

## **Cellphones: Safe or Carcinogenic?**

With an estimated five billion worldwide users, the public debate over cellphone and the possible link to cancer is one of critical importance. The concern is that cellphones may cause the growth of any one of three types of tumors: cancer of the parotid (a gland near the ear), glioma (a rapidly spreading brain tumor), and acoustic neuroma (a tumor that typically develops on the nerve connecting ear and brain).

### **Scientist 1**

There is growing evidence to support the conclusion that there may be a cellphone-cancer connection. The Interphone Study is the largest and longest study of cellphones and cancer. Including nearly 20,000 participants from 13 countries, the study found that those who used cellphones most frequently had a 40% higher incidence of glioma. Another peer-reviewed study conducted in Israel found that there was 58% greater occurrence of parotid tumors among heavy cellphone users. A Swedish survey of 16 scientific studies concluded that the incidence of acoustic neuroma and glioma was two times greater among those who used cellphones for 10 years. After reviewing a large collection of published studies, a group of 31 scientists from 14 countries commissioned by the World Health Organization classified cellphones as a possible carcinogen. This classification indicates that there is sufficient evidence of the connection to warrant further investigation and watchfulness. Reporting in an esteemed peer-reviewed journal, the National Institute of Health showed that a single hour of cellphone use significantly increases glucose metabolism rates at locations closest to the antenna. Even areas far from the antenna showed biological effects, a sign that the radiation may be capable of so-called non-thermal effects upon the brain. Cellphone radiation may be stimulating free radicals to destructive action or even initiate some form of inflammatory response within the brain. These could trigger a chain of actions that lead to tumor development.

### **Scientist 2**

There is no credible evidence establishing a connection between cellphone use and cancer. Studies like the Interphone Study and others are observational studies that show only an association between cellphone usage and the occurrence of cancer. Such studies are biased in terms of how survey questions are asked of cellphone users who have acquired cancer. These methodological flaws do not lend credibility to their results. Statistical studies like these are not cause-effect studies. They do not isolate other variables and so they cannot determine that the cancer was actually caused by cellphone use. Furthermore, the tumors that are associated with cellphone use are so rare that even a doubling of probability of cancer would be equivalent to a small increase in the total numbers. Cellphones give off a form of radiation known as **non-ionizing radiation**. The frequencies associated with this form of electromagnetic radiation are too low and the signal is too weak to be able to break biochemical bonds within body tissues and to be able to damage DNA molecules. Such effects are known as *thermal effects*. Study after study has shown that cellphone radiation does not have a thermal effect upon the brain; that is, it doesn't *fry our brain*. No scientist has yet proposed an acceptable biological mechanism to explain how cellphones can cause cancer via *non-thermal effects*. Simply speculating that there is increased glucose metabolism rate associated with cellphone use does not establish that cellphones cause cancer. Because there is no cause-effect model proposing how cellphones cause cancer, and because the studies associating cellphone use with cancer have obvious flaws, there is no reason for the general public to fear that cellphone use causes cancer.

**Questions:**

1. The Interphone Study found a 40% higher incidence of glioma in heavy users of cellphones. The data from the study also found that the incidence of cancer among all cellphone users - from heavy to light use - was slightly less than the incidence of cancer among non-users of cellphones. How would **Scientist 1** most likely interpret the results of this study?
  - a. Heavy use of cellphones can cause cancer; light use of cellphones actually protects the user from cancer.
  - b. Statistical findings are highly unreliable and cannot be trusted as a source of evidence in the cellphone-cancer debate.
  - c. Averaging a large amount of data for many subjects in a study sometime produces less reliable findings than looking at the data for a smaller group of subjects.
  - d. It is important to sort the cellphone data into high use, moderate use and low use; the frequency of exposure plays a critical role in the probability of getting cancer.
  
2. Which one of the following statements would both **Scientist 1** and **Scientist 2** agree with?
  - a. Radiation must be of the ionizing form in order to cause cancer.
  - b. Cellphone radiation is dangerous because of its ability to break biochemical bonds in body tissue.
  - c. Surveys of cellphone users who develop cancer are an important source of evidence of the connection between cellphones and cancer.
  - d. To establish a cellphone-cancer connection, there must be some form of biochemical mechanism that explains the connection.
  
