36:15, 36:16, 37:5, 38:21, 39:1, 39:3, 39:9
nanocarriers
36:19, 36:21, 37:4, 37:8, 37:10, 37:16, 37:19, 39:11
nanoparticle
8:11, 15:16, 21:19, 22:3, 22:16, 23:21, 26:3, 27:1, 28:2, 28:18, 35:6, 35:12, 36:1, 36:4, 37:2, 41:12, 41:20, 51:21, 54:12, 54:17, 55:21, 64:15, 70:4, 71:5, 71:9, 75:15, 81:10, 81:12, 81:13
nanoparticles
12:13, 12:16, 12:21, 12:22, 13:8, 15:8, 17:13, 18:2, 18:3, 19:3, 19:8, 21:12, 21:21, 22:4, 22:8, 23:4, 23:16, 28:5, 28:13, 28:22, 29:19, 31:5, 31:10, 33:1, 35:17, 36:17, 38:8, 38:14, 38:22, 41:21, 48:13, 52:6, 54:16, 55:7, 62:2, 70:6, 70:9, 70:10, 70:12, 70:14, 70:17, 71:8, 71:13, 71:16, 71:19, 71:22, 75:11, 76:18, 77:7, 77:17, 78:1, 80:13, 81:1, 84:6, 86:3, 86:7, 86:10, 86:13, 86:19, 87:1, 87:2, 87:11
nanostructured
23:8
nanostructures
37:6
nature
84:8
necessarily
17:19
need
36:9, 47:19, 63:11, 74:15
needs
45:15, 87:11
neutral
70:1, 70:20, 71:3, 72:16, 72:19, 73:13
new
3:8
next
86:1
nice
9:17
nlcs
23:8
non-viral
8:15
none
60:1, 60:10
northwest
3:17
notarial
90:11
notary
2:14, 9:9, 89:1, 89:3, 90:19
notice
2:13
novel
8:4, 49:12, 50:13
nowadays
71:8, 86:13, 87:14
nucleic
12:10, 13:4, 13:6, 13:9, 13:14, 13:18, 13:19, 14:1, 14:3, 14:4, 14:6, 14:9, 14:11, 14:14, 14:19, 14:22, 15:3, 15:8, 15:14, 15:15, 16:4, 16:9, 16:11, 16:13, 16:16, 16:21, 17:3, 17:7, 17:10, 17:17, 18:4, 18:13, 18:17, 21:7, 21:8, 22:6, 22:9, 22:12, 22:17, 22:20, 23:2, 23:10, 23:15, 23:19, 24:3, 24:5, 24:8, 24:12, 24:17, 24:21, 25:2, 25:3, 25:10, 25:15,

27:9, 31:8, 31:16, 31:18, 32:13, 34:14, 35:1, 43:9, 43:12, 43:15, 44:5, 54:1, 54:11, 54:14, 57:19, 58:21, 59:7, 64:13, 78:17, 78:20, 83:22
nucleotide-based
50:18
number
78:11
numbers
16:18, 34:4, 69:9

O

oath
9:20
object
45:12, 73:15
objection
15:6, 20:5, 22:22, 25:12, 26:14, 27:4, 28:9, 29:11, 30:17, 31:13, 32:1, 38:15, 42:22, 46:3, 47:16, 48:2, 53:18, 54:8, 57:8, 60:11, 61:9, 61:21, 62:11, 65:20, 73:2, 76:2, 76:10, 77:9, 79:8, 84:17
objective
34:20
objectives
34:17
observe
47:14
observing
48:1
obtaining
35:4, 35:10
occurred
89:19
october
8:8, 49:9, 49:11
offer
68:1
offered
27:17
office
1:1
offices
2:2, 89:19
okay
10:10, 11:15, 12:5, 15:3, 15:18, 20:15, 21:18, 23:20, 24:19, 27:15, 34:9, 37:1, 37:14, 38:6, 38:12, 40:22, 41:17, 41:18, 42:1, 42:11, 47:21, 48:12, 49:20, 51:12, 53:9, 56:1, 59:18, 61:16, 67:2, 67:10, 69:10, 69:13, 75:15, 81:20, 86:9, 87:15
once
23:9, 63:21, 86:20
one
9:18, 12:3, 13:7, 18:11, 19:2, 19:13, 22:17, 23:9, 25:17, 27:8, 30:21, 32:13, 33:17, 34:15, 35:18, 36:3, 40:15, 47:22, 48:9, 54:15, 62:12, 62:15, 69:1, 74:12, 78:14, 80:2, 87:11
ongoing
43:14, 44:1, 44:2
only
22:9, 31:2, 31:10, 31:20, 32:8
opinion
27:22, 28:6, 28:16, 28:21, 30:21, 31:2, 35:14, 54:4, 56:16, 57:13, 58:6, 58:10, 58:17, 59:5, 59:10, 60:19, 61:6, 61:17, 61:20, 68:1, 70:11, 71:1, 71:11, 71:20, 83:12, 84:15
opinions
27:16, 51:14
options
26:11
order
66:13
ordinary
23:13, 24:1, 24:22, 25:11, 25:22, 26:12, 29:22, 30:8, 30:14, 31:3, 31:11, 31:19, 31:21, 32:6, 39:6, 42:19, 51:4, 54:5, 66:11, 81:3, 83:14, 86:16
original
10:5, 10:7, 10:17, 21:14, 21:17, 21:22, 22:14, 22:18, 26:2, 28:11, 29:4, 53:16, 53:20, 54:5, 54:10, 54:21, 55:3
other
10:13, 12:20, 14:12, 15:10, 17:16, 17:17, 18:2, 18:13, 19:7, 22:11, 22:13, 22:19, 23:14, 23:20, 24:3, 24:20, 25:20, 27:20, 27:22, 28:6, 28:17, 29:18, 29:20, 30:6, 31:6, 31:7, 37:18, 37:21, 38:2, 38:11, 38:13, 38:17, 43:18, 56:9, 59:9, 59:12, 64:13, 81:14, 81:15, 83:12
others
83:20
otherwise
90:7
out
63:6, 85:15
outcome
90:8
outlined
82:17, 83:19
outlining
83:6
outside
45:13, 46:3, 47:17, 48:3, 73:16, 77:10
over
13:17, 14:15, 15:7, 32:21, 70:6, 86:11, 86:12, 87:4
overall
55:5

oversee
15:21
overview
21:13, 21:16, 21:18, 21:22, 22:2, 22:7, 26:1, 80:11, 80:12, 80:22, 83:9, 85:7
own
20:11
owner
1:9, 4:13, 9:11

P

page
6:2, 34:6, 69:4, 69:7, 70:18, 75:6, 75:7, 81:19, 81:22, 82:1, 82:22, 85:17, 86:1, 86:2
pages
1:21
panel
75:19
paper
52:15
papers
36:6, 74:10, 74:12
paragraph
12:1, 12:5, 12:9, 13:11, 15:13, 20:19, 23:1, 23:7, 26:2, 27:14, 27:16, 27:19, 29:5, 34:4, 34:13, 37:13, 37:15, 38:7, 39:2, 40:16, 42:1, 42:6, 51:11, 51:13, 51:16, 51:18, 52:2, 53:2, 53:7, 53:10, 54:9, 54:19, 54:21, 55:4, 55:9, 55:11, 55:18, 57:17, 59:14, 59:16, 59:19, 60:5, 60:16, 61:5, 64:3, 64:4, 64:6, 66:17, 66:19, 67:1, 67:5, 67:7, 67:16, 67:20, 68:5, 68:6, 68:9, 69:16, 69:21, 70:18, 81:22, 82:1, 82:17, 83:19, 85:1, 85:4
park
3:7
particle
83:4
particles
23:2, 82:5
particular
14:17, 14:20, 15:5, 52:15, 68:8, 71:17, 72:3, 72:7
parties
89:15, 90:4, 90:6
past
23:6, 43:18, 44:6
patent
1:1, 1:3, 1:9, 1:12, 4:13, 6:10, 6:14, 6:16, 6:19, 7:6, 7:10, 9:11, 10:6, 10:7, 10:8, 12:2, 26:8, 26:20, 27:3, 28:20, 29:3, 29:7, 29:10, 34:10, 37:18, 68:21, 72:5
patents
71:14, 71:16, 72:1, 72:5
pathogen
54:19, 55:9
pathogens
13:2, 57:9
paul
3:6, 3:16
peg
70:20, 71:4
pegylated
70:2, 72:17, 72:20
penalties
9:8
people
82:8
peptide
25:4, 84:13, 85:8
peptide-based
21:11, 25:5, 25:8
peptides
13:17, 14:21, 25:2, 78:13
perceive
66:20
percent
40:4, 42:12, 42:14
perform
16:11
performance
65:1, 65:5, 65:16, 65:19, 66:13
period
32:21
perjury
9:8
permit
34:21
person
23:13, 24:1, 24:21, 25:10, 25:21, 26:12, 29:22, 30:8, 30:14, 31:3, 31:11, 31:19, 31:21, 32:6, 32:9, 39:6, 42:19, 51:3, 54:5, 66:11, 81:3, 83:14, 86:16
personal
16:8
personally
16:5, 16:14, 16:22, 17:9, 17:16, 18:18, 19:5, 19:15
petitioner
3:3, 4:3
petitioners
1:6, 89:15
pfizer
1:5, 4:3, 72:11, 72:13, 72:18, 72:21, 73:7, 73:9, 73:11, 73:13, 73:19, 74:2, 76:13, 76:18, 77:3, 77:7, 77:13, 77:17, 78:1, 78:5, 89:15
pfizer's
73:22, 74:4, 74:6, 74:11, 74:14, 76:8, 76:21
ph
1:14, 2:1, 3:5, 5:5, 6:2, 6:9, 6:13, 7:5, 7:9, 9:7, 88:5, 89:7, 89:19
physiological
83:3
pickering
4:15