3. Cellphones are one of 900 environmental factors that the World Health Organization (WHO) has studied over the last couple of decades. The WHO categorizes these factors in one of five ways - definitely carcinogenic (107 cases), probably carcinogenic (59 cases), possibly carcinogenic (266 cases), definitely not carcinogenic (1 case), and non-classifiable (508 cases). An environmental factor receives the non-classifiable categorization if they are unable to reach an evidence-based conclusion. Which one of the following statements would best represents **Scientist 1's** response to the categorizing of cellphone radiation as possibly carcinogenic?
  - a. Cellphones are definitely cancer causing and should be banned until further research proves their safety.
  - b. The fact that the WHO has only placed one factor of 900 in the definitely not carcinogenic category indicates a strong bias.
  - c. The fact that WHO categorized cellphones as only possibly carcinogenic indicates that their study cannot be used to support the possibility of a cellphone-cancer connection.
  - d. The fact that WHO categorized cellphones as possibly carcinogenic indicates that they saw possible evidence for a cancer connection. In the absence of such evidence, they would categorize them as non-classifiable or not carcinogenic.

4. Which slogan below is inappropriately matched to the scientist's feelings regarding cellphone use and cancer?
  - a. **Scientist 1:** Better safe than sorry.
  - b. **Scientist 1:** Cellphones are guilty until proven innocent.
  - c. **Scientist 2:** Cellphones are innocent until proven guilty.
  - d. **Scientist 2:** You can prove just about anything using statistics.
  
5. Which one of the following assumptions is **NOT** made by **Scientist 2**?
  - a. The skull of the brain provides a protective barrier against cellphone radiation.
  - b. The radiation emitted by cellphones is not capable of thermal effects upon the brain.
  - c. Statistical studies are inferior to cause-effect studies and are subject to bias and methodological flaws.
  - d. To be considered cancer causing, it is important to identify the biological mechanism by which a factor causes tumor development.
  
6. Suppose that a biological mechanism attributing tumor development to non-thermal effects caused by cellphone radiation was proposed and then validated by a research study. Which statement describes the most likely effect that this development have on the thinking of the two scientists?
  - a. **Scientist 1** would no longer believe in the validity of statistical studies.
  - b. **Scientist 1** would advocate research into thermal effects of cellphone radiation.
  - c. **Scientist 2** would call for more statistical surveys of cellphone users who developed tumors.
  - d. **Scientist 2** would accept the conclusion that there is evidence for a possible cellphone-cancer connection.
  
7. The findings of the National Institute of Health that reported increased brain activity after an hour of cellphone usage was based on having the phone in receive-only mode. It is an established fact that the radiation signal is stronger when the phone is transmitting a signal. Which statement best describes the response of **Scientist 1** and **Scientist 2** to this fact?
  - a. **Scientist 1:** Cellphones should be immediately banned.
  - b. **Scientist 2:** The study is biased because it failed to examine all the functions of cellphones.
  - c. **Scientist 1:** If an effect is observed for the weaker signal, even greater caution should be adopted for the stronger transmission signal.
  - d. **Scientist 2:** Statistical studies of cellphone users who acquired tumors should be performed to see how they most often used their cellphone.



## Answers and Explanations

1. **Answer:** D

**Explanation:** The process of elimination is a good strategy for this question and most questions in this passage. **Scientist 1** uses the Interphone Study as part of the argument for the possible cellphone-cancer connection. Choice B can be eliminated since it suggests that **Scientist 1** would consider the study unreliable. The Interphone study is a type of statistical study in which an effort is made to determine if those subjects in the research group that had developed a tumor happened to use cellphones more than those who had not. As is common in any study involving data, averaging is considered an appropriate statistical method that improves data reliability. And so choice C can be eliminated. This leaves choices A and D. Choice A suggests that there may be some protective benefit in the light use cellphones. Neither side would likely agree with such a conclusion. The slight difference in the overall results is more likely explained by the presence of other random variables that impact tumor development. **Scientist 2** would more likely conclude that the cancer-causing effects of cellphones are only observed when cellphones are used with high frequency. Choice D is the best answer.

2. **Answer:** D

**Explanation:** Like most questions in this passage, the process of elimination is a useful approach to arriving at an answer. **Scientist 1** would definitely disagree with choice A. Part of the argument of **Scientist 1** is that the discovery that cellphone radiation produced increased glucose metabolism is evidence that cellphones may be triggering a chain of actions that lead to cancer; these are non-thermal effects. **Scientist 2** would disagree with choice B because it suggests that cellphone radiation is dangerous. **Scientist 2** disagrees with this idea. **Scientist 2** would disagree with choice C; it is a fundamental feature of **Scientist 2's** argument that statistical survey data is flawed and lacks credibility. Both scientists would agree with choice D. Like all scientists, they each believe that to accept the cellphone-cancer connection, it is essential that a mechanism that explains how cellphone radiation leads to tumor development be proposed and accepted. Choice D is the best answer.