place
37:11, 81:18
plasmid
19:8
platform
18:1, 21:12, 29:15, 48:16, 52:7, 64:1, 66:8, 82:9, 84:4
platforms
18:21, 78:15, 80:18, 80:20, 83:22
please
9:14, 51:11, 88:3
plga
24:4, 24:6, 24:8, 24:10, 38:18, 38:20, 38:22, 39:12, 40:12, 40:14, 41:5, 41:9, 41:10, 42:3, 42:8, 42:16, 42:17, 42:21, 43:2, 66:21, 67:1, 67:6, 79:14, 79:17, 84:2, 84:3, 84:5, 84:11, 84:13, 84:20, 84:22, 85:4, 85:7
point
37:11, 40:19, 62:3, 62:6, 81:18
polymer
24:3, 24:4, 24:9, 25:6
polymer-based
24:13, 24:17, 24:19, 33:4
polymers
24:11, 24:12, 81:15
posa
23:17, 25:13, 28:13, 30:4, 30:11, 30:18, 31:14, 39:10, 43:1, 51:7, 51:16, 51:19, 52:5, 53:22, 55:6, 55:11, 55:18, 58:8, 58:13, 60:14, 60:22, 61:3, 61:11, 62:1, 62:5, 62:17, 63:1, 63:6, 64:1, 64:18, 65:11, 66:6, 66:14, 67:5, 81:7, 83:16, 84:18
positively
24:11
possible
42:15, 45:22, 47:22
post-immune
47:13
postdoctoral
12:12, 12:15, 12:18, 13:7, 14:20, 15:1, 19:2
potential
19:9, 25:9, 75:13, 78:10, 78:22, 79:5, 79:7, 81:17, 82:4, 82:10, 84:3
preclinical
50:11
preparation
33:19
present
5:3
presented
26:3
pretty
35:13
previously
6:6, 7:2, 8:2, 11:6, 33:10, 49:4, 74:18, 79:20
primarily
12:15, 25:6
principal
15:20
prior
11:13, 26:9, 26:20, 29:7, 29:9, 44:4, 59:4, 59:10, 67:2, 67:14, 68:6, 83:20
problematic
63:18
proceeding
11:7, 11:13, 21:15
proceedings
11:4, 11:16, 27:18, 33:11, 49:5
producing
19:22, 54:7
production
65:11, 66:6, 66:12
project
15:5
projects
14:15, 19:3, 43:14, 43:18
prolong
32:21, 84:9
prominent
18:16, 22:17, 23:9, 25:17, 27:9, 29:14, 30:21
prominently
30:5, 38:17
promising
22:4, 79:14, 84:6, 84:12
property
5:6
proposition
47:21
pros
83:17, 84:20
protamine
25:3, 25:4, 25:5, 48:9, 48:11, 48:12, 48:15, 48:17, 48:21, 49:22, 50:2, 50:6, 67:20, 67:22, 68:2, 68:4, 68:9
protamine-based
50:4, 51:6
protected
56:17, 56:19
protection
57:7
protein
52:13, 52:22, 54:11, 55:14, 57:21, 60:4, 62:14, 62:15, 63:2, 63:16, 63:20, 63:22, 64:7, 64:20, 65:11, 65:13, 66:6, 66:12, 85:8
protein-based
84:14, 84:15
protein-encoding
61:2, 61:12, 62:3, 62:7
proteins
13:18, 14:21, 20:1, 52:18, 60:13, 78:13
provide
10:1, 26:6, 26:18, 29:5, 54:4, 57:6, 85:7
provided
21:13, 21:16, 27:19, 34:2, 53:5, 71:17, 80:22, 82:14
provides
42:7

public
2:14, 9:9, 89:1, 89:4, 90:19
publication
6:17
publications
37:19, 43:13, 43:20, 44:5
publish
43:17
published
13:8, 43:19, 44:5, 49:11, 52:11, 74:10, 74:12, 80:5, 80:7, 80:15, 80:20, 84:1
pull
85:15
purchasing
87:19
purposes
61:7
pursuant
2:13
put
33:9, 40:21
putting
59:3, 77:5

Q

qualifications
12:8
qualified
29:2
quantifies
40:4
question
13:21, 16:6, 32:3, 35:8, 41:14, 61:16, 77:14, 77:20
questions
45:13, 73:16, 87:16

R

rather
26:5, 26:18
ratios
72:7, 74:7, 74:15, 77:2, 77:5
read
30:11, 30:18, 36:6, 41:13
readily
61:2, 64:18, 65:12
reading
30:1, 30:4, 30:13, 39:10, 43:1, 53:22, 60:14, 84:18
ready
43:17
reason
9:22, 23:11, 51:17, 87:9
reasonable
51:15, 53:11, 53:13, 53:15, 54:6, 54:22, 58:7, 58:13, 62:16, 63:3
reasonably
51:19, 55:12, 55:19
reasons
70:15
rebecca
5:4
recall
19:11, 38:3, 43:10, 43:11, 52:15, 53:5, 78:7, 78:8, 87:9
recessed
43:4, 68:14, 85:12
recognize
49:6, 64:19, 65:12, 65:22, 68:18, 68:19, 74:19, 79:21
reconvened
43:5, 68:15, 85:13
record
9:15, 85:11, 89:11
redness
47:7
refer
33:4, 38:7, 38:10, 39:18, 46:19, 51:1, 71:8
reference
30:3, 30:16, 33:9, 33:14, 33:21, 36:9, 37:9, 37:18, 40:10, 40:21, 41:2, 41:8, 68:9, 70:11, 73:8
referenced
6:7, 7:3, 8:2
references
33:17, 37:22, 38:2, 38:4, 38:5, 38:7, 38:10, 48:20, 59:12, 67:3, 67:4, 67:16, 69:1, 74:9
referring
71:7, 75:5, 87:13
refers
36:17, 39:19, 50:12, 64:12, 86:14
regarding
40:11, 51:14, 68:9
regular
87:20, 88:1
relate
12:19
related
26:7, 26:19, 29:6, 90:3
relates
28:20, 29:2, 41:9
relating
43:22
release
32:21, 33:1, 34:22, 35:5, 35:11, 35:16, 35:19, 35:21, 36:8, 36:11, 84:9
relevant
28:1, 28:8, 28:17, 74:9
remained
82:11
remaining
83:7
remember
38:9
repeat
32:2, 35:8, 69:7, 77:20
replicate
19:22
reply
27:12, 51:9, 55:10, 59:15, 64:5, 66:18, 82:13
report
21:17, 22:1, 22:18, 23:11, 26:3, 29:4, 33:20, 49:18, 53:6, 53:20, 54:5, 54:10, 54:21, 55:3, 84:22
reported
1:22, 42:9, 42:14
reporter
2:14, 55:22, 87:18, 87:21, 88:1, 89:1, 89:3
reports
51:1
represented
89:16

representing
9:18
rereview
74:15
research
15:19, 15:20, 15:22, 16:11, 16:14, 17:2, 19:6, 20:11, 24:2, 24:16, 25:1, 35:20, 43:8, 43:12, 49:7, 78:18, 79:1, 79:10, 79:17
respect
15:18, 42:21
respectfully
61:16
respects
60:21
respond
27:16, 51:13
response
44:11, 44:13, 44:15, 45:17, 46:1, 46:10, 46:11, 46:12, 46:14, 47:11, 47:13, 48:1, 52:1, 52:4, 52:8, 52:12, 52:22, 54:7, 55:15, 55:20, 56:4, 56:6, 56:11, 56:12, 56:15, 56:18, 56:20, 57:1, 57:3, 57:4, 57:15, 57:16, 58:5, 58:8, 58:12, 58:16, 59:2, 63:4, 63:10, 63:12, 63:14, 63:17, 66:1
responses
45:7, 48:5, 52:10, 56:7, 56:13, 57:6, 57:10, 59:8, 63:20, 65:17, 66:3
responsive
7:4, 7:8, 10:6, 10:9, 11:16, 11:20, 12:1, 12:7, 20:19, 45:13, 53:8, 73:17
result
20:1, 55:13, 56:17, 57:14, 58:11
resulted
43:13
resulting
60:4, 66:7
results
52:16, 65:10, 66:15
review
29:9, 35:14, 36:9, 40:10, 43:19, 44:4, 47:19, 50:5, 71:6, 73:19, 74:8, 74:13, 74:21, 75:2, 75:4, 75:6, 77:12, 79:22, 80:3, 80:5, 80:8, 80:12, 80:14, 80:18, 81:2, 81:5, 81:8, 82:19, 83:9, 84:1, 84:13, 84:18, 85:5, 85:6, 87:7
reviewed
10:22, 11:2, 11:9, 29:13, 33:18, 33:19, 33:21, 34:1, 38:5, 40:13, 59:20, 59:22
reviewing
38:4, 77:13
right
12:6, 16:19, 34:20, 79:6, 83:1, 85:9
right-hand
81:21
rna
18:6, 19:12, 19:21, 57:20, 57:22, 58:22, 66:20, 70:21, 70:22, 71:19
rnactive
8:6
role
15:18
rough
87:19, 88:2
routinely
44:13
row
42:14
ryan
3:4
ryanmeuth@paulha-stings
3:10

S

sahdev
8:12
said
11:3, 11:12, 11:19, 14:1, 20:12, 55:18, 77:16, 77:22, 79:4, 79:6, 82:3
same
10:7, 10:9, 40:7, 46:3, 54:8, 58:7, 60:6, 61:4, 61:7, 61:18, 62:2, 62:6, 63:7, 63:21, 71:2, 71:12, 71:15, 71:18, 71:21, 72:22, 73:3, 73:6, 73:7, 75:21, 76:20, 78:5, 87:22
sarna
19:10, 19:15, 19:17, 19:18, 19:19, 19:20, 20:2, 20:3, 20:4, 20:6, 20:7, 20:8, 20:16, 20:18
say
29:1, 37:7, 50:15, 51:2, 52:3, 52:17, 55:11, 56:3, 56:15, 57:11, 65:3
saying
50:17, 84:11
says
50:1, 53:3, 83:1
schematic
76:11
schleckser
4:5
scholarly
8:3, 8:9, 8:14
schrum
28:2, 28:4, 28:12, 28:18, 28:21, 29:17, 29:20, 30:1, 30:4, 30:6, 30:7, 30:11, 30:13, 30:19, 30:20, 30:22, 33:9, 33:14, 33:16, 33:21, 34:10, 37:9, 37:18, 38:4, 38:10, 38:12, 38:16, 39:3, 39:8, 40:10,