3. **Answer:** D

**Explanation:** The process of elimination is a useful method of approaching this question. **Scientist 1** uses the WHO results as part of their argument in favor of the cellphone-cancer connection. Since choice C indicates a down-playing of the WHO's categorization, it can be eliminated from the set of reasonable answers. Choice A should also be eliminated since **Scientist 1** does not ever advocate such a ban. In fact, **Scientist 1** would like to identify a mechanism before being more confident of the conclusion of the cellphone-cancer connection. The new information presented in this question is that there are two strong categories that WHO could have placed cellphones into if they felt more strongly about their potential dangers. The *possibly of possibly carcinogenic* may indicate some uncertainty to some people. For **Scientist 1**, it is important to emphasize that the categorizing of cellphones as possibly carcinogenic is a middle category with just as many less condemning options as more condemning options. Choice B would downplay this fact by claiming that WHO seldom uses the least condemning option – not carcinogenic. Choice D is the best answer. **Scientist 1** would likely defend their argument by claiming that the categorizing of

cellphones as *possibly* carcinogenic would not have been made unless there was some evidence that they are *possibly* linked to cancer. In fact, this is the very argument of **Scientist 1**.

4. **Answer:** B

**Explanation:** In this question, one must find out which slogan does not accurately characterize the arguments of the two scientists. **Scientist 1** believes there is enough evidence in the connection between cellphones and cancer to warrant *playing it safe* rather than *being sorry* at a later date. This eliminates choice B. **Scientist 2** does not believe that cellphones are guilty; he/she believes there is no evidence for such a conclusion and would like to argue that they must be proven guilty by evidence. Until done so, **Scientist 2** believes they are *innocent*. Choice C can be eliminated. **Scientist 2** also believes that statistical studies are subject to bias and flaws and should not be the basis for any arguments against cellphones. Choice D can be eliminated. The best answer to this question is choice B. **Scientist 1** believes that it is necessary to prove that cellphones are guilty. Choice B suggests that cellphones must prove that they are innocent and that they are guilty until this is done.

5. **Answer:** A

**Explanation:** **Scientists 2's** confidence that cellphones do not cause cancer is centered around the fact that it is a non-ionizing form of radiation that does not produce thermal effects on the brain; this eliminates choice B. **Scientist 2** is also quick to reject statistical studies that correlate cellphone use with cancer and prefers scientific studies that focus on isolated causes that are associated with corresponding effects; this eliminates choice C. **Scientist 2** also believes that any effort to establish the cellphone-cancer connection must involve the proposal of an accepted biological mechanism that explains how the radiation causes cancer; this eliminates choice D. Choice A is the best answer because nowhere in **Scientists 2's** argument does he/she argue that the skull provides the brain with protection from otherwise dangerous cellphone radiation.

6. **Answer:** D

**Explanation:** The thrust of **Scientist 2's** argument is that the statistical studies correlating cellphone use and cancer are biased and flawed; this eliminates choice C. **Scientist 2** argues that no scientific cause-effect study has ever established the connection. In fact, the passage states that no scientific study has yet shown that the radiation from cellphones causes either thermal or non-thermal effects that lead to cancer. **Scientist 1** claims that the National Institute of Health study involving glucose metabolism provides some evidence that cellphones may cause harm via non-thermal effects. **Scientist 2** refutes this claim because it is only speculation and not yet *proven* and accepted. If there were an established and accepted mechanism that is supported by evidence that associates cellphone radiation with cancer, **Scientist 2** would be willing to alter his/her position. This makes choice D the best answer. Choice A can be eliminated since **Scientist 1** would welcome the results described in this question and would not need to call for further statistical studies. Choice B can be eliminated as well since **Scientist 1** does not suggest cellphone radiation causes cancer via thermal effects.

7. **Answer:** C

**Explanation:** The National Institute of Health study focused on the least intense of the two modes of cellphone use. One could safely infer from this that using more intense radiation would produce the same or even greater alterations in the glucose metabolism. This does not indicate a flaw or a bias in the study; thus, choice B can be eliminated. **Scientist 2** does not believe in the value of statistical studies and so choice D can also be quickly eliminated. This leaves choices A and C. In the passage, **Scientist 1's** language regarding this study is expressed with some degree of uncertainty; the phrase was that "cellphone radiation may be capable of so-called non-thermal effects ...". It is unlikely that **Scientist 1** would call for a ban on cellphones with this degree of uncertainty; choice A can be eliminated. **Scientist 1** would strengthen his/her argument for the cellphone-cancer connection by suggesting that a stronger signal than that used in the study would likely cause more noticeable affects and would be a reason for even greater caution. Choice C is the best answer.