40:13, 40:16, 41:2, 41:8, 42:2, 42:15, 42:17, 52:17, 52:19, 52:20, 52:21, 53:3, 53:21, 54:10, 54:13, 54:16, 55:5, 55:6, 59:21, 59:22, 60:1, 60:6, 60:12, 60:22, 61:4, 64:2, 64:7, 65:9, 71:15
schrum's
30:9, 42:20, 59:16, 59:18, 60:3, 64:9
scientists
68:11, 86:21
scope
45:13, 46:4, 47:17, 48:3, 73:16, 77:10
screen
17:4
screening
17:2
se
1:5, 3:3, 5:4, 89:15
seal
90:11
section
12:6, 21:22, 22:7, 26:4, 26:17, 27:6, 34:10, 41:13, 42:2, 47:7
sections
38:11, 40:13, 40:15, 87:6
see
10:3, 20:22, 21:1, 33:13, 33:16, 34:12, 34:18, 34:19, 35:2, 35:3, 37:15, 37:21, 38:1, 39:5, 40:18, 41:10, 41:21, 42:9, 42:14, 44:5, 45:22, 46:14, 47:22, 49:7, 49:14, 49:18, 50:10, 55:17, 69:5, 69:19, 75:8, 75:9, 85:17, 86:4
seeing
46:1
seeking
83:15
seems
50:6, 70:8
select
17:5
self-adjuvanted
8:6
self-amplifying
18:6, 19:12, 19:21, 20:18
self-replication
20:16
senior
5:6, 75:1
sentence
12:20, 34:13, 39:2, 39:5, 39:10, 50:16, 82:22, 83:1
separate
86:7, 87:6
september
1:16, 9:4, 89:22, 90:12
serum
44:19
set
89:8, 90:10
several
43:21, 66:20, 67:11, 67:13, 68:2
shifting
68:13
short
85:10
shorthand
89:1
showcase
81:9
showed
64:7, 75:18
showing
52:12, 52:21, 75:13, 76:3, 76:12
shown
70:18, 72:3, 75:15
shows
42:11, 42:17
sic
26:6, 26:7, 26:8
side
46:20
signal
44:22
signature
88:4
signature-p1kal
90:17
significant
64:21, 65:14
signs
45:3, 47:6
simian
20:20, 21:6, 21:9
similar
79:16
simply
56:16, 57:13
since
10:22
sirna
17:21, 17:22, 18:3
sirna-based
17:18
sites
47:6
size
83:4
skill
23:13, 24:1, 24:22, 25:11, 25:22, 26:12, 29:22, 30:8, 30:14, 31:3, 31:11, 31:19, 31:21, 32:6, 32:9, 39:7, 42:20, 51:4, 54:5, 66:11, 81:3, 83:14, 86:17
skin
47:8, 58:2
slow
55:22
smaller
85:21, 86:2
snalps
23:2
solely
17:20
solid
23:2
solubility
83:3
some
10:3, 13:12, 23:20, 24:6, 25:1, 25:2, 35:19, 42:7, 48:4, 48:7, 55:15, 55:19, 56:4, 58:16, 59:1, 81:9, 82:14, 86:22, 87:1, 87:10
someone
77:16, 77:22, 79:4
something
35:5, 35:11
sometimes
40:8

soon
43:17
southwest
2:7, 4:7, 89:20
speaking
75:3
specific
16:3, 16:20, 16:21, 67:4, 74:14
specifically
12:11, 27:13, 54:13
specifications
72:4, 72:9
specificity
83:5
specify
13:21, 16:6, 45:8, 56:10
spike
52:13, 52:22, 55:14
sporozoites
13:3, 14:17, 14:18, 14:22
stand
11:3, 11:12, 11:19, 84:11
start
10:16
started
63:6
starting
62:3, 62:6
state
4:16, 9:14, 51:18, 64:18, 67:10, 80:9, 82:7, 84:19
stated
12:14, 26:4, 52:2, 53:21, 57:18, 65:2, 81:16, 84:5
statement
35:13, 47:19, 58:19, 59:13, 77:19, 78:3, 84:11
states
1:1, 34:14, 39:3
stating
51:16, 55:5
still
79:10
stimuli
46:12
street
3:17, 4:16
strike
17:8, 18:22
strong
45:16, 45:18, 60:4, 63:19, 65:7, 65:11, 66:5, 66:8, 66:15
studied
18:5, 18:9, 18:14, 24:14, 78:16
studies
17:6, 45:19, 46:21, 47:5, 52:9, 63:5, 82:3, 83:2
study
17:2, 44:9, 45:19, 47:8
studying
46:20, 78:18
submitted
10:17, 10:18, 10:20, 11:15, 21:14
submitting
11:1
subsequent
17:3, 17:5
subset
24:7
success
51:15, 53:11, 53:14, 53:15, 54:7, 55:1, 55:3, 58:7, 58:14, 62:16, 63:4
successful
62:13, 65:6
successfully
51:20, 52:18
suggest
50:6, 82:3
suggests
19:21, 32:20
summarizes
83:10
supervise
15:20
supporting
59:10
supports
59:5, 59:12
supposed
82:20
sure
13:10, 13:22, 16:7, 35:9, 37:12, 45:9, 56:21, 85:11
sustain
36:8
sustained
33:1, 34:21, 35:4, 35:10, 35:15, 35:19, 35:20, 36:11
sustained-release
32:15, 32:17, 32:19, 33:3, 33:8, 36:5
swelling
47:7
sworn
9:8, 89:9
synthesized
36:18
synthetic
36:12, 36:14, 36:16, 36:19, 36:21, 37:3, 37:5, 37:8, 37:9, 37:16, 37:19, 38:21, 39:1, 39:3, 39:8, 39:11
system
24:4, 35:6, 35:12, 36:1, 37:2, 50:4, 51:21, 52:19, 55:21, 71:9
systems
8:12, 8:16, 17:18, 24:3, 24:9, 24:17, 25:9, 26:8, 26:20, 29:7, 36:5, 36:7, 44:10, 67:21, 81:10, 81:12, 81:13

T

t-cell
45:18, 46:7, 46:17, 52:10, 56:8, 56:13, 57:15
t-cells
45:4, 46:2, 47:15, 57:3
table
42:6, 42:10, 42:11
take
40:18, 43:3, 68:12, 85:10
taken
89:10
talk
41:16, 48:7
talked
43:8, 78:6
talking
15:13, 20:10, 48:8
target
17:19, 83:4

targeted
14:9, 15:9
targets
13:12
taught
55:9, 61:5
teaches
54:13, 54:16, 60:6, 64:2
teaching
55:6, 65:10, 66:4
teachings
39:7, 42:21
technically
26:5, 26:17, 27:7
technologies
15:1, 15:4, 16:22, 17:17, 21:19, 22:14, 22:20, 23:10, 23:15, 23:22, 24:14, 24:20, 25:17, 25:21, 26:4, 27:9, 27:21, 28:1, 28:7, 28:17, 29:18, 29:20, 30:2, 30:6, 30:15, 30:20, 31:7, 31:15, 32:6, 32:11, 32:12, 32:20, 38:13, 38:18, 48:8, 80:16, 81:5, 81:8
technology
8:5, 21:9, 21:13, 21:16, 21:18, 21:22, 22:2, 22:3, 22:7, 22:9, 25:10, 25:22, 27:2, 30:22, 31:3, 31:10, 32:8, 33:2, 36:9, 48:13, 49:13, 51:6, 51:8, 66:14, 71:2, 74:14
telephone
3:9, 3:19, 4:9, 4:18
tell
87:10
term
36:12, 36:14, 37:5, 39:14, 39:16, 39:21, 40:2, 40:4, 40:6, 70:5, 86:22, 87:1
terminologies
23:5
terminology
26:9, 26:21, 29:8
terms
84:21, 86:10, 86:20, 87:3
test
61:4, 62:4, 63:2, 64:1
tested
19:8, 50:10
testify
9:9
testimony
10:1, 11:10, 27:5, 29:12, 53:19, 59:3, 61:10, 61:22, 89:11
testing
46:22
th
90:11
therapeutic
60:20, 61:7, 61:18, 62:10, 62:21, 63:13, 63:15, 63:17
therapeutics
63:22
therefore
15:21, 22:6, 65:11, 66:6
thing
31:21
things
31:18
think
12:3, 18:13, 18:16, 26:10, 50:17
third
34:20
thought
47:12
three
18:16, 34:7
through
74:3
time
32:10, 32:22, 82:7, 84:5
tissues
44:21, 47:7
titers
44:20
title
41:5, 41:10, 49:12, 49:14
today
10:1, 10:4, 10:14
took
85:16
top
32:14, 34:5, 62:12, 75:7, 75:18
topics
68:13
trademark
1:1
transcript
11:9, 87:19
transfection
19:4, 20:1
translate
52:18
treat
58:15
trial
1:3
true
82:11, 82:12, 89:11
try
16:3
trying
35:20, 63:20
turn
37:13, 40:16, 42:1, 53:7, 59:14, 64:22, 65:4, 65:16, 66:17, 69:4, 75:6, 86:1
tweaks
62:5, 63:6
two
86:7, 87:6
tx
1:8, 4:13, 5:7, 9:12
type
17:7, 17:10, 18:13, 20:3, 20:7, 20:8, 46:6, 47:22, 56:22
types
18:4, 45:6

U

under
9:8, 9:20, 34:11, 69:16
understand
9:20, 30:12, 30:19, 39:10, 50:3, 55:6, 87:13
understanding
26:7, 26:19, 29:6, 73:11, 74:6
understood
23:17, 25:14, 30:4, 43:2,

52:5, 53:22, 60:14, 61:1, 61:11, 66:7, 81:7, 83:16, 84:20, 86:17
united
1:1
usage
84:8
use
13:8, 18:5, 18:10, 28:13, 39:4, 39:12, 43:2, 51:21, 52:6, 54:17, 54:22, 55:4, 55:7, 61:6, 61:18, 62:10, 62:21, 63:9, 63:13, 63:15, 64:10, 66:5, 68:2, 72:18, 73:7, 78:16, 83:10
uses
43:15, 60:20, 72:12, 72:13, 72:21, 73:9, 73:11, 73:13
using
16:21, 17:16, 19:3, 19:8, 24:2, 24:6, 24:11, 24:16, 25:1, 25:2, 34:15, 35:16, 35:21, 39:8, 40:11, 40:14, 42:16, 44:14, 44:18, 50:6, 51:6, 54:15, 55:20, 58:9, 60:12, 61:8, 61:14, 66:21, 70:13, 70:19, 70:21, 71:4, 71:15, 71:18, 72:8, 76:20, 79:10, 84:13, 86:15
usually
33:3, 39:19, 40:4, 46:11, 64:12, 64:16, 86:13

V

vaccinate
58:15
vaccination
8:5, 13:2, 17:21, 18:1, 49:13, 50:14, 52:20, 57:5
vaccine's
73:19
vaccines
8:7, 12:18, 13:4, 13:5, 13:10, 13:12, 13:14, 13:15, 13:18, 13:19, 14:2, 14:3, 14:4, 14:6, 14:11, 14:14, 14:18, 14:19, 15:12, 15:14, 15:16, 16:1, 16:4, 16:12, 16:13, 17:11, 17:12, 17:14, 17:16, 17:20, 18:5, 18:11, 20:11, 20:13, 20:14, 20:15, 22:6, 28:14, 28:22, 43:9, 43:13, 44:6, 44:9, 45:15, 46:20, 48:4, 48:18, 50:18, 53:4, 54:2, 61:5, 62:5, 63:11, 66:16, 72:18, 75:11, 77:4, 79:3, 79:12, 79:18, 83:8, 84:14, 84:16
validate
57:21
various
12:21, 13:2, 15:16, 17:14, 23:18, 31:15, 32:12, 44:21, 48:5, 56:7, 60:13, 75:13, 78:19, 79:2, 79:11, 79:17, 80:17, 80:22, 81:7, 83:10, 86:21
vehicle
28:14
vehicles
85:18
versus
62:10, 64:8
vesicles
64:12
via
54:12
virus
20:21, 21:6, 21:10
vitro
16:1, 17:4, 57:21, 60:5
vivo
16:1, 17:4, 59:2, 59:8, 60:5, 65:9, 65:11, 66:6

W

want
34:3, 43:7, 63:15, 63:19, 65:6, 66:2
wanted
40:18
warren
27:17
washington
1:15, 2:8, 3:18, 4:8, 89:21
way
87:12, 90:7
we've
48:8
went
38:3
whereof
90:10
whereupon
9:6
whether
28:1, 28:18, 33:5, 36:10, 38:3, 38:6, 38:9, 43:18, 46:15, 46:22, 47:4, 50:22, 53:4, 55:2
whichever
12:3
whole
41:13, 50:5
widely
17:22, 67:17, 68:10
williams
2:6, 4:6, 89:20
wilmer
4:15
within
19:22, 30:16, 39:20, 72:3, 72:9, 74:2, 89:4
without
46:1, 46:7, 47:14, 48:1, 77:13
witness
15:7, 20:6, 23:1, 25:13, 26:16, 27:6, 28:11, 29:13, 30:18, 31:14, 32:2, 38:16, 40:22, 43:1,

45:15, 46:5, 47:18, 48:4, 53:20, 54:9, 56:1, 57:9, 60:12, 61:11, 62:1, 62:12, 65:21, 73:3, 73:18, 76:3, 76:11, 77:11, 79:9, 84:18, 89:8, 89:12, 90:10
witness's
27:5, 29:12, 53:19, 61:10, 61:22
wo
6:20
word
55:3, 55:4
words
54:22
work
12:12, 12:15, 12:18, 13:7, 14:13, 14:20, 15:2, 16:1, 17:4, 17:10, 19:1, 19:2, 19:5, 20:20, 33:18, 44:1, 44:2, 44:4, 51:5, 62:6, 74:3, 74:16
worked
13:6, 13:16, 13:20, 14:1, 14:3, 14:5, 14:6, 14:10, 14:11, 14:15, 14:22, 15:7, 15:15, 16:5, 16:17, 16:22, 17:18, 18:18, 18:20, 19:15, 19:17, 20:12, 20:14, 20:17, 21:3, 21:5
working
17:16, 43:21, 50:13, 59:17, 59:19, 59:20, 59:22, 60:1, 60:3, 60:9, 60:13, 63:1, 67:6
works
61:1, 61:12, 62:2, 62:7, 62:15, 62:17, 63:21
wouldn't
31:9
wrote
26:2, 26:16, 29:4, 54:9, 57:17

X

xun
4:4

Y

yeah
20:8, 30:18, 37:21, 40:20, 48:5, 49:2, 51:7, 59:18, 68:8, 73:18, 77:21, 81:19
years
13:17, 14:16, 15:7, 70:7, 86:11, 86:12, 87:4
york
3:8
yourself
41:15, 44:7

0

006369
6:21
01359
1:11
02109
4:17
0266640
6:18
05
1:17, 9:3, 89:22

1

10
6:8, 6:12, 7:4, 7:8, 8:17, 12:1, 12:5, 13:11, 15:13, 43:4, 43:5
10,702,600
6:14, 7:11
10,933,127
1:12, 6:10, 7:7
1004
6:8, 6:12
1009
6:16, 33:11, 33:12, 33:13, 33:14, 33:16
1010
6:19, 68:17, 68:18, 68:20, 69:1, 69:4
10166
3:8
11
68:14, 68:15
1161
7:4, 7:8
12
6:21, 20:19, 85:12, 85:13, 88:6, 89:22
127
10:6, 26:8, 26:20, 27:3, 28:20, 29:3, 29:7, 29:10, 71:13, 71:16, 71:22, 72:4, 72:9
13
1:16, 9:4, 89:22
14
8:13
142
75:6
15
41:2, 41:16, 41:19, 41:22
1700
3:19
18
43:4, 90:11
19
8:15, 26:2, 29:5, 72:11, 72:13, 72:21, 73:22, 75:11, 75:14, 76:9, 76:13, 76:19, 76:21, 77:8, 77:18, 78:2

2

20
8:17
200
3:7
20024
2:8, 4:8, 89:21
20036
3:18
2012
6:21
2013
6:18, 8:8, 49:9, 49:11
2014
80:6, 80:7, 80:10, 80:14, 80:21, 81:16, 82:8, 82:19, 84:2, 85:4, 87:6
2015
18:4, 18:8, 18:10, 18:12, 18:14, 18:17, 19:14, 22:8, 22:12, 22:16, 22:20, 23:10,

23:13, 23:17, 24:1, 24:13, 24:18, 24:22, 25:3, 25:11, 25:14, 26:13, 29:15, 31:12, 31:14, 32:7, 32:14, 48:17, 48:22, 49:1, 52:12, 52:17, 58:18, 78:10, 78:15, 78:17, 78:20, 78:21, 79:14, 79:16, 81:4, 82:11, 82:12, 83:16, 83:21, 84:19, 86:16
202
2:9, 3:19, 4:9
2023
1:11, 10:18, 10:21, 11:4
2024
1:16, 8:3, 9:4, 49:4, 49:6, 89:22, 90:12
2025
48:22
2029
90:14
2050
3:17
2077
8:9, 79:20, 79:21, 85:15
2078
8:14, 74:18, 74:19, 74:21
21
27:14, 27:16
212
3:9
22
8:13
23
6:11, 6:15, 42:6, 42:10, 42:11
24
7:7, 7:11, 23:1
25
6:11, 6:15, 23:7
2566
85:17
2570
81:19, 82:1, 82:22
29
85:12

3

30
7:7, 7:11
31
68:14, 69:4, 69:8, 70:18, 90:14
318
3:9
32
69:8, 85:13
33
6:16
34
43:5
363
34:4, 34:6, 34:8
397
53:2, 54:19, 55:9, 60:6, 60:16, 61:5, 64:3

4

40
88:6, 89:22
432
37:13, 37:15, 39:2
434
2:9, 4:9
44
59:14, 59:16, 59:19
46
68:15
49
8:3

5

5000
2:9, 4:9
51
54:9, 54:21
526
4:18
551
3:19
553401
1:20
57
69:9

6

60
4:16
600
3:9, 10:8, 71:13, 71:16, 71:22, 72:4, 72:10
6000
4:18
617
4:18
67
51:11, 52:2
68
6:19
680
2:7, 4:7, 89:20

7

70
34:5
72
64:4
74
8:14, 34:6
79
8:9

8

86
66:17, 66:19, 67:1, 67:5, 85:1, 85:4
88
67:7, 82:17, 83:20
89
67:20, 68:5, 68:7, 68:9

9

9
1:17, 9:3, 89:22
90
1:21
97.1
42:12, 42:14
973
40:16, 40:22
98
53:7, 55:11, 55:18
982
42:1

Michael Xun Liu, Esquire
Williams & Connolly LLP (DC)
680 Maine Avenue, SW
Washington, DC 20024

Re: Deposition of **James J. Moon, Ph.D.**
Date: 9/13/2024
Case: BioNTech SE and Pfizer, Inc. -v- Moderna TX, Inc. (PTAB)

Dear Sir/Madam,

Attached please find the above-referenced deposition transcript. If applicable, signature is required within 30 days from the date of this letter.

In accordance with the disposition of signature at the deposition or the pertinent jurisdictional rules, the deponent should follow these instructions to complete the Errata Sheet:

(1) Read the transcript and indicate any corrections or changes in ink on the enclosed Errata Sheet. Please include page and line numbers. If more space is needed for corrections, please use a blank sheet of paper. If no corrections or changes are necessary, please indicate "no corrections" or "no changes" on the Errata Sheet.

(2) Sign and date the Errata Sheet and Acknowledgement of Deponent/Affiant pages.

(3) Please return the executed Errata Sheet and Acknowledgement pages to the address indicated below, submit via fax (888-503-3767) or email (transcripts@planetdepos.com).

A copy of this letter and the returned signature pages, if any, will be distributed to counsel.

Sincerely,

Production Department
Planet Depos, LLC
451 Hungerford Drive
Suite 400
Rockville, Maryland 20850

No. 553401

No. 553401

Re: Deposition of **James J. Moon, Ph.D.**
Date: 9/13/2024
Case: BioNTech SE and Pfizer, Inc. -v- Moderna TX, Inc. (PTAB)
Return to: transcripts@planetdepos.com

Page	Line	Correction/Change and Reason
47	12-13	"Post-Immune" should be "Host Immune" (Transcription Error)

Oct 7, 2024
(Date)

(Signature)

Re: Deposition of **James J. Moon, Ph.D.**
Date: 9/13/2024
Case: BioNTech SE and Pfizer, Inc. -v- Moderna TX, Inc. (PTAB)
Return to: transcripts@planetdepos.com

(Date) (Signature)

ACKNOWLEDGMENT OF DEPONENT

I, James J. Moon, Ph.D., do hereby acknowledge that I have read and examined the foregoing testimony, and the same is a true, correct and complete transcription of the testimony given by me and any corrections appear on the attached Errata sheet signed by me.

Oct 7, 2024 _____

(Date) (Signature)